MASTER PRODUCTION SCHEDULING

- MPS represents an anticipated build schedule of our finished goods (level 0)
- Finished Goods represented by
  - forecast and\or actual orders

MPS Considerations

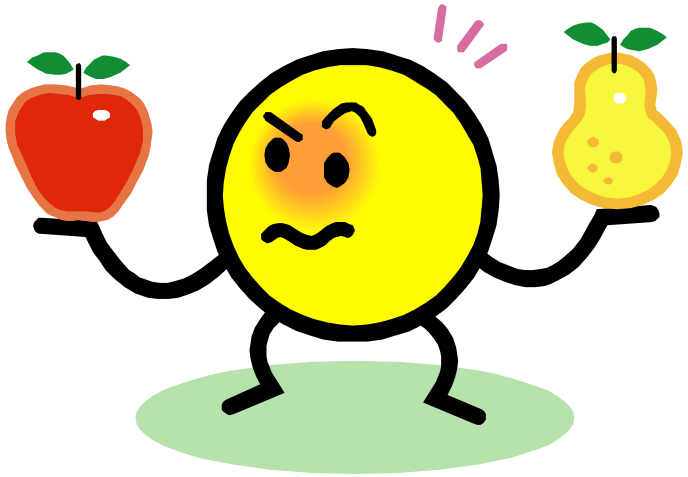
- Constraints
  - available time (capacity)
  - inventory
  - money
  - market
  - seasonality of demand

