



ΠΑΝΕΠΙΣΤΗΜΙΟ
ΠΑΤΡΩΝ
UNIVERSITY OF PATRAS

ΑΝΟΙΚΤΑ ακαδημαϊκά
μαθήματα ΠΠ

Μηχανουργική Τεχνολογία II

“Σχεδιασμός και Λειτουργία Συστημάτων Παραγωγής”

Καθηγητής Γεώργιος Χρυσολούρης

Πολυτεχνική Σχολή

Τμήμα Μηχανολόγων & Αεροναυπηγών Μηχανικών



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Manufacturing Processes II

“Design and Operation of Manufacturing Systems”

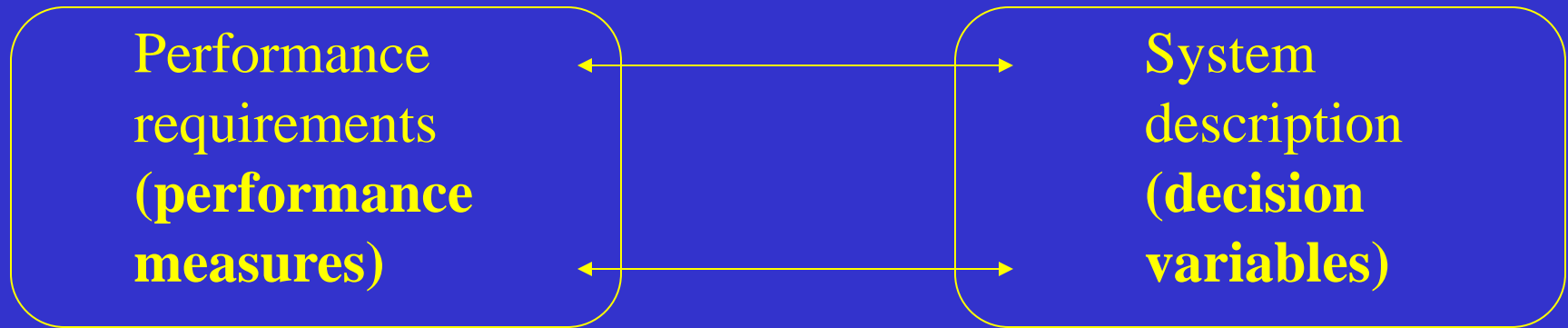
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School of Engineering

Dept. of Mechanical Engineering & Aeronautics

The Manufacturing System Design Problem

Fig 5.1



Performance Measures

- production rate
- cost/part
- order lead time
- work-in-process

Decision Variables

- equipment types
- equipment quantities
- equipment layout
- buffer sizes

Characteristics of the Manufacturing System Design Problem

- Manufacturing systems are complex:
 - many interacting components
 - dynamic
 - influenced by external (e.g., market) demands
 - multiple, possibly conflicting, performance requirements
- The relationship between performance measures and decision variables is difficult to establish:
 - no handy formulas
 - computer simulation required

