

# Ch5 Notes

Tuesday, May 01, 2012  
6:46 PM

The screenshot shows the CourseSmart interface for the book 'Manufacturing Facilities Design and Material Handling, Fourth Edition'. On the left, a 'Table of Contents' sidebar lists chapters from Page ii to Page 441. The main content area displays the 'Preface' page, which includes the following information:

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## Flow Analysis Techniques

### OBJECTIVES:

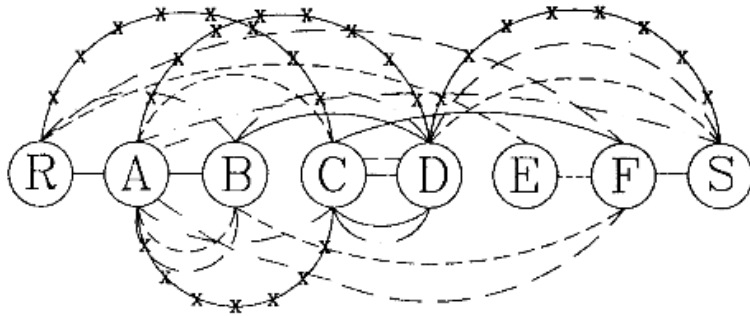
Upon the completion of this chapter, the reader should:

- Understand the importance of material flow and flow analysis
- Be able to identify and construct various flow analysis tools
- Be able to calculate flow efficiency by the use of a from-to chart

### FABRICATION OF INDIVIDUAL PARTS

These techniques are used mostly in process layouts. The study of individual parts flow results in the arrangement of machines and workstations. Route sheets are the primary source of information. To establish this best arrangement of equipment, facilities designers use four techniques:

1. String diagram
2. Multicolumn process chart
3. From-to chart
4. Process chart



1. \_\_\_\_\_
2. - - - - -
3. - - - - -
4. - - - - -
5. \* - \* - \* - \*

MULTI-COLUMN PROCESS CHART						
PART NUMBERS						
	1	2	3	4	5	
R	○	○	○	○	○	
A	○	○	○	○	○	
B	○	○	○	○	○	
C	○	○	○	○	○	
D	○	○	○	○	○	
E	○	○	○	○	○	
F	○	○	○	○	○	
S	○	○	○	○	○	
# STEPS	9	13	17	17	11	TOTAL 67
LEAST STEPS	7	7	7	7	7	35

EFFICIENCY -  $35/67 = 52\%$

Figure 5-5 Multicolumn process chart.

		TO									
		R	A	B	C	D	E	F	S	T	P.P.
R		1 ①	18 ③6	7.5 ②2.5			1 ⑤	30 ①80		57.5	244.5
A			1 ①	31 ⑥2	7.5 ②2.5				18 ①08	57.5	193.5
F	B		1 ②			19 ③8				20	40
R	C		25.5 ①02			31 ③1		1 ③		57.5	136
O	D				19 ③8				38.5 ①15.5	57.5	153.5
M	E							1 ①		1	1
F	F		30 ③00	1 ⑧					1 ①	32	309
S	S									-	-
T	P.P.		57.5	20	57.5	57.5	1	32	57.5	283	1077.5

P.P. = penalty points

Figure 5-10 From-to chart—Alphabetical layout analysis.

## Process Chart

The *process chart* (see Figure 5-12) is used for just one part, recording everything that happens to that part from the time it arrives in the plant until it joins the other parts. Symbols are used to describe what happens:

Symbol	Description
○	= operation, work on the part
➔	= transportation, moving the part
▽	= storage, storerooms, warehouse, work in process
D	= delay, very temporary storage, usually at a workstation; both incoming containers and outgoing containers of parts
□	= inspection, quality control, work on the product
◻	= combination operation and inspection

Process charting lends itself to a standard form. A properly designed form will lead designers to ask questions of each step. Designers want to know the why, who, what, where, when, and how of every operation, transportation, inspection, storage, and delay. Once designers understand the answers to these questions, they can ask

1. Can I eliminate this step?
2. Can I automate this step?
3. Can I combine this step with another one?
4. Can I change the routing to reduce distances traveled?
5. Can I move workstations closer together?
6. Can I justify production aids to increase effectiveness?
7. How much does this part cost to produce?