MPS Environments

1. make to stock
2. make to order
3. assemble to order

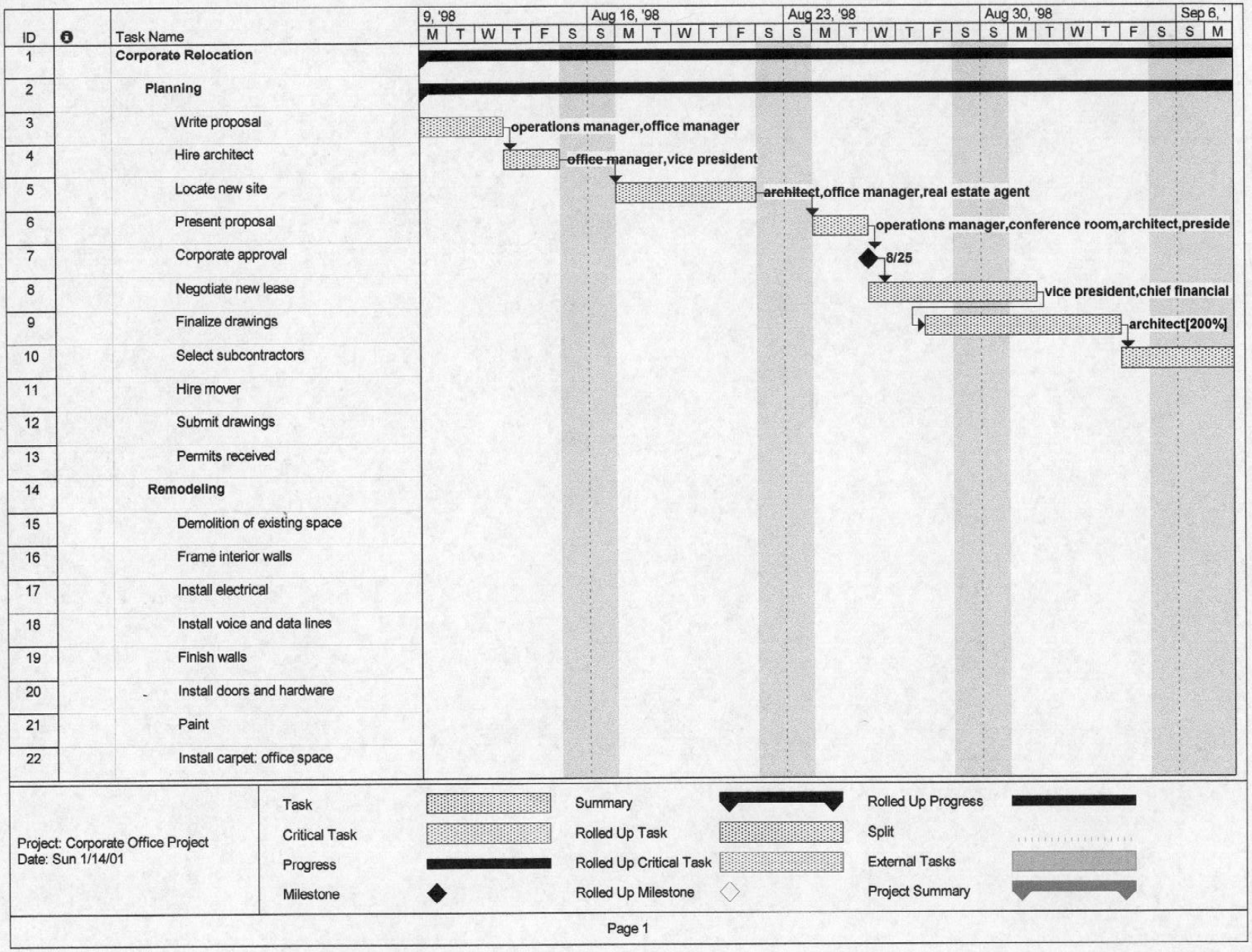
MPS Basic Inputs

1. what?-- part number of finished product
2. how many? -- qty
3. when? -- promise due date



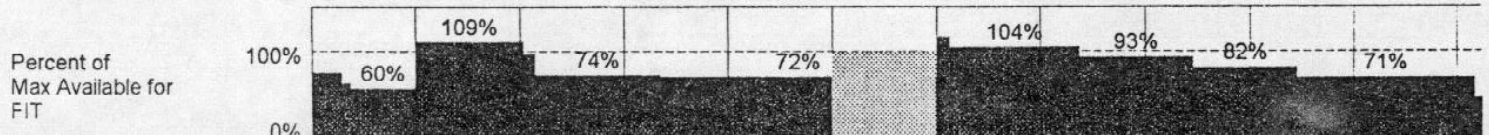
Scheduling in Job Shops

- How to distribute the load --- the assignment of jobs to work centers?
- How to sequence the jobs to the processing?


ID
Task Name
9, '98
Aug 16, '98
Aug 23, '98
Aug 30, '98
Sep 6, '
M T W T F S S M T W T F S S M T W T F S S M T W T F S S M
1 Corporate Relocation
2 Planning
3 Write proposal
4 Hire architect
5 Locate new site
6 Present proposal
7 Corporate approval
8 Negotiate new lease
9 Finalize drawings
10 Select subcontractors
11 Hire mover
12 Submit drawings
13 Permits received
14 Remodeling
15 Demolition of existing space
16 Frame interior walls
17 Install electrical
18 Install voice and data lines
19 Finish walls
20 Install doors and hardware
21 Paint
22 Install carpet: office space
operations manager,office manager
office manager,vice president
architect,office manager,real estate agent
operations manager,conference room,architect,preside
8/25
vice president,chief financial
architect[200%]
Project: Corporate Office Project
Date: Sun 1/14/01
Task
Critical Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Critical Task
Rolled Up Milestone
Rolled Up Progress
Split
External Tasks
Project Summary

