Production Planning & Control
BMM4823

Scheduling

by
Dr. Ahmad Nasser Mohd Rose
nasser@ump.edu.my

Chapter Description

- Aims
  - To understand the importance of short term scheduling in planning
  - To determine the best scheduling for production planning.

- Expected Outcomes
  - Able to determine the best scheduling through FCFS, EDD, LPT and SPT
  - Able to plan correctly for production planning

- References

Heizer, J and Render,B. 2011. Principles of Operations Management, 8th Edition, Pearson Prentice Hall, Inc.

Introduction

Introduction

Organisation	Managers schedule the following
MAS Airlines	Maintenance Departure time tables Flight crews, catering, gate and ticketing
Kuantan Medical Centre	Operation room use Patient admissions Medical officer visits Nursing, security, maintenance Outpatient treatment Meals
UMP	Classrooms Lecturers Accommodation Transport

The importance of scheduling

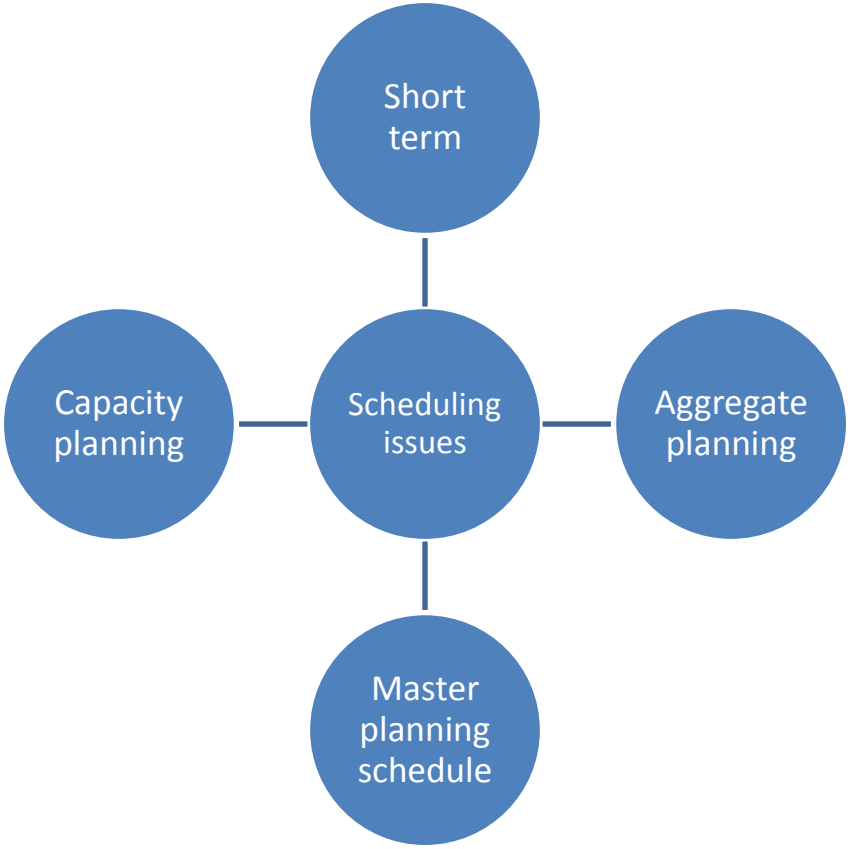
Why should we have effective and efficient scheduling ?

- ❑ As a competitive advantage
- ❑ Able to reduce cost
- ❑ Better use or manage of company assets
- ❑ Faster throughput and on time delivery

Issues of scheduling

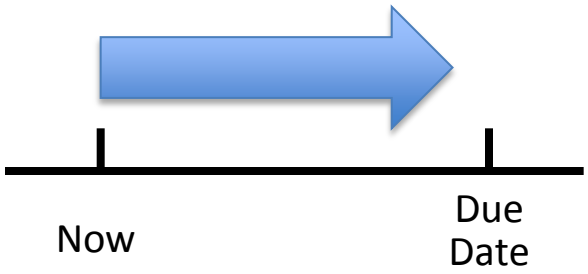
- Dealing with timing on operation
- Allocation and prioritisation of demand
- Scheduling method such as forward or backward
- Considering the product/service

Scheduling issues



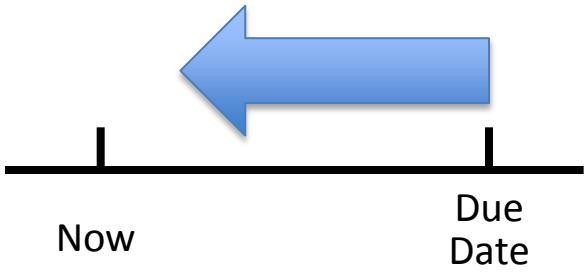
Forward scheduling

- Forward scheduling starts immediate once receive the order
- Feasible schedule but may not meet required date/due date
- Build up work-in-process inventory



