INDUSTRIAL ENGINEERING

Lesson 9
Capacity & Facility Planning

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Synopsis

This chapter introduces the concept of capacity planning. Critical decisions in capacity planning are discussed. Subsequently, the concept of facility planning will be addressed along with techniques used to design the facility layouts. At the end of this chapter, line balancing techniques will be elaborated.

Expected Outcome

1. Understand the concept of capacity planning.
2. Explain two critical decisions in capacity planning.
3. Understand the concept and objectives of facility planning.
4. Understand three basic layout types.
5. Apply the techniques in designing process and product layouts.
6. Apply the concept of line balancing to smooth the production line.

What is capacity?

Maximum capability to produce.

Maximum amount of work that an organization is capable to complete.

What is capacity planning?

The process of determining maximum capability to produce in a given period.

Why capacity planning is important?

Capacity decisions affect lead times, customer responsiveness, costs, & ability to compete

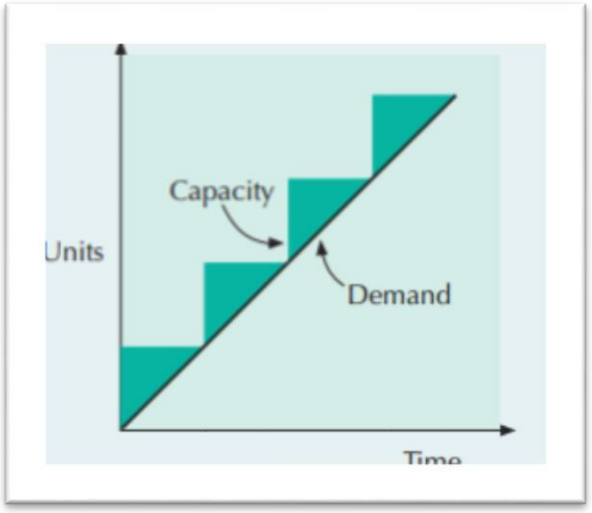
Inadequate capacity may lose customers

Excess capacity can drain resources & prevent investments

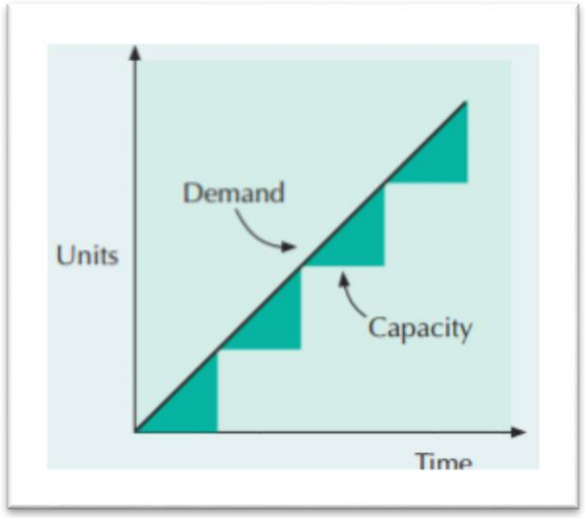
Critical decisions in capacity planning

1. When to alter capacity?
2. How much to alter?

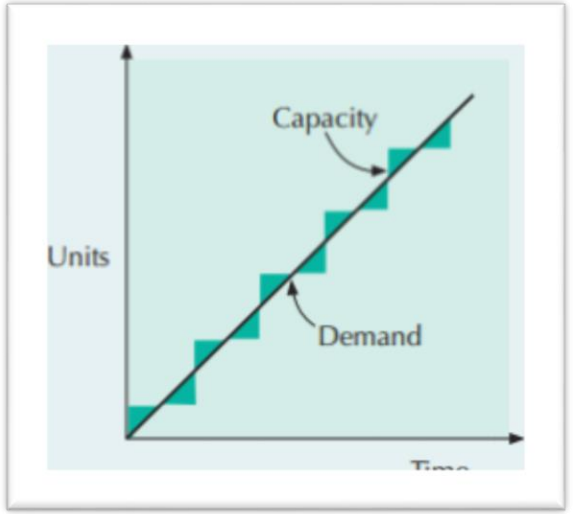
Strategies of Capacity Planning



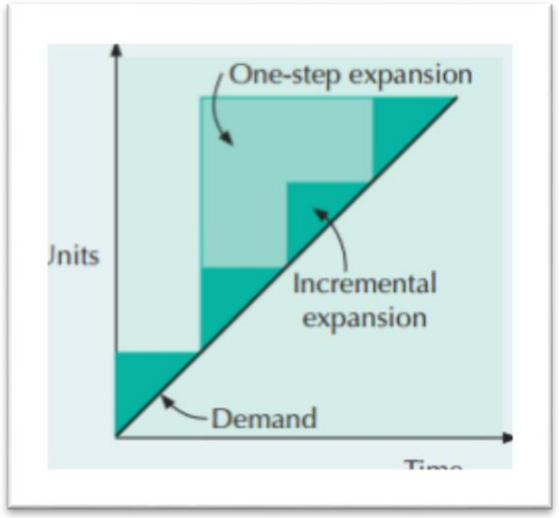
Capacity lead strategy



Capacity lag strategy



Average capacity strategy



Incremental vs one-step expansion

Source: Heizer & Render (2014)

How much to increase capacity?

- The volume & certainty of anticipated demand
- Strategic objectives (i.e., growth, customer service, & competition)
- The costs of expansion & operation

Facility Planning

It may affect...

(1) Worker efficiency.

(2) Manufacturing lead time.

(3) System responsiveness to changes in product design, mix, or volume.

Facility Layout

The arrangement of resources (workstation, office, etc.) within an existing or proposed facility.

Basic objective :

To smooth flow of work, & resources through the system.