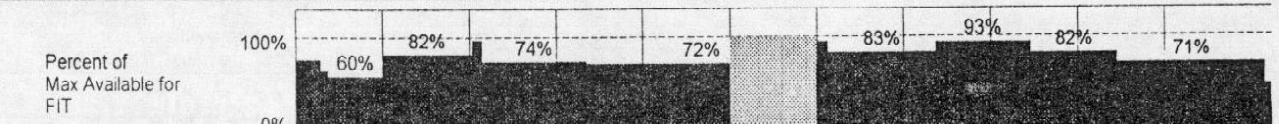
PRODUCTION SCHEDULE UNLEVELED

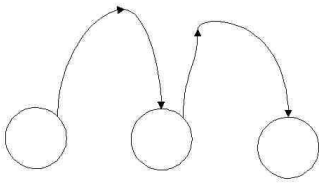
Task Name	Start	End	Resource Assignments	93/10						93/11				
				26	27	28	29	30	31	1	2	3	4	5
2850 FIT	93/10/18	93/10/19	FIT* 1.0											
3108K FIT	93/10/22	93/11/03	FIT*^ 1.0	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	4.10 h		
3379B,C,D FIT	93/10/22	93/10/28	FIT*^ 1.2	10.20 h	10.20 h	0.20 h								
3108M FIT	93/10/22	93/11/02	FIT*^ 1.0	8.70 h	8.70 h	8.70 h	8.70 h	8.70 h	8.70 h	8.70 h	3.20 h			
3058 FIT	93/10/23	93/10/28	FIT*^ 2.0	17.20 h	17.20 h	2.50 h								
3006A FIT	93/10/23	93/10/29	FIT*^ 0.2	1.90 h	1.90 h	1.90 h	0.60 h							
3006B FIT	93/10/25	93/10/26	FIT* 0.5	2.70 h										
3380 I,J FIT	93/10/26	93/10/26	FIT* 1.0	7.00 h										
3193 FIT	93/10/27	93/11/09	FIT*^ 2.5		22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h
3379A FIT	93/10/27	93/11/04	FIT*^ 1.0		9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	4.50 h	
3381 A,B FIT	93/10/27	93/11/01	FIT*^ 1.0		8.30 h	8.30 h	8.30 h	8.30 h	8.30 h	1.00 h				
73110 FIT	93/11/01	93/11/19	FIT*^ 1.9							17.70 h	17.70 h	17.70 h	17.70 h	17.70 h
3380 A-H FIT	93/11/01	93/11/06	FIT*^ 2.0							22.40 h	22.40 h	22.40 h	22.40 h	22.40 h
otals for FIT				56.70 h	87.70 h	63.00 h	59.00 h	58.40 h	58.40 h	91.20 h	84.70 h	76.60 h	67.10 h	62.60 h



PRODUCTION SCHEDULE LEVELED

Task Name	Start	End	Resource Assignments	93/10						93/11				
				26	27	28	29	30	31	1	2	3	4	5
2850 FIT	93/10/18	93/10/19	FIT* 1.0											
3108K FIT	93/10/22	93/11/03	FIT*~ 1.0	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	9.00 h	4.10 h		
3379B,C,D FIT	93/10/22	93/10/28	FIT*~ 1.2	10.20 h	10.20 h	0.20 h								
3108M FIT	93/10/22	93/11/02	FIT*~ 1.0	8.70 h	8.70 h	8.70 h	8.70 h	8.70 h	8.70 h	8.70 h	3.20 h			
3058 FIT	93/10/23	93/10/28	FIT*~ 2.0	17.20 h	17.20 h	2.50 h								
3006A FIT	93/10/23	93/10/29	FIT*~ 0.2	1.90 h	1.90 h	1.90 h	0.60 h							
3006B FIT	93/10/25	93/10/26	FIT* 0.5	2.70 h										
3380 I,J FIT	93/10/26	93/10/26	FIT* 1.0	7.00 h										
3379A FIT	93/10/27	93/11/04	FIT*~ 1.0		9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	9.90 h	4.50 h	
3381 A,B FIT	93/10/27	93/11/01	FIT*~ 1.0		8.30 h	8.30 h	8.30 h	8.30 h	8.30 h	1.00 h				
3193 FIT	93/10/28	93/11/10	FIT*~ 2.5			21.90 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h	22.50 h
3380 A-H FIT	93/11/01	93/11/06	FIT*~ 2.0							22.40 h	22.40 h	22.40 h	22.40 h	22.40 h
73110 FIT	93/11/02	93/11/22	FIT*~ 1.9								10.10 h	16.20 h	16.20 h	16.20 h
otals for FIT				56.70 h	65.20 h	62.40 h	59.00 h	58.40 h	58.40 h	73.50 h	77.10 h	75.10 h	65.60 h	61.10 h

