Chapter 9

CHARTING AND DIAGRAMMING TECHNIQUES FOR OPERATIONS ANALYSIS

Reference:

Work Systems and the Methods, Measurement, and Management of Work by Mikell P. Groover, ISBN 0-13-140650-7.

©2007 Pearson Education, Inc., Upper Saddle River, NJ. All rights reserved.

Objectives of Charts and Diagrams

- To permit work processes to be communicated and comprehended more readily
- 2. To use algorithms specifically designed for the particular diagramming technique
- 3. To divide a give work process into its constituent elements for analysis purposes
- 4. To provide a structure in the search for improvements
- 5. To represent a proposed new work process or method

How to Create the Chart or Diagram

- Analyst is intimately familiar with the process and develops a graphic to represent it
- Analyst observes and records information about the process
- One-on-one interviews with those familiar with the process
 - A graphic model of the process is developed based on the interviews
- □ Group meetings with personnel familiar with process
 - A graphic model of the process is developed based on the group meetings

How to Analyze the Chart or Diagram

- Algorithmic analysis (e.g., line balancing, critical path methods)
- Checklists general questions applied to the particular process
- Brainstorming team activity in which participants contribute recommendations
- Separating value-added and non-value-added operations
 - Value added steps:
 - 1. Important to customer
 - 2. Physically change the product or service

Categories of Charts and Diagrams

- 1. Network diagrams
- 2. Traditional industrial engineering charts and diagrams
- 3. Block diagrams and process maps

3. Industrial charting and diagram techniques

- Charts and diagrams techniques intended to graphically displays relationships among the various entities included in the graphic.
- To analyze an existing operations, sequence of operation or other work activities for the purpose of making improvement.

Industrial charting and diagram techniques

Improvements includes:

- Reducing cycle time and cost.
- Eliminating unnecessary steps
- Mitigating safety hazards.
- Improving product quality.

Industrial charting and diagram techniques

Types and categories of charting and diagrams:

- Operation charts.
- Process chart.
- Flow diagram.
- Activity chart.

Industrial charting and diagram techniques

Symbols used in operation, process, and flow diagrams .(table 3,page232)

symbol	letter	description
\bigcirc	0	Operation
	1	Inspection
\implies	Μ	Move
D	D	Delay
\bigtriangledown	S	storage

Operational chart:

Graphical and symbolic representation of the operations used to produce a product

- Two types of operations:
 - 1. Processing and assembly operations
 - Changing the shape, properties or surface of a material or workpart
 - Joining two or more parts to form an assembly
 - 2. Inspection operations
 - Checking the material, workpart, or assembly for quality or quantity



Checklist of Questions

- What alternative starting material could be used?
- Make or buy decision: should the part be produced in our factory or purchased?
- □ Is this processing operation necessary?
- Can this operation be eliminated, combined, or simplified?
- Could a different joining method be used?
- □ Is this inspection necessary?
- Could the inspection task be automated?

Process chart

- Process chart: is a graphical and symbolic representation of the processing activities performed on something or by somebody.
- Vertical list of steps performed on or by the work entity using symbols: process operation, inspections, moves ,delays, other activities.
- Process chart is used to study a single material or work parts rather than the multiple component of an assembly.
- Example (page 233)

Principal types of process chart:

- Flow process chart :analyze material and work piece being process(flow of the activities done on material or work piece).
- Worker process chart: analyze worker performing process(worker movement around the facility).
- Form process chart: analyze the processing of paperwork forms(processing on documents). (two additional activities used: creation C. , disposal x :X

Process chart

Uses five symbols to detail the work performed on a material or workpart as it is processed through a sequence of operations and activities:

- Operation processing of a material
- □ Inspection check for quality or quantity
- Move transport of material to new location
- Delay material waiting to be processed or moved
- Storage material kept in protected location