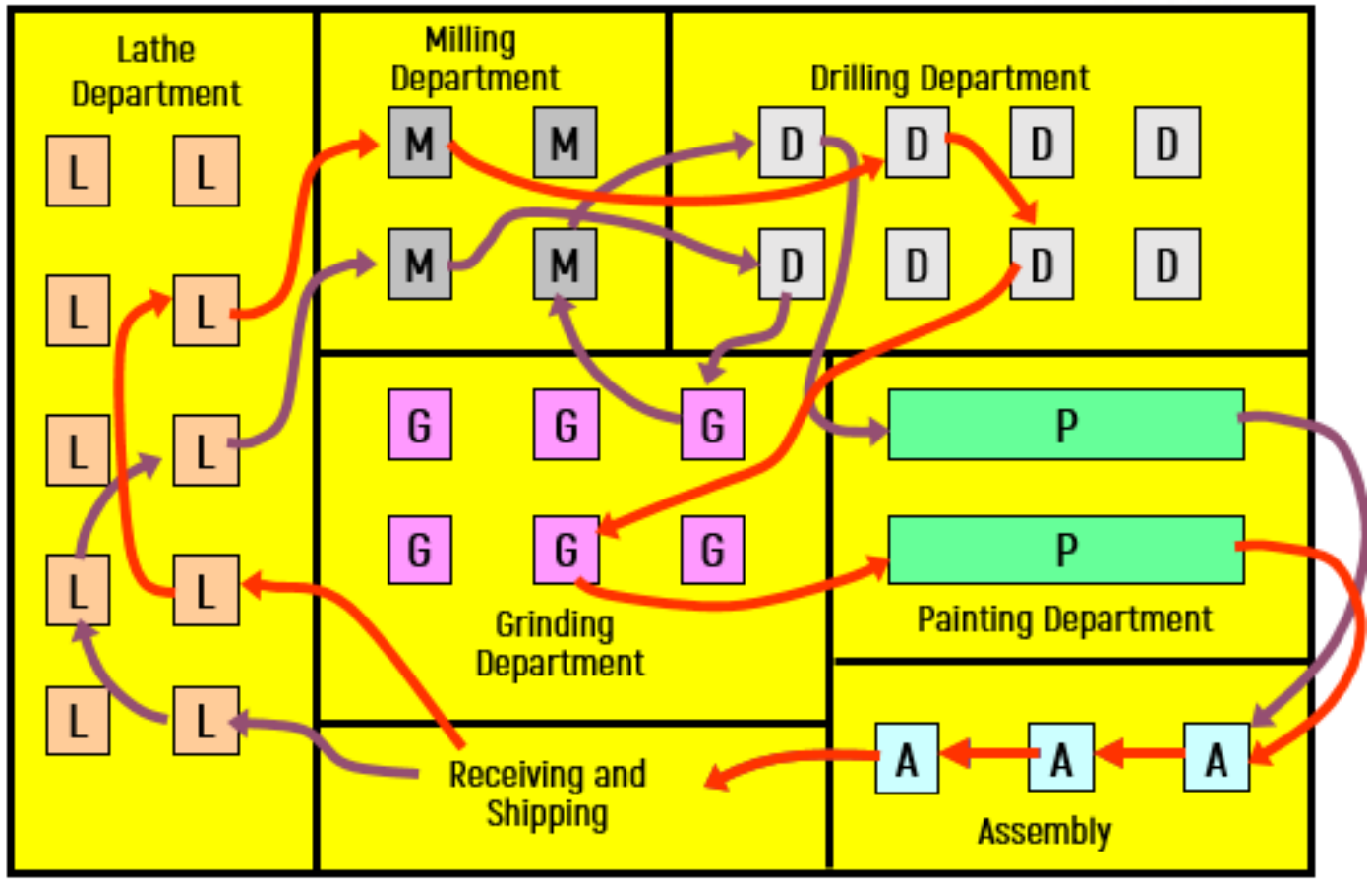
3 Basic Layout Types

- ✓ Process layout
- ✓ Product layout
- ✓ Fixed-position layout

Process Layouts

Also known as functional layouts, grouping similar functions in the same department.

Manufacturing Process Layouts