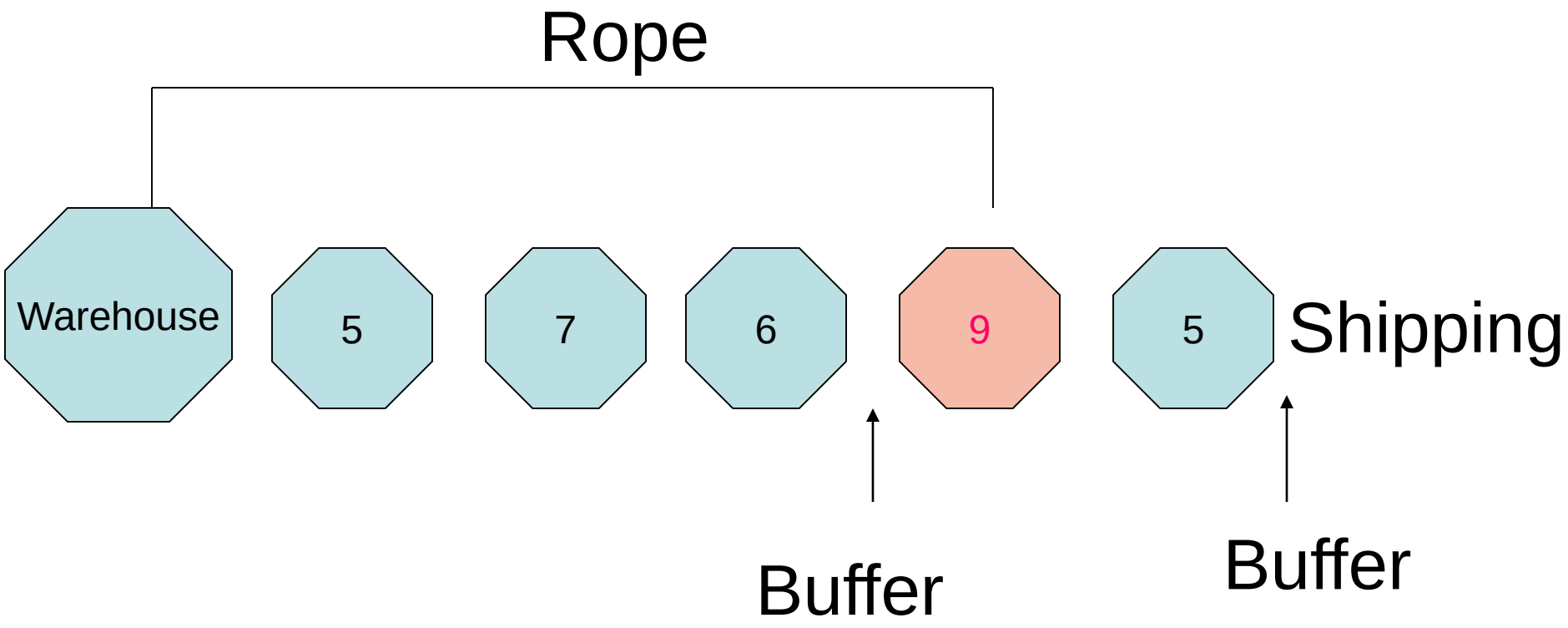




Drum-Buffer-Rope

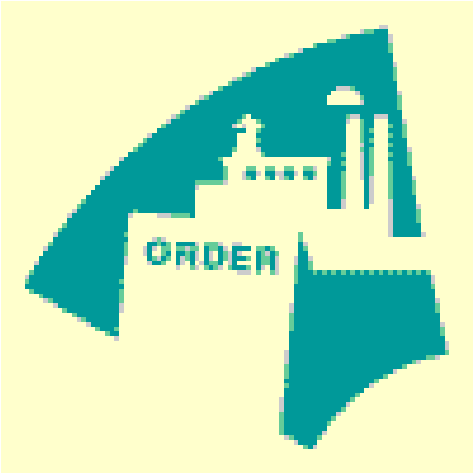
- Drum - the pace of the slowest machine or the most loaded machine
- Buffer - time protection against Murphy -- schedule some inventory at critical points in the plant-- in front of the constraint and at the shipping dock
- Rope - tie the constraint (drum) back to the first resource (warehouse) for the release of material

DBR



Sequencing Rules

- FIFO first in first out
- SPT shortest processing time
- DD due date
- S/O slack per operation



Sequencing Problem

Job	Process Time	Due Date
A	2	7
B	8	16
C	4	4
D	10	17
E	5	15
F	12	18

Sequencing Problem FIFO

Job	Process Time	Due Date	Flow Time	Days Late
A	2	7	2	0
B	8	16	10	0
C	4	4	14	10
D	10	17	24	7
E	5	15	29	14
F	12	18	41	23
Total Days Late				54

Sequencing Problem SPT

Job	Process Time	Due Date	Flow Time	Days Late
A	2	7	2	0
C	4	4	6	2
E	5	15	11	0
B	8	16	19	3
D	10	17	29	12
F	12	18	41	23
		Total Days Late		40