Job Shop

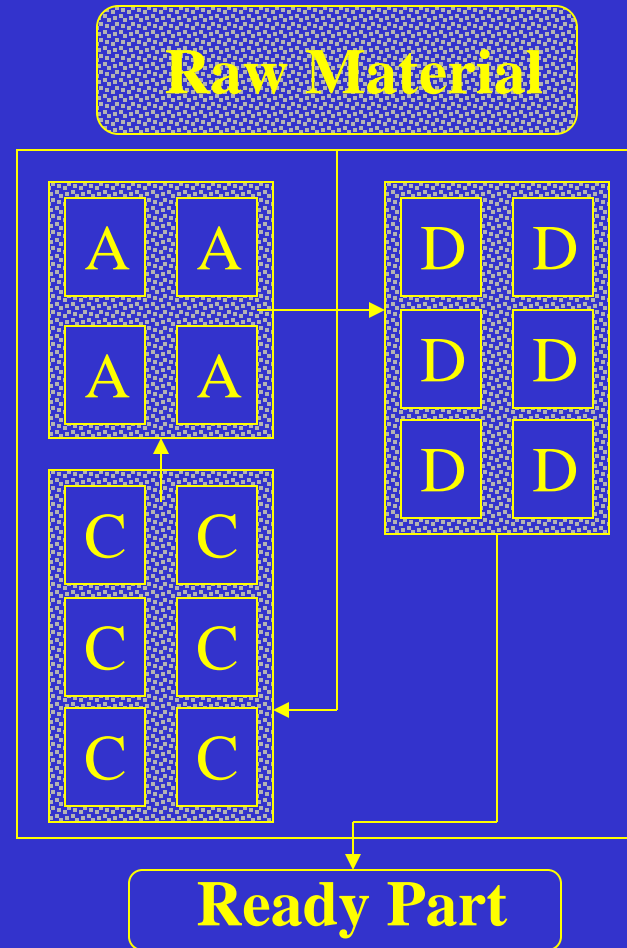


Fig 5.2

Machines/Resources
are grouped according
to the process they perform

Cellular System

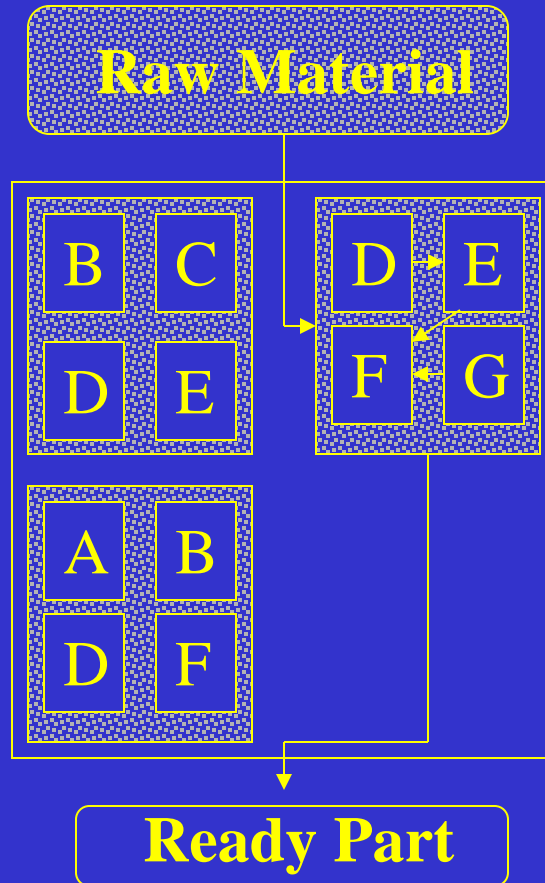


Fig 5.4

Machines/Resources
are grouped according to the
processes required for part families

Flow Line

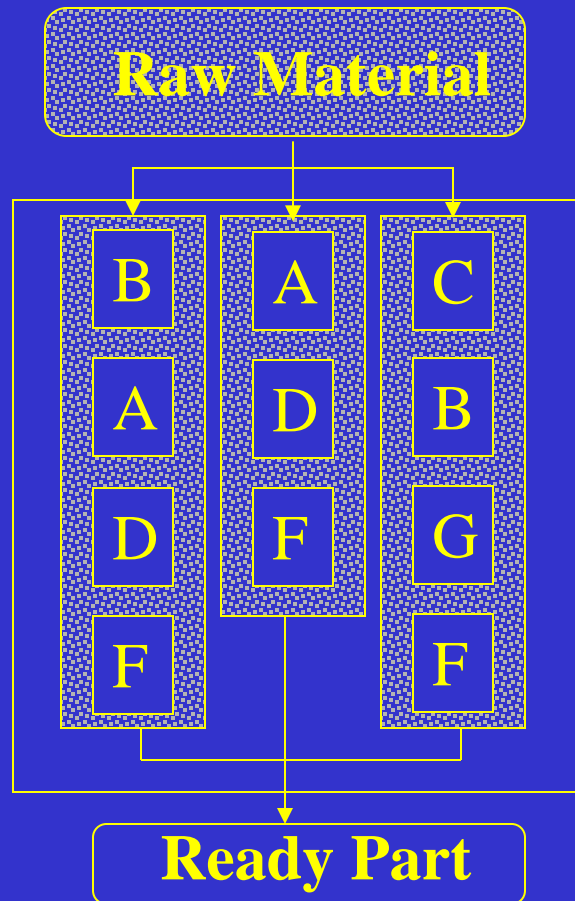


Fig 5.5

Machines/Resources

are grouped in lines according to the operation sequence of one or more part types