		Flow	v Process (Chart						
Part	No. 459011	Material: Steel C1045 forging	; Descr	Description: Forgings processed in batches o						
Seq.	Activity Des	scription	Symbol	Time	Distance	Analysis Notes				
1	Forgings tra	nsported from forge shop	\rightarrow		300 m	Forklift truck				
2	Inspection of	f incoming forgings		1 hr						
3	Forgings mo	oved and placed in storage	\rightarrow		75 m	Hand truck				
4	Storage		ν	7 days		Factory warehouse				
5	Forgings ret	rieved from storage	\rightarrow		75 m	Hand truck				
6	Transport to	machine shop	\rightarrow		180 m	Forklift truck				
7	Move to mil	ling machine	\rightarrow		20 m	Hand truck				
8	Delay in que	eue for milling machine	D	5 hr						
9	Milling oper	ration (roughing and finishing)	0	8 min/pc		Milling Machine No. 573				
10	Move to dri	ll press	\rightarrow		20 m	Hand truck				
11	Delay in que	eue for drill press	D	2 hr						
12	Drilling and	tapping operations (6 holes)	0	3 min/pc		CNC Drill Press No. 226				
13	Delay waitir	ng for inspection	D	4 hr						
14	Inspection f	or machining operations		0.2 hr						
15	Delay waitir	ng for transport to cleaning	D	3 hr						
16	Transport to	o finishing department	\rightarrow		75 m	Forklift truck				
17	Move to clea	aning operation	\rightarrow		10 m	Hand truck				
18	Delay in que	eue for cleaning operation	D	30 min						
19	Cleaning op	eration (all parts in batch)	0	10 min		Solvent clean tank				
20	Move to nickel plate operation		\rightarrow		15 m	Hand truck				
21	Delay in queue for nickel plate operation		D	45 min						
22	Nickel plate operation (all parts in batch)		0	20 min		Electroplating tank				
23	Delay waitin	ng for transport to storage	D	30 min						
24	Transport to	storage	\rightarrow		200 m	Forklift truck				
25	Storage awa	iting assembly	∇			Factory warehouse				

Date:		FI	low Proce	ess Chart		Page	of					
Analy	yst:	Approval:		Summary of Activities								
Job:		Part No:		Activity	(symbols)	Count	Time	Distances				
Mate	rial:			Operatio	ons (O, O)							
Desci	ription:			Inspectio	ons (\Box, I)							
			2	Moves	; (→, M)							
				Delay	s (D , D)							
				Storag	es (∇, S)	~						
Seq.	Activity Description		Symb	ol Time	Distance	Analysis N	otes					
1												
2												
3				0	-							
4												
5												
6						0						

Flow diagram

- Flow diagram: a drawing of a facility layout with the addition of lines representing movement of material or worker to a specific locations in the facility.
- Arrows are used in flow diagram to indicate the direction of movement.
- Its used in conjunction with the process chart when the movement of materials, worker, and forms is a major factor in the analysis.
- Can be used to detect excessive backtracking, which might be missed in a process chart
- Example(page237)

Flow Diagram

Flow diagram for worker setting up a milling machine

Note the large number of trips back and forth between the milling machine and the tool crib



Activity Charts

- A listing of the activities of one or more subjects (e.g., workers, machines) plotted against a time scale to indicate graphically how much time is spent on each activity
- Types of activity charts:
 - Right-hand/left-hand activity chart (a.k.a. workplace activity chart)
 - Worker-machine activity chart
 - Worker-multimachine activity chart
 - Gang activity chart (a.k.a. multiworker activity chart)

Activity Chart

Activity chart for a worker performing a repetitive task

Activity Description	Chart	Activity Time (min)	Cumulative time (min)
Pick up plate from tote pan.	29. 29	0.05	0.05
Carry plate to drill press and load.		0.07	0.05
			0.10
Activate press.		0.03	0.15
Semiautomatic machine cycle.		0.20	
			0.20
			0.25
			0.30
			0.35
Remove plate.		0.03	100
Carry to pallet container.		0.05	0.40
Place in pallet container.		0.02	0.45
Walk to tote pan.		0.05	2006.02.00
	///		0.50