Sequencing Problem DD

Job	Process Time	Due Date	Flow Time	Days Late
C	4	4	4	0
A	2	7	6	0
E	5	15	11	0
B	8	16	19	3
D	10	17	29	12
F	12	18	41	23
Total Days Late				38

Slack Per Operation

Slack=Due Date-Process Time

Critical Ratio=Slack÷# Operations

JOB	TIME	DD	# OPS	SLACK	CRIT RATIO	RANK
A	2	7	3	5	1.67	3
B	8	16	6	8	1.33	2
C	4	4	5	0	0	1
D	10	17	2	7	3.50	6
E	5	15	4	10	2.50	4
F	12	18	2	6	3.00	5

Johnson Method of Sequencing

- Algorithm

1. List Jobs & Times

2 Select Job With Shortest Processing Time

If that job is in work center 1, push the job to the front of the schedule

If that job is in work center 2, push the job to the end of the schedule

Break Ties Arbitrarily

Repeat Step 2 Until All Jobs Are Scheduled

Johnson Method Example

Job	**** Work Center ****	
	1	2
A	5	5
B	4	3
C	8	9
D	2	7
E	6	8
F	12	15

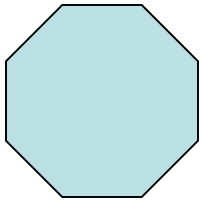
Schedule

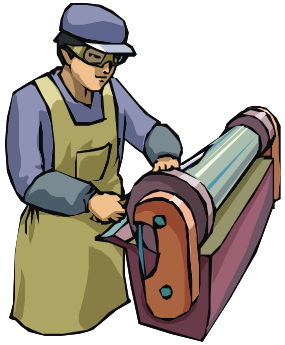
D	E	C	F	A	B

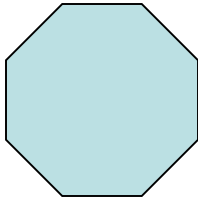
3 Things That Can Happen With Parts Moving Through a Plant

1. Parts Arrive At Second Work Station Just as Worker Completes Parts
2. Parts Arrive At Second Work Station And Worker Has Been Idle Waiting For These Parts
3. Parts Arrive At Second Work Station And Must Wait In The Buffer Until Worker Has Completed Current Parts

1







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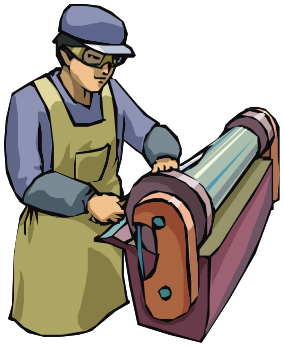

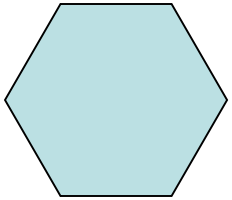

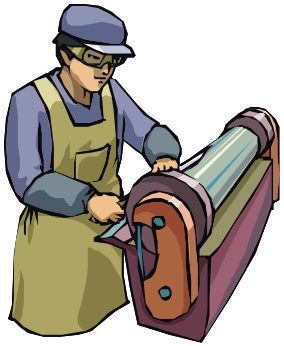

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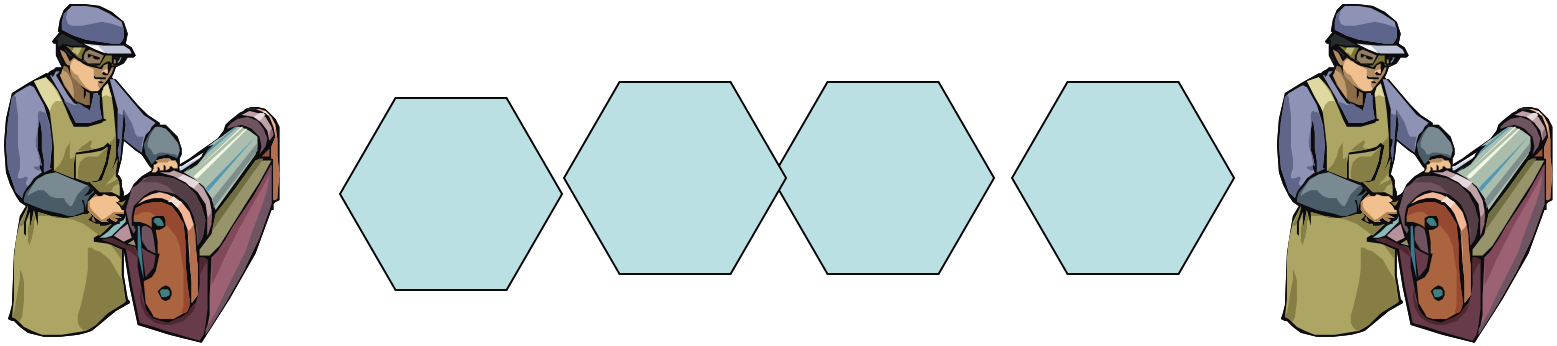