FRED MEYERS & ASSOCIATES										PROCESS CHART				
<input type="checkbox"/> PRESENT METHOD (1)				<input type="checkbox"/> PROPOSED METHOD				DATE: (2)		PAGE OF				
PART DESCRIPTION: (3)														
OPERATION DESCRIPTION: (4)														
SUMMARY				ANALYSIS:				FLOW DIAGRAM (7)						
<input checked="" type="checkbox"/> OPERATIONS		<input type="checkbox"/> TRANSPORT		<input type="checkbox"/> INSPECTIONS		<input type="checkbox"/> DELAYS		<input type="checkbox"/> STORAGES		WHY (6) WHEN		WHG		
										WHERE		HOW		
DIST. TRAVELED				STUDIED BY:										
		FT.		FT.		FT.								
STEP	DETAILS OF PROCESS			METHOD	OPERATION	TRANSPORT	INSPECTION	DELAY	STORAGE	DISTANCE IN FEET	QUANTITY	TIME PER PART	COST PER PART	TIME/COST CALCULATIONS
1					○	➔	□	D	▽					
2					○	➔	□	D	▽					
3	(8)			(9)	○	➔	(10)	D	▽	(11)	(12)	(13)	(14)	(15)
4					○	➔	□	D	▽					

## ■ TOTAL PLANT FLOW

The three techniques studied in this section include the following:

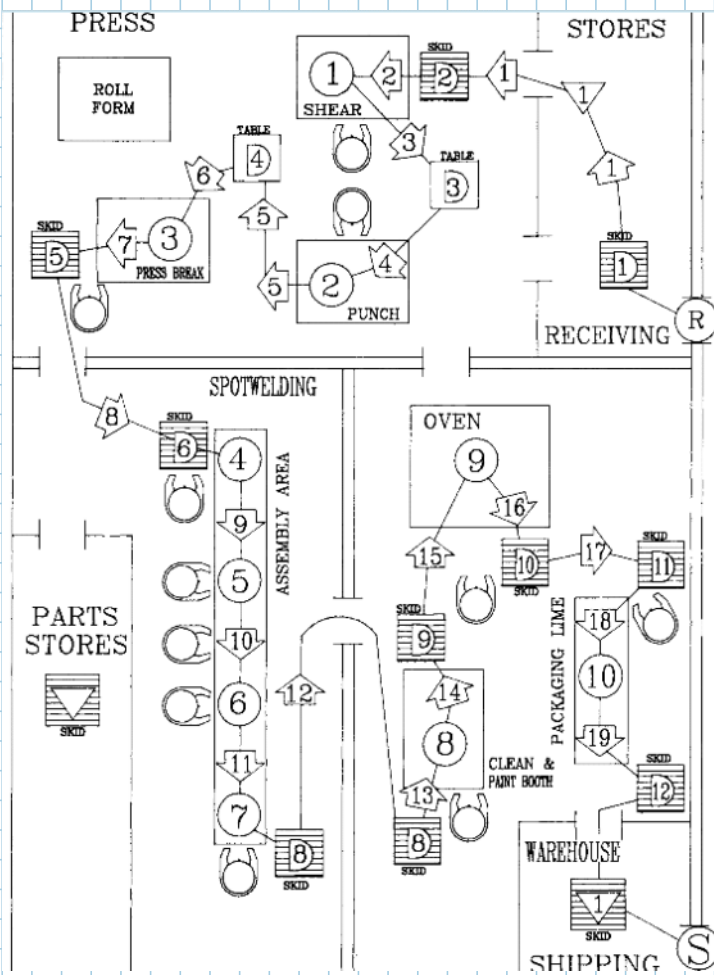
1. Flow diagram
2. Operations chart
3. Flow process chart