Shading Formats for Activity Charts

Shading	Color	Activity
Black	Blue	Operation: Performing an operation. Worker operating on or handling material at workplace. Machine performing an operation on automatic or mechanized cycle.
Gray	Yellow	<i>Inspection</i> : Worker performing an inspection, to check for either quantity or quality.
White (blank)	White (blank)	Idle time: Worker or machine is idle, waiting, or stopped.
Diagonal lines	Green	<i>Moving</i> : Worker walking outside immediate workplace (e.g., to fetch tools or materials).
Horizontal	Red	<i>Holding</i> : Worker holding an object in fixed position without performing any work on it.

Right-Hand/Left-Hand Activity Chart

Task involves placing pegs into a peg board

Note that left hand is used as a workholder

Left Hand	Time (min)	Right Hand	Cumulative time (min)
Pick up board	0.08		0.08
Hold board	0.06	Pick up peg and insert	0.14
Hold board	0.06	Pick up peg and insert	0.20
Hold board	0.06	Pick up peg and insert	0.26
Hold board	0.06	Pick up peg and insert	0.32
Hold board	0.06	Pick up peg and insert	0.38
Hold board	0.06	Pick up peg and insert	0.44
Hold board	0.06	Pick up peg and insert	0.50
Hold board	0.06	Pick up peg and insert	0.56
Put assembly in tote pan	0.06		0.62

Worker-Multimachine Activity Chart

Can be used to indicate *machine interference* (when a machine must wait for service because worker is currently servicing another machine)

Worker	Time (min)	Machine 1	Time	Machine 2	Time	Cumulative time (min)
Walks to machine 1 Services machine 1 Walks to machine 2 Services machine 2	0.2 0.3 0.2 0.3	Idle Automatic cycle	0.3	Idle	0.3	0.5 1.0
Walks to machine 1 Services machine 1	0.5 0.2	Idle	1.2	Automatic cycle		1.5
Walks to machine 2 Services machine 2 Idle	0.3 0.2 0.3	Automatic cycle	0.5	Idle Automatic cycle	1.2 0.3	2.5
Walks to machine 1	0.5 0.2		1.2			3.0
Services machine 1 Walks to machine 2 Services machine 2	0.3 0.2	Idle Automatic cycle	0.3	Idle	1.2	3.5

Improvement on operation charts:

- Step 1: developing the detailed listing of operations for the components and their assembly in to the final entity(operation chart).
- Step2: examination of the chart to discover possible improvement by questioning procedure aimed at the material and operations.
- Step3:developing proposal for improvement on the operation chart for an existing work situation based on the results of the questioning procedure.

Improvement on operation charts:

Questioning used to analyze operation chart:

- Questions related to the materials.
- Questions related to processing or assembly operations.
- Questions related to inspection operations.

5 WHY's questions:- what? Where? When? Who? How?.

Improvement on operation charts:

Examples:

- Why is the activity necessary?
- Why is this activity assigned to this type of operation?
- Why is this activity performed at this time?
- Why is this activity performed in this location?
- …....ext

Improvement on flow process charts:

- According to the more detailed in the flow process chart beyond the operation chart that includes more types of activities ;the examining improvement procedure is expanded to include more questions related to the move, delay and storage process.
- A flow diagram with a modified and improved system should be submitted with the actual one.

□ Table2,page231.table4,page 235.

Improvement on operation charts and process chart:

Cost reduction:

- Can I eliminate this process or activity?
- If YES eliminate
- If NO

Can I combine this process activity with another activity?

- If yes combine
- If NO

Can I rearrange or change the sequence of this activity?

If yes rearrange

If NO

Can I simplify this activity?

- If yes simplify
- If NO No improvement activity is possible.

A case study: Jordan university press

THE OBJECTIVES

APPLY THE MACRO MOTION STUDY TECHNIQUES ON A PART OF A PRODUCT WHICH IS THE PAPER.