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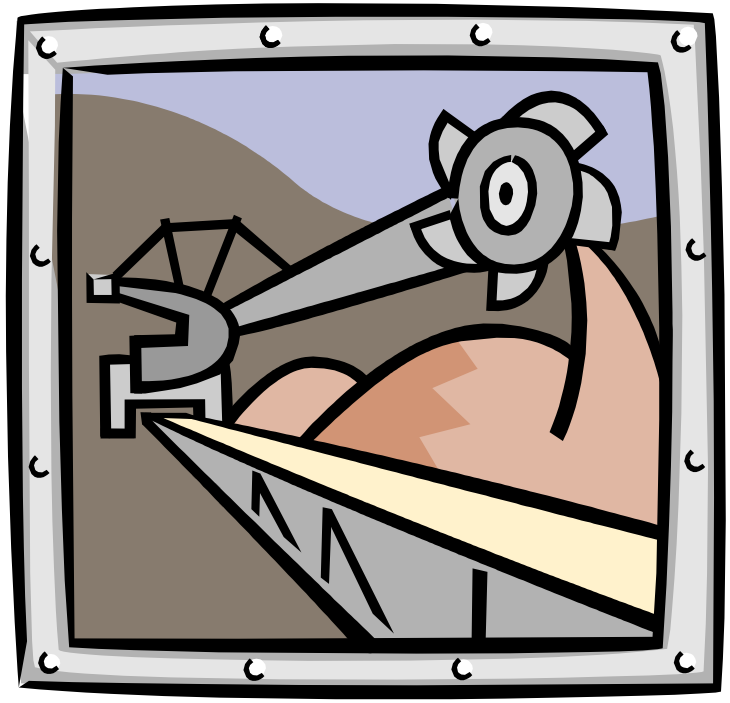

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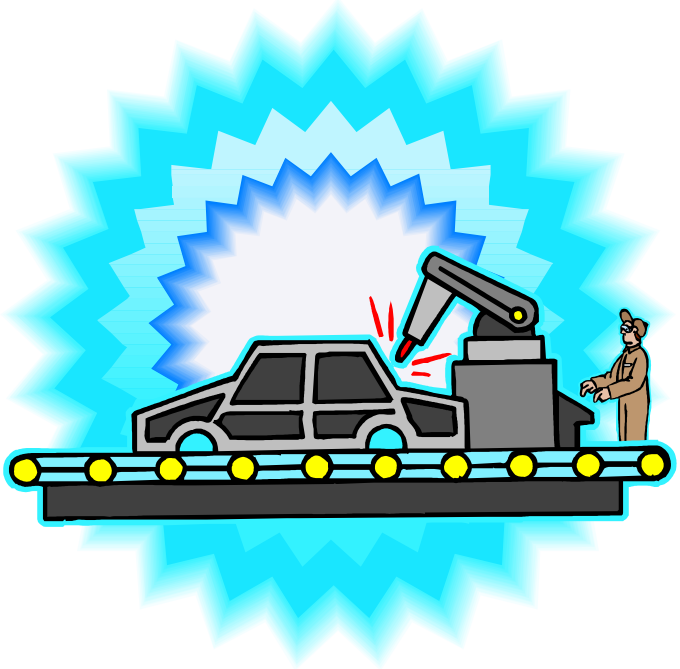