Continuous System

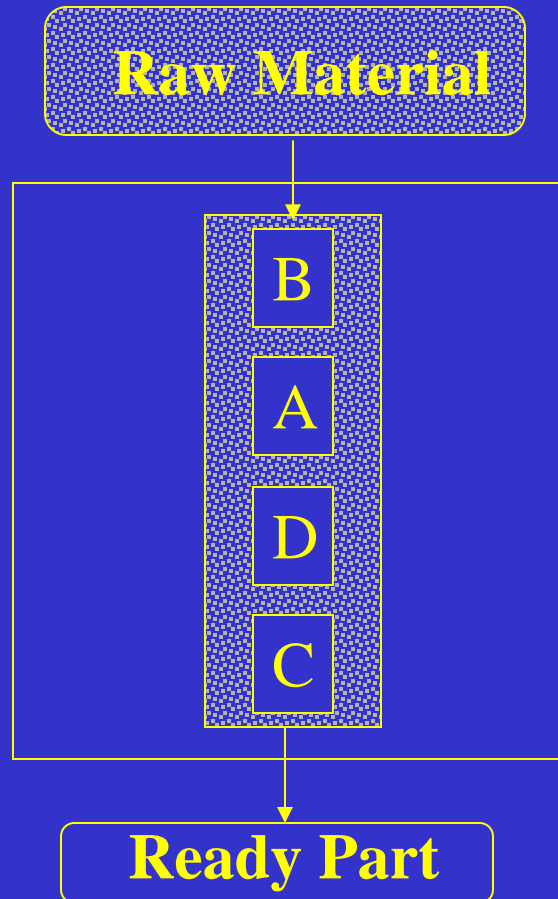
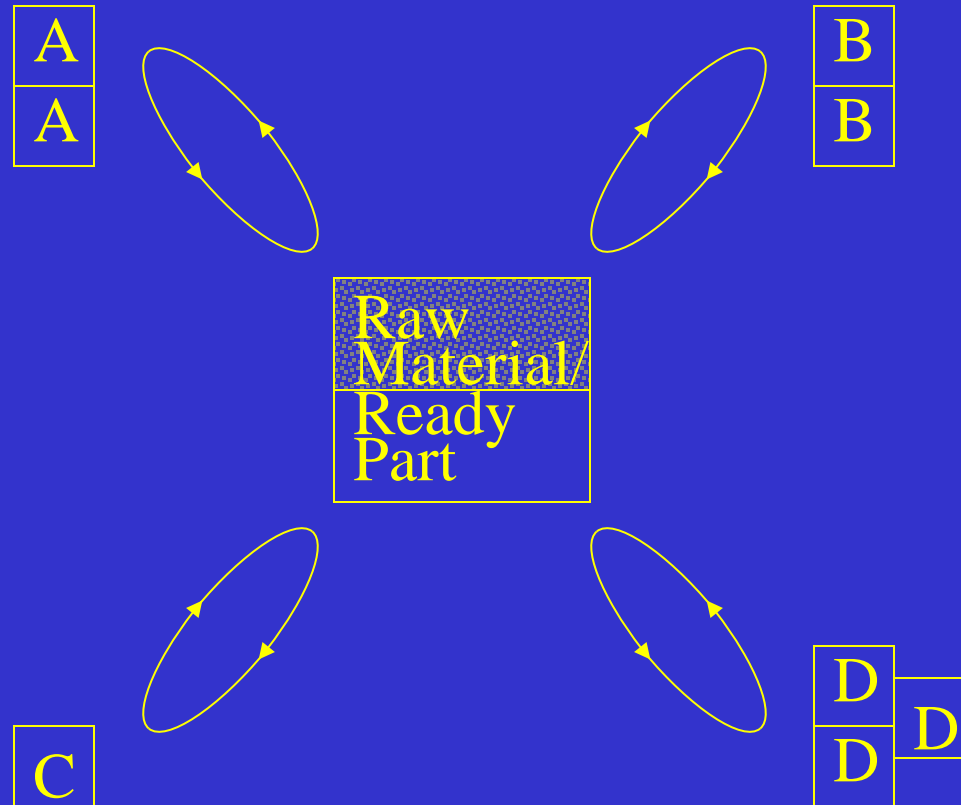