THINK OF A NEW –MORE EFFICIENT– METHOD THAN THE PRESENT METHOD.

Why we choose the Jordan university press?

It produces a lot of books, lab manuals, researches done by faculty members and university magazines.

Its closeness.

The Binding Paper

Its Size is (50X70) cm containing 32 pages of the size P5 (17 X 24 cm).

Process Description





Print 500 copy of one binding paper in the offset printing machine.







Inspection and individualization.



Send it to the folding machine by hand.











Move to table by hand.





Move to the assembly machine by a jack.



Assemble with cover page by glue.



move to the cooling machine by a conveyor





Move to the tri-scissors saw machine.







Move to table by conveyor.

Inspection.

Move out by jack.

Flow diagram for present method





PRESENT METHOD PROPOSED METHOD DATE: 6-12-2010 PAGE 1 OF 2 PART DESCRIPTION: Biding paper, size (50*70) OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY Image: Summary of the second seco		<u>FRED MEYER</u>	<u>.S</u>	<u>& ASSU</u>	<u>ICI /</u>	<u>17E'S</u>) PR	OCESS CHART		
PART DESCRIPTION: Biding paper, size (50-70) OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY RECENT REPORT AND IT ANALYSIS: FLOW DIAGRAM ATTACED VIEW VIEW VIEW ATTACED VIEW VIEW VIEW (INCORTANT) STOPED FILLER (INCORTANT) Anove to hall printing Jack O O O O O O O O O O O O O O O O O O O		PRESENT METHOD		<u>PROPOSED METH</u>	OD	DATE:	6-12-2010	<u>PAGE 1_OF 2</u>		
Size (50° /0) OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY OPERATION SUMMARY OPERATION OPERATION SUMMARY OPERATIONS OPERATION STOPE DETATIONS OPERATION STOPE DETATIONS OPERATION STOPE DETATION STOPE DETATIONS OPERATION OPERATIONS IMOVE to table Jack OPERATIONS <td colspan="2" opera<="" th=""><th> PA</th><th>RT DESCRIPTION: Bidi</th><th>ing pa</th><th>aper,</th><th></th><th></th><th></th><th></th></td>	<th> PA</th> <th>RT DESCRIPTION: Bidi</th> <th>ing pa</th> <th>aper,</th> <th></th> <th></th> <th></th> <th></th>		PA	RT DESCRIPTION: Bidi	ing pa	aper,				
OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY Intering hall printing to leaving the hall printing OPERATIONS Intering hall printing to leaving the hall printing OPERATIONS Intering hall printing to leaving the hall printing OPERATIONS Intering hall printing OPERATIONS Intering hall printing OPERATIONS Intering hall printing OPERATIONS Intering hall printing Ist HAV Important FI FI FI FI FI Important File Move to hall printing Jack Important Intercond Move to table Fack Inspection Important Important Important Move to falor Haud Important Important Important		size	(50*7	/0)						
Intering intering intering to reaving the full printing SUMMARY Intering intering intering to reaving the full printing OPERATIONS FLOW OPERATIONS STEP DETAILS OF PROCESS METHOD A Intering Jost colspan="2">THE-/COST Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2" OPERATILS OF PROCESS METHOD Intering Colspan="2"	OP	ERATION DESCRIPTION	1: Fr	om intering hal	l nrint	ing to le	oving th	e hall printing		
SUMMARY International and the second sec			111	om mæring na	r print	ing to R	a ing in	e nan printing		
O PERALONS P PACK		UMMARY NO. THE	PHO NO.	POSED DIFF.	-	ANALYS	IS:	FLOW		
Inspection Inspection <td>B</td> <td>OPERATIONS TRANSPORT</td> <td>┨─┤</td> <td>· · · · · · · · · · · · · · · · · · ·</td> <td>- WHY</td> <td>, _</td> <td>WHEN</td> <td>DIAGRAM</td>	B	OPERATIONS TRANSPORT	┨─┤	· · · · · · · · · · · · · · · · · · ·	- WHY	, _	WHEN	DIAGRAM		