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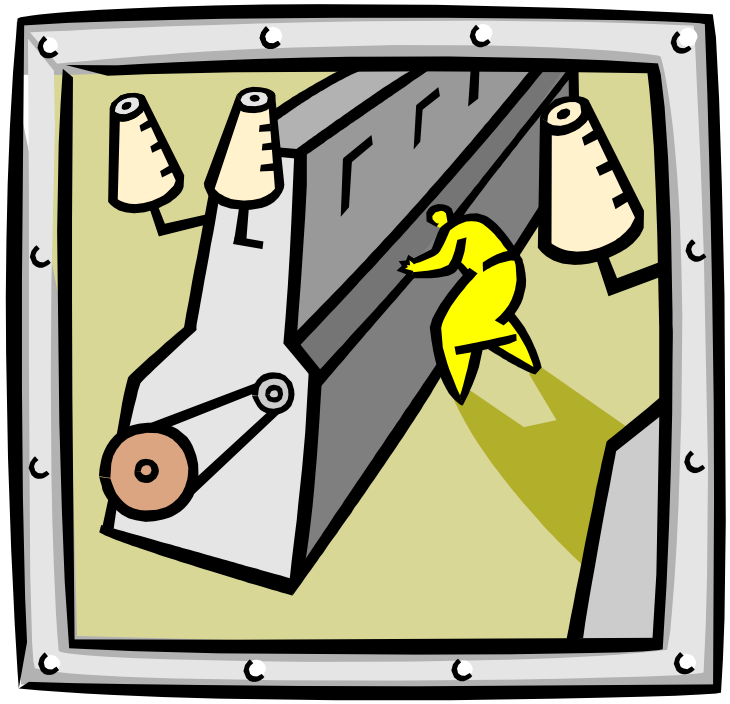

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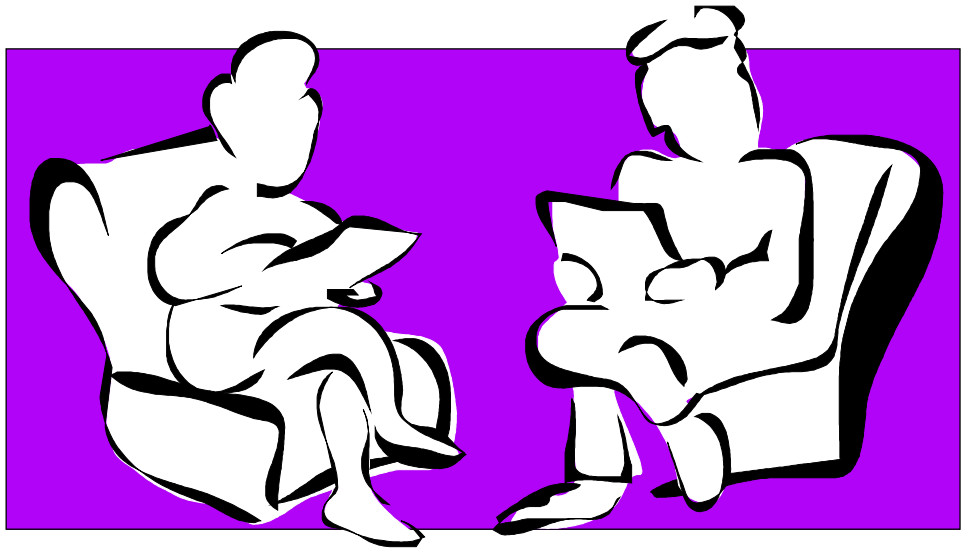
Service System Scheduling

- Reservation or Appointment System
- Variability in both Service Time and Arrival Times



Special Projects

- Pert -- Project Evaluation Review Technique
- CPM -- Critical Path Method

MPS Problem

- There is an order for 2,000 units of product X which requires the sequence of four operations shown on the next slide.

- How many clock-hours will it take to process this order if four hours are allowed between operations?
- How many parts will have to be started into production to produce 2,000 good units?

Op	Machine Service Time Daily (minutes)	Percent Scrap after Operation	Operation Time/Unit Operation(mins)	Operator Lost Time (hrs)
1	40	1	2.41	.5
2	28	2.5	6.20	.5
3	17	1.5	0.76	.6
4	44	3	1.37	.4

MPS Problem

Column	Description
1	Operation
2	Minutes Per Unit
3	Quantity Required
4	Total Minutes
5	Total Hours
6	Operating Hrs. Per Day
7	Total Days
8	Total Hrs @ 8 Hrs Per Day

Scrap Factor Analysis

- Op. Equation

  4 2,000/.97 = 2,061.9 (2,062)