Backward scheduling

- Backward scheduling starting with the due date.
- Start final operation first
- Backward schedule based on due date
- Should enough of resources



Criteria in Scheduling

1. Minimising completion time – Average completion time
2. Maximising the utilization of facilities
3. Minimising of work-in-process (WIP) inventory – Number of jobs in the system
4. Minimising customer waiting time – Average number of late days

Through these criteria the production objectives will be achieved

Scheduling methods

1. ***Input and output***
2. ***Gantt charts***
3. ***Assignment method***
4. ***Sequencing Rules***
5. ***Johnson Rules***

Sequencing jobs

We use 4 criteria in sequencing jobs

- FCFS: First come, first served
- SPT: Shortest processing time
- EDD: Earliest due date
- LPT: Longest processing time

Scheduling criteria will be based on

$$\text{Average completion time} = \frac{\text{Total flow time}}{\text{Number of jobs}}$$

$$\text{Utilization} = \frac{\text{Total job work time}}{\text{Total flow time}}$$

$$\text{Average number of jobs in the system} = \frac{\text{Total flow time}}{\text{Total job work time}}$$

$$\text{Average job lateness} = \frac{\text{Total late days}}{\text{Number of jobs}}$$

Source : Heizer & Render 2011

Example

ABC company would like to measure their scheduling efficiency through each of the criteria.

Job	*Job Estimation (Days)*	*Due Date (Days)*
A	**6**	**8**
B	**2**	**6**
C	**8**	**18**
D	**3**	**15**
E	**9**	**23**

FCFS: Sequence A-B-C-D-E

Job Sequence	*Job Estimation (Days)*	*Flow Time*	*Job Due Date*	*Job Lateness*
A	6	6	8	0
B	2	8	6	2
C	8	16	18	0
D	3	19	15	4
E	9	28	23	5
	28	77		11

SPT: Sequence B-D-A-C-E

Job Sequence	*Job Estimation (Days)*	*Flow Time*	*Job Due Date*	*Job Lateness*
B	2	2	6	0
D	3	5	15	0
A	6	11	8	3
C	8	19	18	1
E	9	28	23	5
	28	65		9

EDD: Sequence B-A-D-C-E

Job Sequence	*Job Estimation (Days)*	*Flow Time*	*Job Due Date*	*Job Lateness*
B	2	2	6	0
A	6	8	8	0
D	3	11	15	0
C	8	19	18	1
E	9	28	23	5
	28	68		6

LPT: Sequence E-C-A-D-B

Job Sequence	*Job Estimation (Days)*	*Flow Time*	*Job Due Date*	*Job Lateness*
E	9	9	23	0
C	8	17	18	0
A	6	23	8	15
D	3	26	15	11
B	2	28	6	22
	28	103		48