Source: Heizer & Render (2014)

Process Layouts in Service

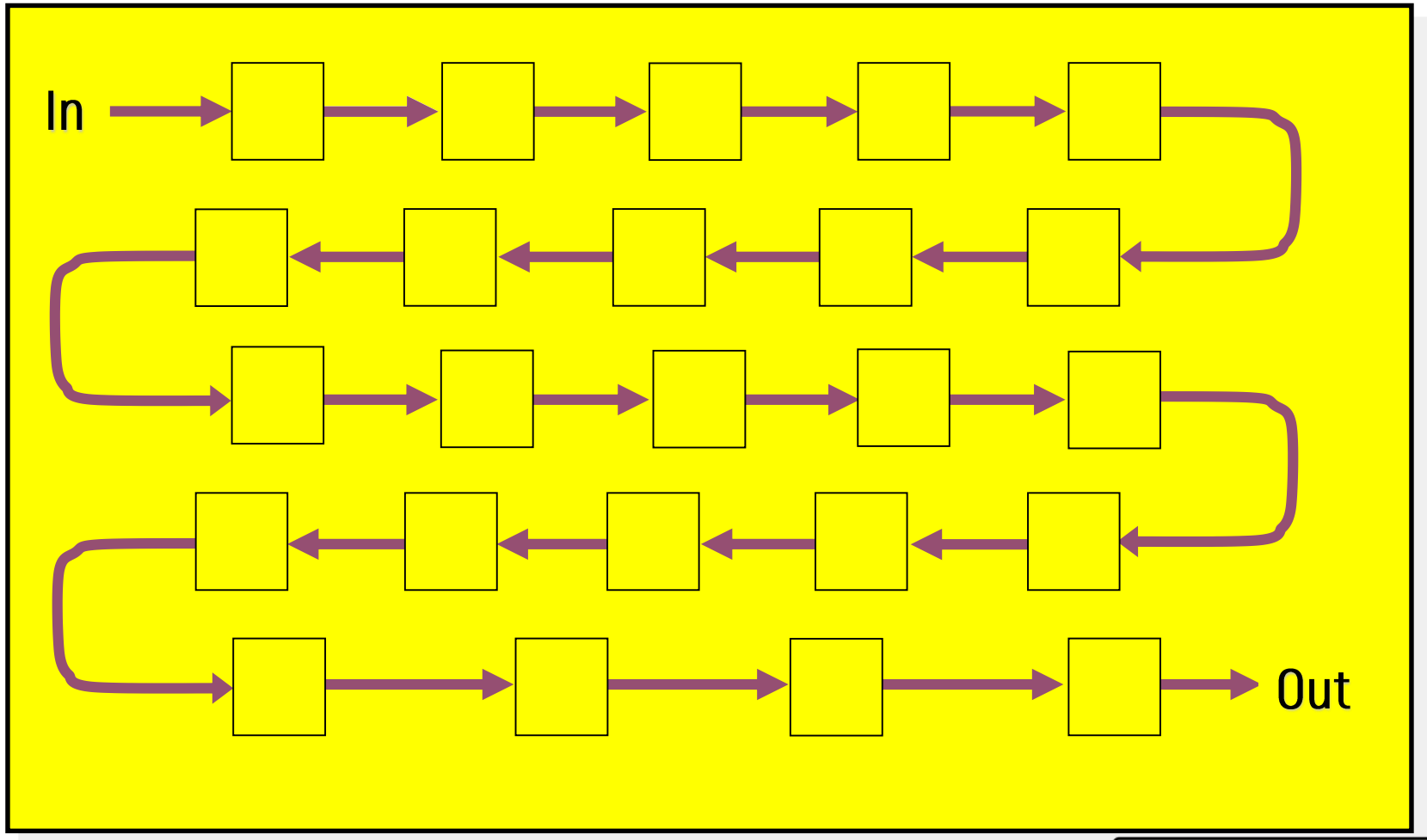
Women's sportswear	Shoes	Housewares
Women's dresses	jewelry	Children's department
Cosmetics	Entry & display area	Men's department