Fig 5.6

Processes are grouped in lines according to the process sequence of the products

Project Shop

Fig 5.3



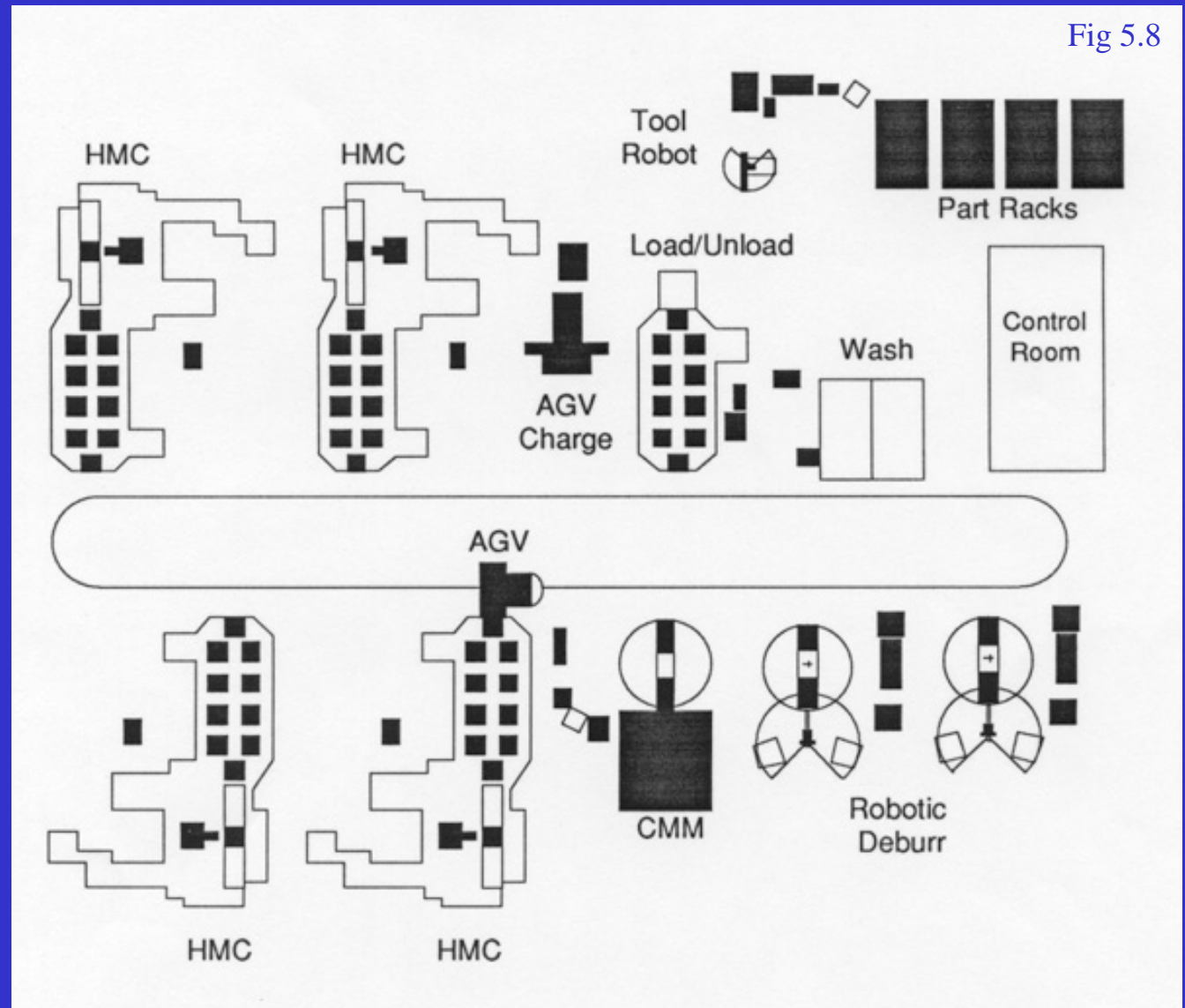
Machines/Resources are brought and removed from stationary part as required