STOP 18 :s DIST. IRAVELED FI. STEP DETAILS OF PROCESS I Move to hall printing Jack I Move to table Jack Inspection Inspection Individualization Individualization Individualization Inspection Individualization Inspection Individualization Individualization Inspection Inspection Individualization Inspection Inspection Individualization Inspection Individualization Inspection Individualization Inspection Inspection <t< th=""><th></th><th>INSPECTIONS</th><th></th><th></th><th>- WHV - WHP</th><th>li ag⊈</th><th>WHU (HOW)</th><th>(IMPORTANT)</th></t<>		INSPECTIONS			- WHV - WHP	li ag⊈	WHU (HOW)	(IMPORTANT)		
OISI. HAVELED 1 FL FL1 FL1 STEP DETAILS OF PROCESS Nethod Image: Step Color of Col		STORAGES			STUDI	ED BY:				
SIEP DETAILS OF PROCESS ETHOL/S S CALCULATION 1 Move to hall printing Jack Image: Comparison of the second secon		<u>ST. TRAVELED F1.</u>						/ TIME/COST		
1 Move to hall printing Jack 2 Printing 3 Move to table Jack Image: Constraint of the state of th	STEP	DETAILS OF PROCESS	NETHO	1) č / ž / ž /	<u> ¥ §</u>			CALCULATION		
2 Printing Image: Second	1	Move to hall printing	Jack		$\nabla \nabla$					
3 Move to table Jack Impection 4 Inspection Impection Impection 5 individualization Impection Impection 6 Move to machine Hand Impection Impection 7 Folding Impection Impection Impection 8 Move to floor Hand Impection Impection 9 Wait Impection Impection Impection 10 Move to table Hand Impection Impection 11 Organizing Impection Impection Impection 12 Move to machine Jack Impection Impection 13 Assembly with cover page Impection Impection Impection 14 Move to machine Convertor Impection Impection Impection 15 Cooling Impection Impection Impection Impection	2	Printing			∇C					
4 Inspection Inspection 5 individualization Image: Constraint of the state	3	Move to table	Jack		ÌŻ			1		
5 individualization 6 Move to machine 7 Folding 8 Move to floor 9 Wait 9 Wait 10 Move to table 11 Organizing 12 Move to machine 13 Assembly with cover page 14 Move to machine 15 Cooling	4	Inspection			Ĵ			4		
6 Move to machine Hand Image: Constraint of the second seco	5	individualization			Ĵ			-		
7 Folding Image: Conversion of the conver	6	Move to machine	Hand		$\overline{\nabla}$					
8 Move to floor Hand Image: Conversion of the state of the	7	Folding			$\nabla \nabla$					
9 Wait Image: Conveyor of the second se	8	Move to floor	Hand		$\nabla \nabla$]		
10 Move to table Hand Image: Comparison of the company of the com	9	Wait		$\bigcirc \bigcirc \bigcirc \bigcirc \bigcirc$	$\nabla \nabla$					
11 Organizing Image: Constraint of the system Image: Constraint of the system 12 Move to machine Jack Image: Constraint of the system Image: Constraint of the system 13 Assembly with cover page Image: Constraint of the system Image: Constraint of the system Image: Constraint of the system 14 Move to machine Constraint of the system Image: Constraint of the system Image: Constraint of the system 15 Cooling Image: Constraint of the system Image: Constraint of the system Image: Constraint of the system	10	Move to table	Hand	\bigcirc	$\nabla \nabla$					
12 Move to machine Jack Image: Conversion of the second se	11	Organizing			$\sum \nabla$					
13 Assembly with cover page 14 Move to machine 15 Cooling	12	Move to machine	Jack		$\nabla \nabla$					
$\begin{array}{ c c c c c } \hline 14 & Move to machine & Conveyor & \hline $	13	Assembly with cover page			$\nabla \nabla$					
$ 15 _{\text{Cooling}} \qquad \bigcirc \square \bigcirc \bigtriangledown \bigcirc \bigtriangledown \bigcirc \bigtriangledown \circ \square \bigcirc \bigtriangledown \circ \square \bigcirc \bigtriangledown \circ \square \bigcirc \bigtriangledown \circ \square \bigcirc \bigcirc \bigcirc \bigcirc$	14	Move to machine	Conveyor	\bigcirc	$\sum \nabla$					
	15	Cooling			$\sum \nabla$					
16 Move to machine	16	Move to machine	Conveyor		$\sum \nabla$					
$17 Cutting \bigcirc $	17	Cutting			$\nabla \nabla$					