Source: Heizer & Render (2014)

Product Layouts

Better known as assembly lines.
It arranges activities based on the process sequence.

Product Layouts



Source: Heizer & Render (2014)

Product vs Process Layouts

Product		Process
Sequential arrangement of activities	Description	Functional grouping of activities
Continuous, mass production, mainly assembly	Type of process	Intermittent, job shop, batch production, mainly fabrication
Standardized, made to stock	Product	Varied, made to order
Stable	Demand	Fluctuating
High	Volume	Low
Special purpose	Equipment	General purpose

Product vs Process Layouts

Product		Process
Limited skills	Workers	Varied skills
Low in-process, high finished goods	Inventory	High in-process, low finished goods
Small	Storage space	Large
Fixed path (conveyor)	Material handling	Variable path (forklift)
Narrow	Aisles	Wide
Part of balancing	Scheduling	Dynamic
Line balancing	Layout decision	Machine location
Equalize work at each station	Goal	Minimize material handling cost
Efficiency	Advantage	Flexibility

Fixed Position Layouts

It is a layout suitable for fragile, bulky, or heavy products.

Product remains immobile for the all cycle.

All the resources are brought to the production site.

Designing Process Layouts

Objective:

To minimize material handling cost.

Consequently…

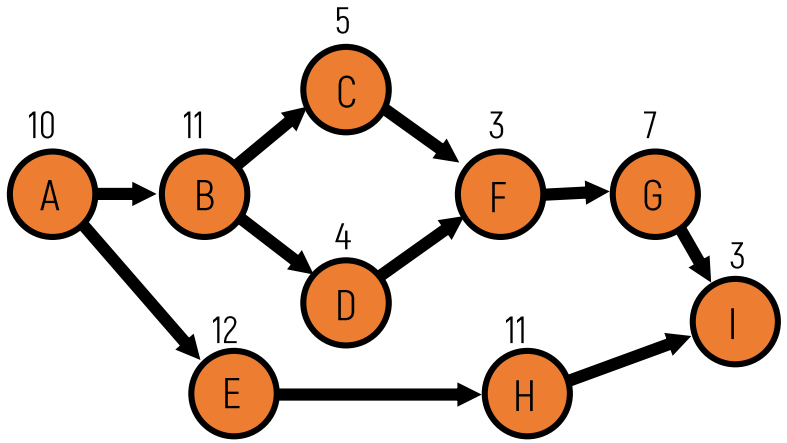
Inter-department departments should be located closer.

Techniques in Designing Process Layouts

- Block Diagramming
- Relationship Diagramming

Designing Product Layouts

Main input to product layout decision:
precedence requirement.



Source: Heizer & Render (2014)

Designing Product Layouts

Product layouts are used for high-volume production.
To achieve the efficient process, jobs are broken down into work elements.

Focuses on grouping work elements into workstations.

Designing Product Layouts

If each workstation takes the same amount of time; process will move smoothly between workstations with no waiting & idle.