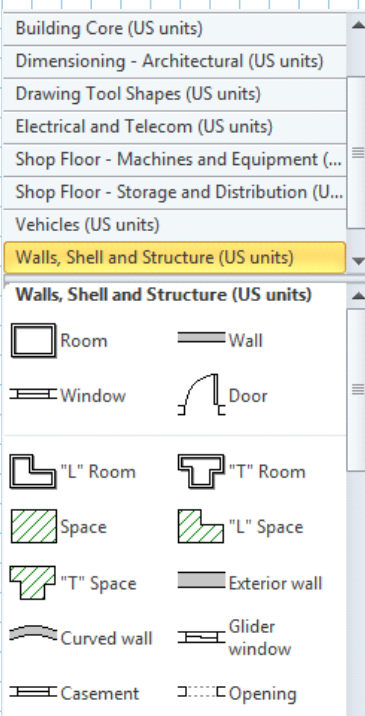
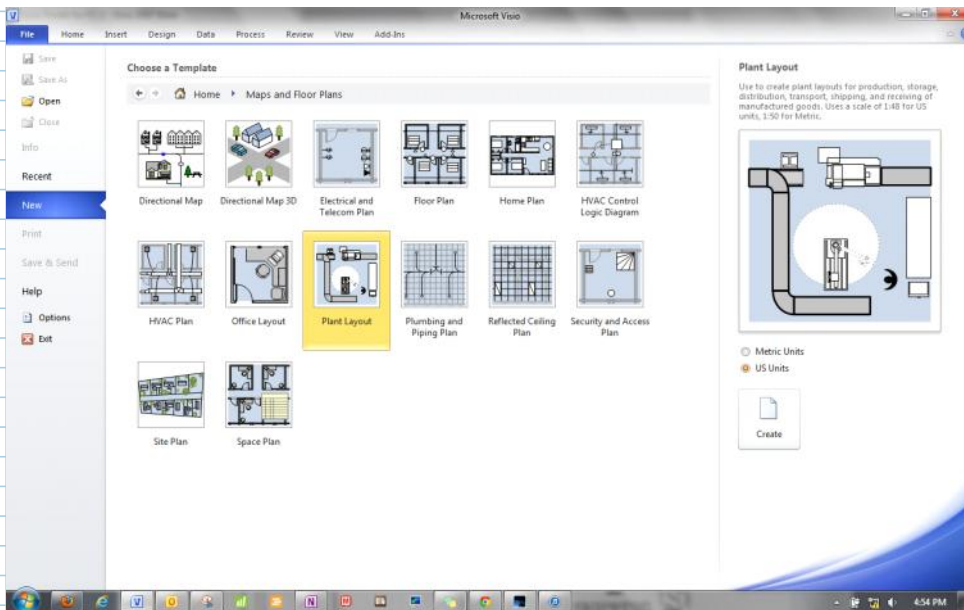
We will consider every step in the process for fabrication, assembly, and packout of the product. The techniques use the same symbols as those used in the process chart, but in a different way. All parts are considered, not just one.

### Flow Diagrams

*Flow diagrams* show the path traveled by each part from receiving to stores to fabrication of each part to subassembly to final assembly to packout to warehousing to shipping. These paths are drawn on a layout of the plant.

The flow diagram will point out problems with such factors as cross traffic, backtracking, and distance traveled.

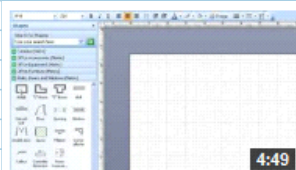




**How to create a floor plan within 3 minutes**

by Floorplanner • 4 years ago • 115,357 views

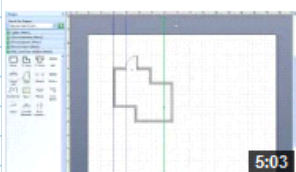
This movie shows you how to create an accurate floor plan with Floorplanner.com within 3 minutes



**Microsoft Visio - Scale drawing Part 1**

by NetresultTraining • 4 years ago • 105,046 views

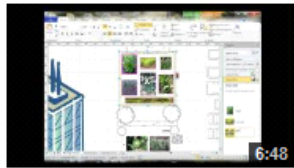
www.visio-tutorial.com. Using Visio 2007 we create a scale drawing for an office layout using the Space shape. I show you how ...



**Microsoft Visio scale drawing Part 2**

by NetresultTraining • 4 years ago • 44,487 views

The second part deals with irregular shaped layouts and inserting walls doors and windows. Watch lots more FREE tutorials at ...



**Visio 2010 - Community Garden Layout.wmv**

by aalhay • 2 years ago • 1,478 views

An introduction to some of the new features in Visio 2010. Beginner Level review of the diagramming software. I used it to ...