SIEb	Details of (mexant) method	HE THOD	AN A			è/		TIME/COST CALCULATIONS]
18	Move to table	Conveyor	$\overline{\bigcirc}$	•	DV				1
19	Inspection		$\overline{\bigcirc}$	\Box	$D\nabla$:		
20	Move to store	Jack	$\overline{\bigcirc}$		$\overline{D\nabla}$				
21			C	\Box	$\overline{D}\nabla$				
22			0	\Box	$D\nabla$				
23			$\overline{\bigcirc}$	\Box	$D\nabla$				
24		(\bigcirc	\Box	$D\nabla$				
25			$\overline{\bigcirc}$	\Box	$D\nabla$				
26			Ó	\Box	$D\nabla$				ļ
27			\bigcirc	\Box	$\overline{D\nabla}$				Ì
28			\bigcirc	\Box	$D\nabla$		_		
29			$\overline{\bigcirc}$	\Box	$\overline{D}\nabla$				
30			\bigcirc	\Box	$D\nabla$				
31			\bigcirc	\Box	$D\nabla$				
32			\bigcirc	\Box	$\overline{D}\nabla$				
33			\bigcirc	\Box	$\overline{D}\overline{\nabla}$				
34			\bigcirc	\Box	$D\nabla$				{
35			\bigcirc	\Box	$D\nabla$				
36			\bigcirc	\Box	$D\nabla$				
37			$\overline{\bigcirc}$	\Box	$D\nabla$				
38			$\overline{\bigcirc}$	\Box	\overline{DV}				
39			0	\Box	$D\nabla$]	1
40			\bigcirc	\Box	$D\nabla$]	
41		1	\bigcirc	\Box	$\overline{D\nabla}$			}	
42	-		$\overline{\bigcirc}$	\Box	$D\nabla$]	
					 	 			1

Proposed method

Elimination



EVERY STEP IS IMPORTANT.

Combination



THERE IS NO MACHINE COMBINES TWO OPERATIONS TOGETHER, TECHNICIAN SAID.

Rearranging

MACHINES CAN BE MOVED.

REDUCE DISTANCE TRAVELED.