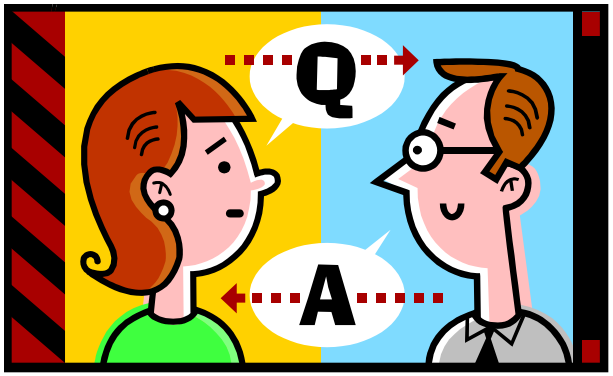
  3 2,061.9/.985 = 2,093.3 (2,093)

  2 2,093.3/.975 = 2,147.0 (2,147)

  1 2,147/.99 = 2,168.7 (2,169)

Possible Answers

- 2,000
- 2,160
- 2,168
- 2,169
- 2,175
- 2,600
- 9,000



Operating Time

Op	Non-Operating	Operating Time
1	40 mins +.5 hrs.	
	=.67+.5 = 1.17 hrs	8-1.17 = 6.83 hrs
2	28 mins + .5 hrs	
	= .47 + .5 = .97 hrs	8-.97 = 7.03 hrs
3	17 mins + .6 hrs	
	= .28 + .6 = .88 hrs	8-.88 = 7.12 hrs
4	44 mins + .4 hrs	
	= .73 + .4 = 1.13 hrs	8-1.13 = 6.87 hrs

MPS Problem

1 Op	2 Mins/Unit	3 Qty Req	4 Tot Mins	5 Tot Hrs	6 Op Hrs\Day	7 Tot Days	8 Tot Hrs@8\Day
1	2.41	2,169	5,227	87.1	6.83	12.75	102.00
2	6.2	2,147	13,311	221.9	7.03	31.56	252.48
3	.76	2,093	1,591	26.5	7.12	3.72	29.76
4	1.37	2,062	2,825	47.1	6.87	6.86	54.88

Total Clock Hrs = 439.12
Add 3 Delays 4 Hrs. each = 12
Total 451.12

MPS Time Phased Record

- Available = Previous Available+MPS (if any) minus larger of (forecast vs. orders)
- Available to Promise = MPS (scheduled receipts) – sum of actual orders up to (but not including) the next MPS

MPS

	1	2	3	4	5	6
Forecast	20	20	20	20	20	20
Orders	12	6	3			
Available(5)	35	15	45	25	5	35
Available to Promise	32		47			50
MPS	50		50			50

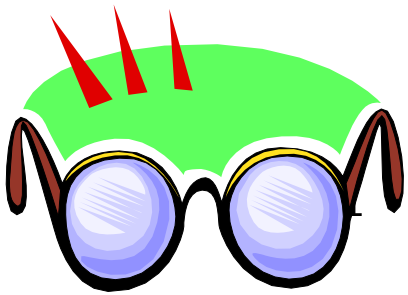
Beginning on Hand = 5

A. Complete the record.

B. Are there any problems?

C. What is the earliest Peter can take an order for 33 units?

- The Spencer Optics Company produces an inexpensive line of sunglasses. The manufacturing process consists of assembling two plastic lenses (produced by the firm's Plastic Molding Department) into a finished frame (purchased from an outside supplier). The company is interested in using material requirements planning (MRP) to schedule its operations and has asked you to prepare an example to illustrate the technique.
- The firm's sales manager has prepared a 10-week sales forecast for one of the more popular sunglasses (the Classic model) to use in your example. The forecast is 100 orders per week. Spencer has customer orders of 110 units, 80 units, 50 units, and 20 units in weeks 1, 2, 3, and 4, respectively. The sunglasses are assembled in batches of 300. We have 140 units available at the beginning of the exercise. Lead time is 1 week.
- Prepare the MRP record for the assembly of sunglasses.



Spencer Optics

	1	2	3	4	5	6	7	8	9	10
F	100	100	100	100	100	100	100	100	100	100
O	110	80	50	20						
A	30	230	130	30	230	130	30	230	130	30
AP		150			300			300		
MPS		300			300			300		
OR	300			300			300