HD

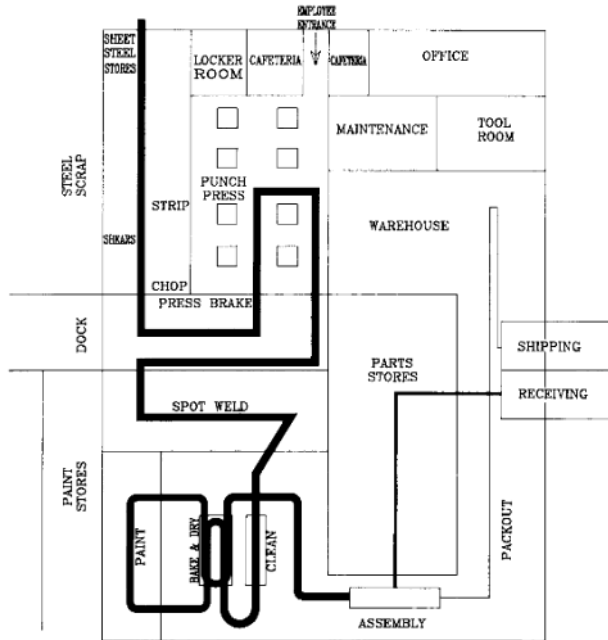
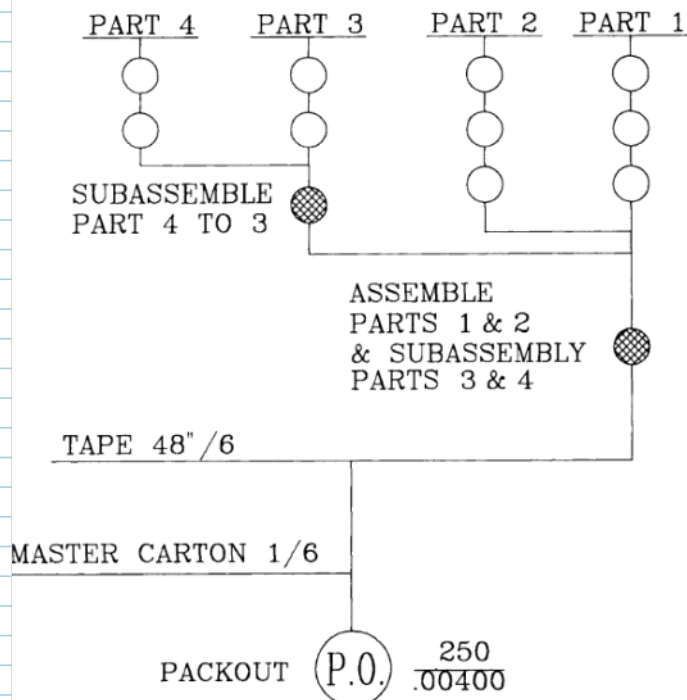


Figure 5-14 Flow diagram—Toolbox plant.

### The Operations Chart

The *operations chart* (see Figures 5-15 and 5-16) has a circle for each operation required to fabricate each part, to assemble each part to the final assembly, and to pack out the finished product. On one piece of paper, every production operation, every job, and every part are included.

Operations charts show the introduction of raw materials at the top of the page, on a horizontal line. (See Figure 5-15.) The number of parts will determine the size and complexity of the operations chart.