Flow diagram for present method



Flow diagram for propose method



PRESENT METHOD PROPOSED METHOD DATE: 6-12-2010 PAGE 1_OF 2 PART DESCRIPTION: Biding paper, size (50°70) Size (50°70) OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY BOTTON: From intering hall printing to leaving the hall printing SUMMARY BOTTON: From intering hall printing to leaving the hall printing SUMMARY BOTTON: From intering hall printing to leaving the hall printing SUMMARY BOTTON: From intering hall printing to leaving the hall printing SUMMARY BOTTON: From intering hall printing to leaving the hall printing SUMMARY BOTTON: From intering hall printing ANALYSIS: SUMMARY BOTTON: From intering hall printing ANALYSIS: SUMMARY BOTTON: From intering hall printing ANALYSIS: SUMMARY From intering hall printing From intering hall printing ANALYSIS: SUMMARY From intering hall printing From intering hall printing Analysis SUMMARY From intering hall printing From intering hall printing From intering hall printing I Move to hall printing From inter		FRED MEYEH	2S	k	AS	SS	ЭСТ	TA T	TE S	5	PR)CESS CHART
PART DESCRIPTION: Biding paper, size (50°70) OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY Intervine hall printing to leaving the hall printing SUMMARY Intervine hall printing to leaving the hall printing SUMMARY Intervine hall printing to leaving the hall printing SUMMARY Intervine hall printing Intervine hall printing Intervine hall printing Intervine hall printing Intervine hall printing Intervine hall printing Intervine hall printing Image: Intervine hall printervine hall printing Intervine hall pr	[PRESENT METHOD	P 📲	ROPO	SED	MET		D	ATE:	6-12-2	2010	PAGE 1 OF 2 .
OPERATION DESCRIPTION: From intering hall printing to leaving the hall printing SUMMARY REPORT IN THE ACTION IN THE ANALYSIS: PERATIONS FOR ALL THE ACTION ANALYSIS: PERATIONS FOR ALL THE ACTIONS FOR ALL THE FOR ALL	P/	NRT DESCRIPTION: Bid	ing pa	nper,								
OPERATION DESCRIPTION: SUMMARY Image: Summary of the state of the st		sıze	(50*7	/0)								
SUMMARY Inference SUMMARY Inference OPERATIONS Inference Inference Inference I	OF	PERATION DESCRIPTION	∜: Fro	om in	terin	ig ha	ll pri	inting	to l	eavir	ig the	hall printing
SUMMARY BO The BO The No. The ANALYSIS: FLOM OPERATIONS Image: Stand S	L	NAME AND A DESCRIPTION OF THE PARTY OF THE P	000	onech	1 5							
Insection Individualization		SUMMARY NO. THE		THE	NO.	T.U	티 .	AN/	ALYS	IS:		FLOW
Def As Important STORIES FI DIST. FRAVELED FI FI FI STEP DETAILS OF PROCESS Move to hall printing Jack J Move to hall printing Jack Jack J Move to table Haud Jack J Inspection J Inspection J Move to table Haud Jack J Move to machine J Jack J Move to machine J Jack J Move to machine J Jack J Jack J Jack J	Ř	TRANSPORT.	┨┈┧					WHAT		WHO		ATTACHED
DETAILS OF PROCESS FIHD FIED FIED <td< td=""><td>E</td><td>DELAYS</td><td></td><td></td><td></td><td></td><td></td><td>WHERE</td><td><u>DV.</u></td><td>HOW</td><td></td><td>(IMPORTANT)</td></td<>	E	DELAYS						WHERE	<u>DV.</u>	HOW		(IMPORTANT)
STEP DETAILS OF PROCESS ETHO////////////////////////////////////	μð	ST. TRAVELED FT.		FI.		Ē			61: 	<u> </u>		
1 Move to hall printing Jack J	STEP	DETAILS OF PROCESS	HETHO	0/2			/#/		E/			
2 Printing 3 Move to table Hand Inspection 4 Inspection 5 individualization 6 Move to machine Hand Image: Compare the system of th	1	Move to hall printing	Jack	0			D٢	7				
3 Move to table Hand Image: Constraint of the second	2	Printing			\Box		٦D	7				
4 Inspection Image: Conserver of the second se	3	Move to table	Hand	O			D٦	7				
5 individualization 6 Move to machine 7 Folding 8 Move to table 9 Wait 9 Wait 10 Move to table 11 Organizing 12 Move to machine 13 Assembly with cover page 14 Move to machine 15 Cooling 16 Move to machine	4	Inspection		$\left \right\rangle$	\Box		Ď٦	7				
6 Move to machine Hand Image: Constraint of the state of th	5	individualization		•	\Box		D٢	7				
7 Folding Move to table Hand 9 Wait 10 Move to table 11 Organizing 12 Move to machine 13 Assembly with cover page 14 Move to machine 15 Cooling 16 Move to machine 17 Cutting	6	Move to machine	Hand	Ó			D٦	7				
8 Move to table Hand Image: Conveyor Conveyo	7	Folding					D٢	7				
9 Wait Image: Second seco	8	Move to table	Hand	Ō			D٢	7				
10 Move to table Hand Image: Constraint of the state of the	9	Wait		0			7	7	Î			
11 Organizing Image: Constraint of the second	10	Move to table	Hand	O			D۲	7	1			
12 Move to machine Jack Jack </td <td>11</td> <td>Organizing</td> <td></td> <td></td> <td></td> <td></td> <td>D۲</td> <td>7</td> <td>1</td> <td></td> <td></td> <td></td>	11	Organizing					D۲	7	1			
13 Assembly with cover page Image: Conveyor Imag	12	Move to machine	Jack	0			D٢	7	1			
14 Move to machine Conveyor Image: Conveyor 15 Cooling Image: Conveyor Image: Conveyor 16 Move to machine Conveyor Image: Conveyor 17 Cutting Image: Conveyor Image: Conveyor	13	Assembly with cover page					Ď٢	7	1			
15 Cooling 16 Move to machine 17 Cutting	14	Move to machine	Conveyor	Ō			D٢	7	1			
16 Move to machine Conveyor 17 Cutting	15	Cooling					Ď۲	7				
	16	Move to machine	Conveyor	O			D۲	7	-			
	17	Cutting					٦Ō	7	1	†		