Summary

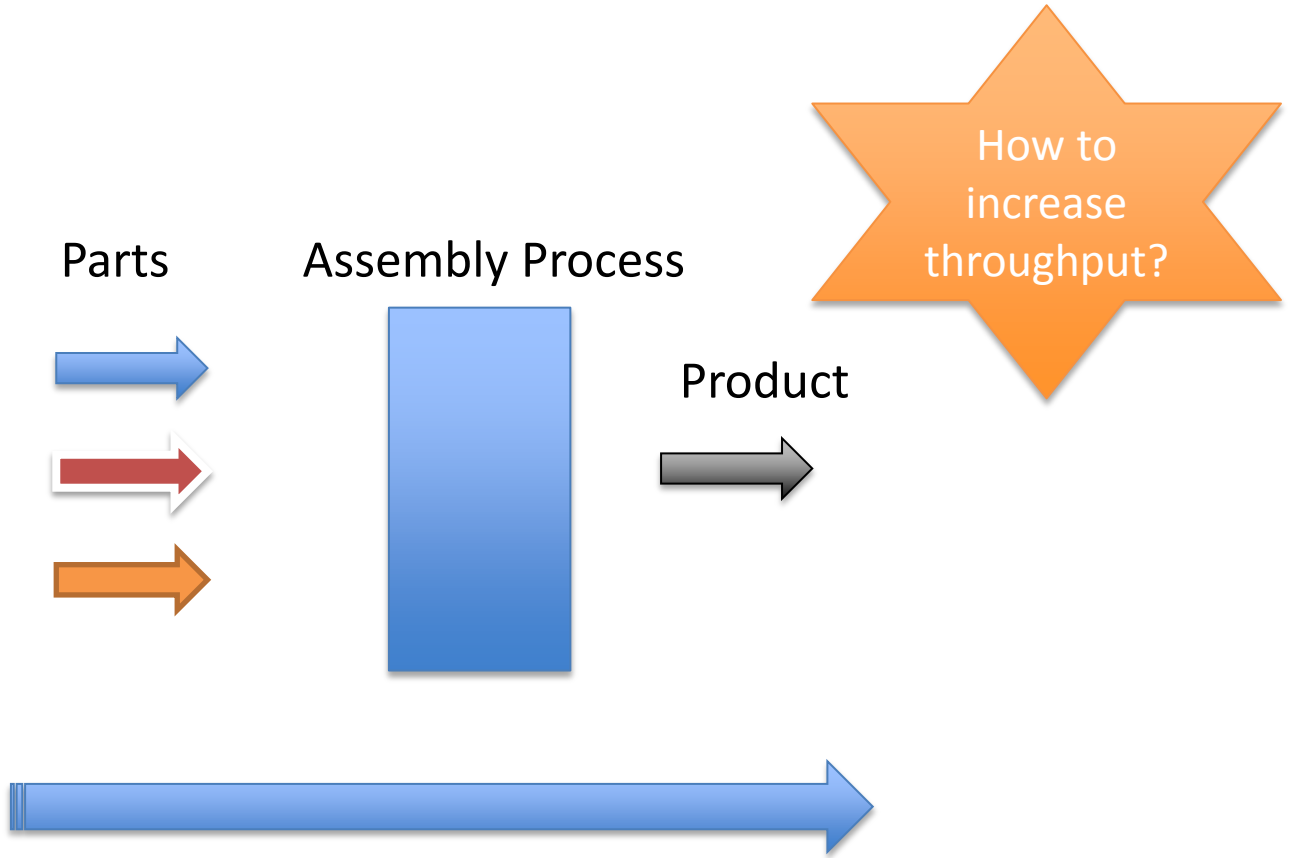
Summary of Rules

Rule	*Average Completion Time (Days)*	*Utilization (%)*	*Average Number of Jobs in System*	*Average Lateness (Days)*
FCFS	**15.4**	**36.4**	**2.75**	**2.2**
SPT	**13.0**	**43.1**	**2.32**	**1.8**
EDD	**13.6**	**41.2**	**2.43**	**1.2**
LPT	**20.6**	**27.2**	**3.68**	**9.6**

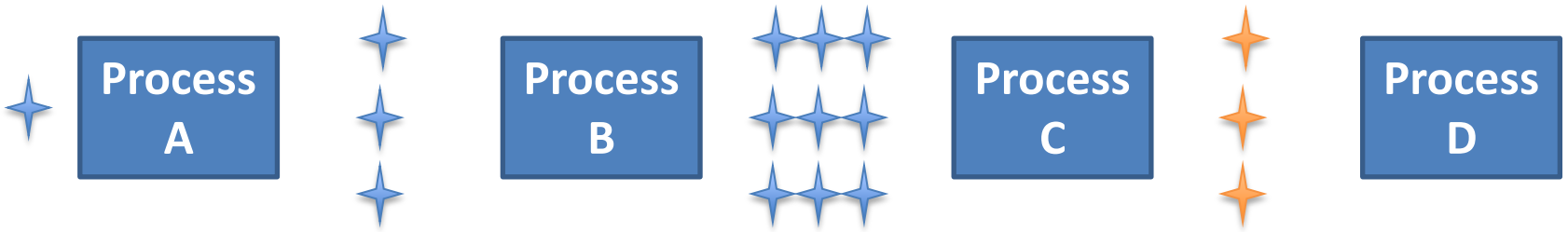
Comparison sequence rules

- ☑ None will excels in all criteria
- ☑ SPT able to minimise flow time
- ☑ SPT able to minimise number of jobs in the system. It is indicate the level of work in process (WIP)
- ☑ However some jobs will be scheduled at the end due to long processing time which might cause customer dissatisfied
- ☑ FCFS act fair to everybody but not excels all criteria
- ☑ EDD able to minimize lateness

Bottleneck


How to increase throughput?
Parts
Assembly Process
Product

Bottleneck



How to solve this problem ?

Actions on bottleneck

- Increasing capacity of constraint
- Provide a training to the unskilled workers
- Create autonomous maintenance and regular maintenance
- Develop a manual or standard operation procedure
- Check the suitability inspection point
- Use any idle resources to support bottleneck

The End