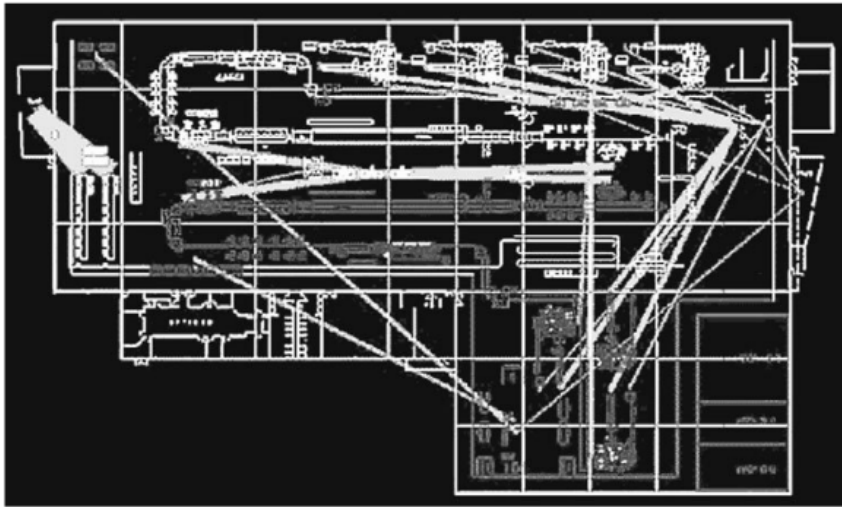
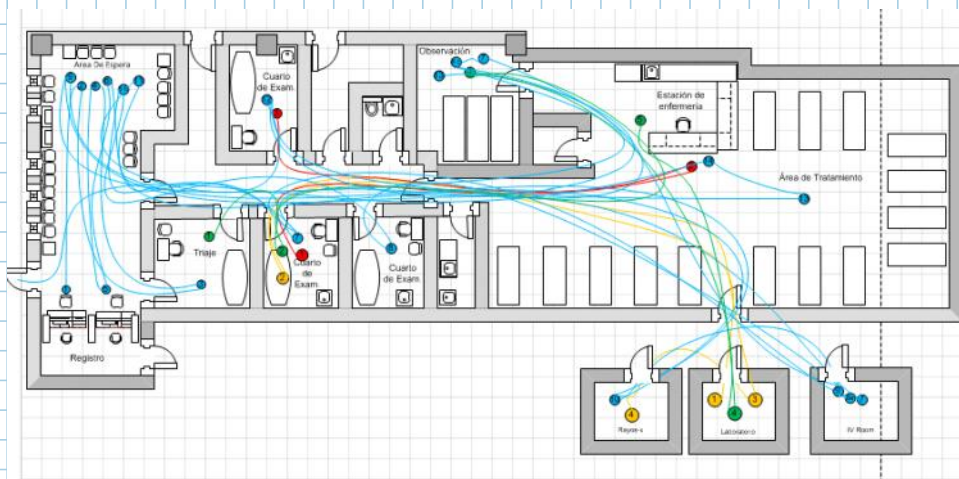


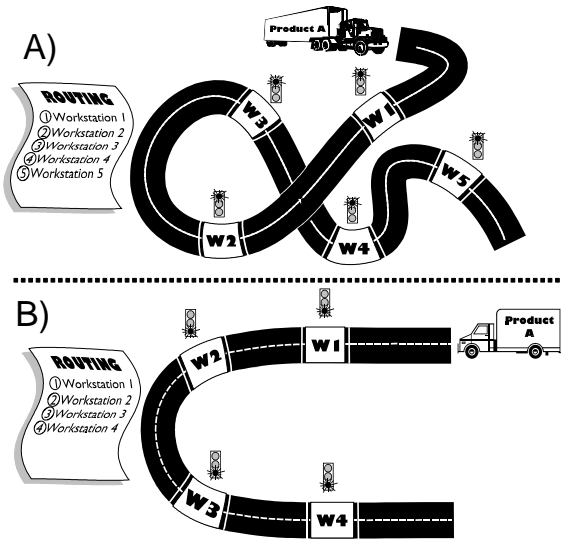
Figure 5-20 Proposed layout for an automotive plant using FactoryFLOW (courtesy of Engineering Animation, Inc.).



Leading Kaizen Events: Common Tools & Techniques

## Spaghetti Diagram

## In which road is shorter?



## Spaghetti Diagram

- Is a flow charting method that uses a continuous line to trace the path of work or employee through all phases of a process
- Is use to visualize the path of work in the workplace
- Is made by following the employees, documents, work through the value stream throughout the facilities
- It is very useful tool to minimize walking distance and time of employees and the travel distances of the work



## Spaghetti Diagram

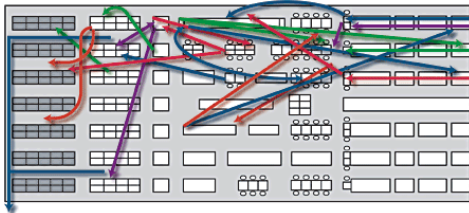
- It is like being in somebody's shoes and make all his work step by step
- Then simply draw on a room's map the distance, paths and sequence
- The result might look like a dish of spaghetti!
- Spaghetti diagrams expose inefficient layouts and large distances traveled between steps