SIEb	DETAILS OF (MESON) METHOD	NETHOD
18	Move to table	
19	Inspection	
20	Move to store	
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
		-

Activity chart

- Activity chart: is a listing of the work activity of one or more subjects(workers, machines) plotted against a time scale to indicate graphically how much time is spent on each activity.
- The format of the activity chart is activity description against a vertical time scale. (vertical line or bars indicating the activities)

Activity chart

Types of activity chart:

- worker –machine activity chart.
- Worker- multimachine chart.
- Multiple-activity chart.
- Right hand-lift hand activity chart.
- Gang chart.
- Multiworker activity chart.

- indicate how the work elements and associated times are allocated between a worker and a machine for the repetitive cycle of a worker-machine system.
- It consist of two main columns one for the worker and the other for the machine.
- The worker-machine activity chart can help to improve and identify opportunities for cycle time improvement.

- Operator ---one unit of production
- □ Machine --- one unit of production.

Notes:

Loading +unloading = set up time

Total Working Time (TWT) of both worker or machine not including the Idle time.

Cycle time = MAX Total working Time (worker /machine).

- Similar to the worker-machine chart except that the worker is responsible for more than one machine .
- A worker cycle must be developed that minimize or eliminate machine interference(the idle time of the machine).

- Example:
 - Loading time=1 min
 - Unloading time=2 min
 - Machine running time=7 min

- Worker multimachine: (one worker + n machine).
- Two conditions:
 - 1 Identical machine time
 - CASE1: TWT (operator) =TWT (machine) ==no idle time
 - Case2: TWT(operator) < TWT(machine)== operator idle</p>
 - Case3: TWT(operator)> TWT(machine)==machine idle
 - 2- Different machine time

Example on case 1:

- A system of 2 identical machine A and B
- Setup time=2 min
- Walking time to the next machine= 1 min.
- Machine running time =4 min.

```
TWT(operator)=n(\text{Setup +walk}).
TWT(A) = (S+R)
TWT(B)=(S+R)
```

Example on case 2:

- A system of 2 identical machine A and B
- Setup time=2 min
- Walking time to the next machine= 1 min.
- Machine running time =5min.

```
TWT(operator)=n(Setup +walk).
TWT(A) = (S+R)
TWT(B)=(S+R)
```

Example on case 3:

- A system of 2 identical machine A and B
- Setup time=2 min
- Walking time to the next machine= 1 min.
- Machine running time =3min.

```
TWT(operator)=n(\text{Setup +walk}).
TWT(A) = (S+R)
TWT(B)=(S+R)
```