Here, line balancing is needed to equalize the workload at each workstation

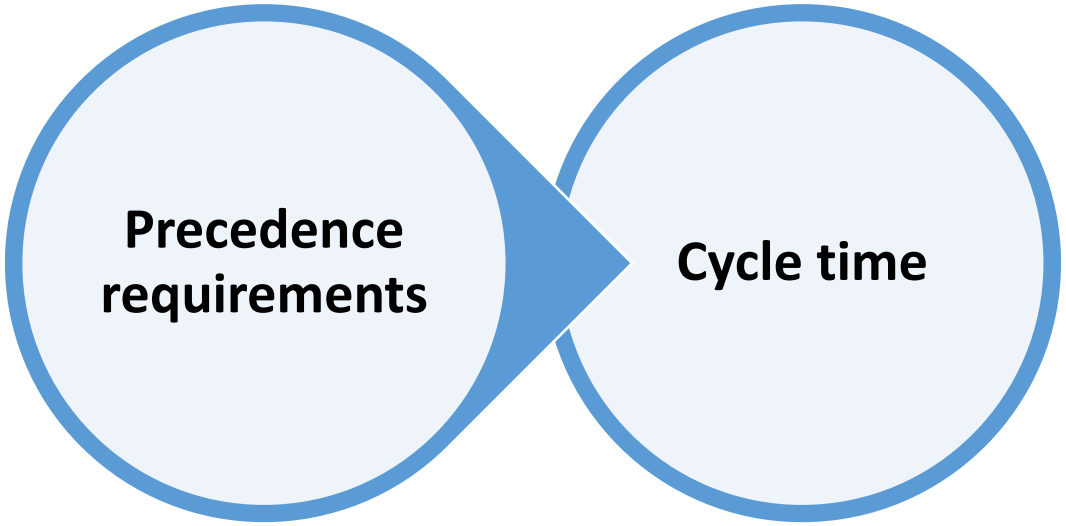
Line Balancing

Objective: To balance the assembly line.

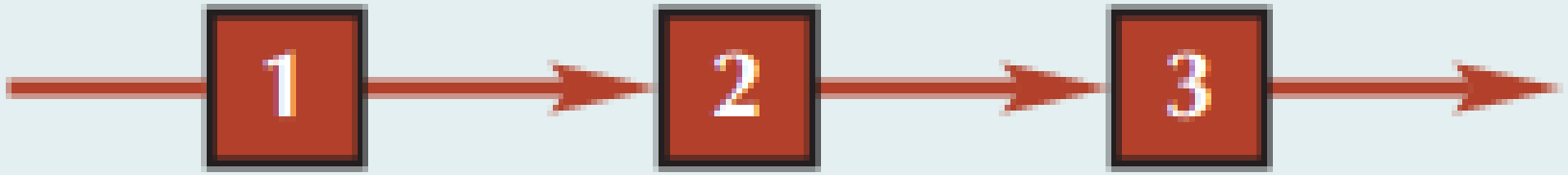
The process of equalizing the amount of work at each work center.

Line Balancing

Constraints:



Cycle Time



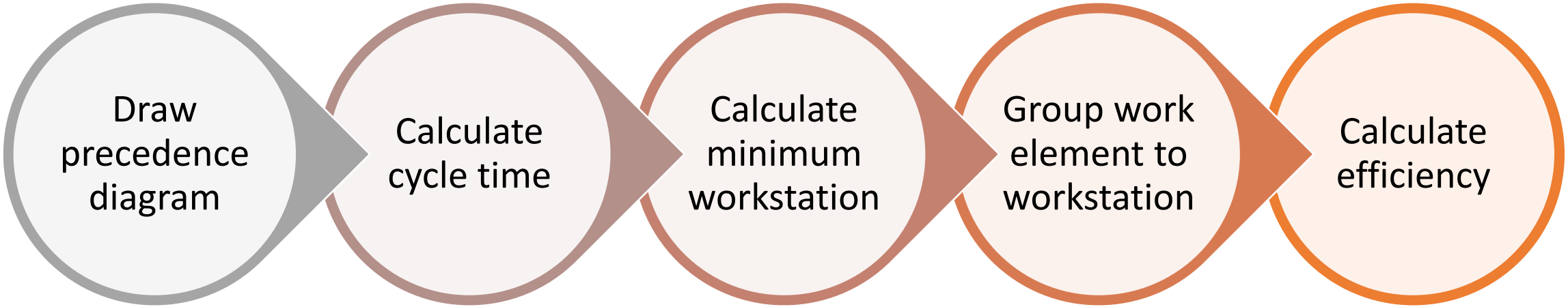
4 minutes 4 minutes 4 minutes

Flow time = 4 + 4 + 4 = 12 minutes

Cycle time = max {4, 4, 4} = 4 minutes

Source: Heizer & Render (2014)

Steps in Balancing Assembly Line



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