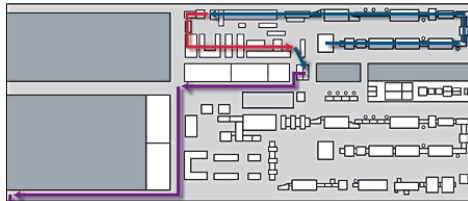
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## Spaghetti Diagram

Current State - Before



Future State - After



5

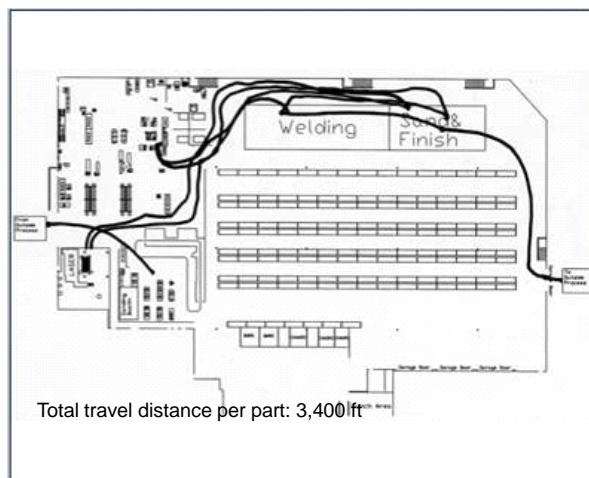
## Creating a Spaghetti Diagram

### Current State

1. Get or draw a layout of the facility or area of interest
2. Walk through the facility following the process flow
  - Focus on observing and understanding the patient, support products or process flows
  - Decide what item will you follow: people, document, materials and work
    - In case you want to follow multiple items in the same diagram, use a different color line for each item
  - Get familiarized with the sequence, equipment, workstation and flow of your item
3. Go back to the process and start drawing a line, as you follow the path of the selected item, that best represents its physical path
4. Number the steps of your process
5. Measure and annotate the total travel distance in feet

6

## Current Spaghetti Diagram



7

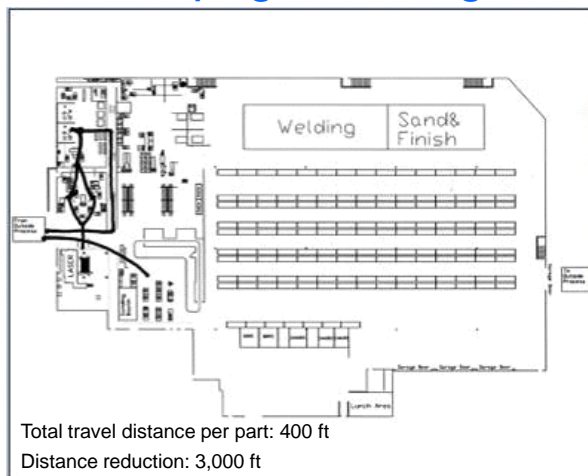
## Creating a Spaghetti Diagram

### Future State

1. Identify opportunities and improve to simplify and untangle the flow
  - Intersections and cross flows
  - Backtracking
  - Complex sequences
2. Identify opportunities and improve to reduce travel and walking distances
  - Based on the importance of the **relationship** of one work area to another determine its **proximity**
  - Relationship could be defined by work sequence or amount of work that flow from one area to the other
  - The higher the relationship, the closer areas should be
3. Make these improvements and draw an new improved layout
4. Draw a the improved path over the new layout
5. Using a From-To Chart compare the total travel distance for the new layout vs. the current state
6. Prepare a plan to implement the improvements

8

## Future Spaghetti Diagram



9

### Assignment

1. Pick a high-volume facility (library, CESI, etc.).
2. Develop the Spaguetti diagram for the current layout
3. Use the Waste types to identify mayor opportunity.
4. Research on lean metrics (for Layout) and develop calculations for those metrics on the current layout.

Due date: January 17th, 2013.

Team-based