Characteristics of Different Types of Manufacturing Systems

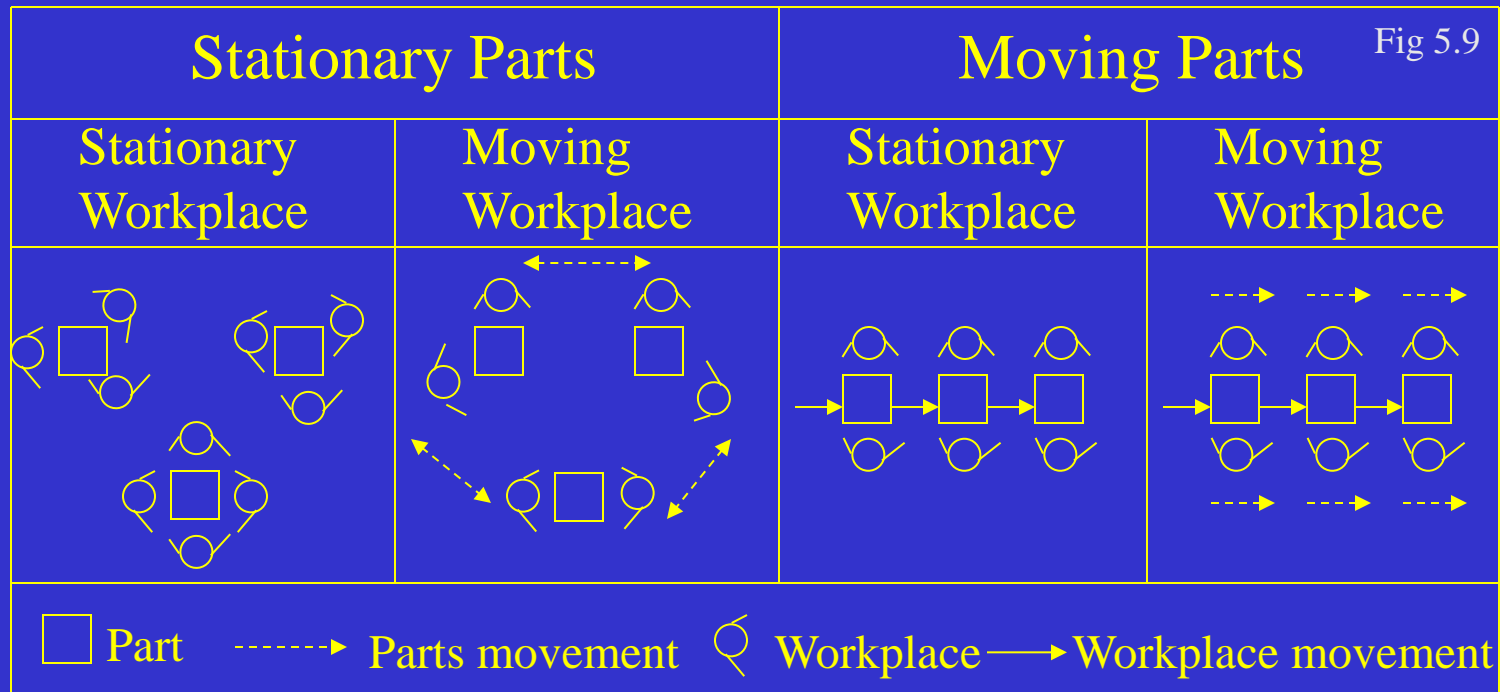
Table 5.1	Type of System		
	Job Shop	Cellular	Flow Line
Part Type Similarity	Low	Medium	High
Production Volume	Low	Medium	High
Lot Size	1- 100	100- 1,000	1,000- 10,000

Flexible Manufacturing System

- hybrid between job shop and cellular system
- automated material and information flows



Types of Assembly Systems

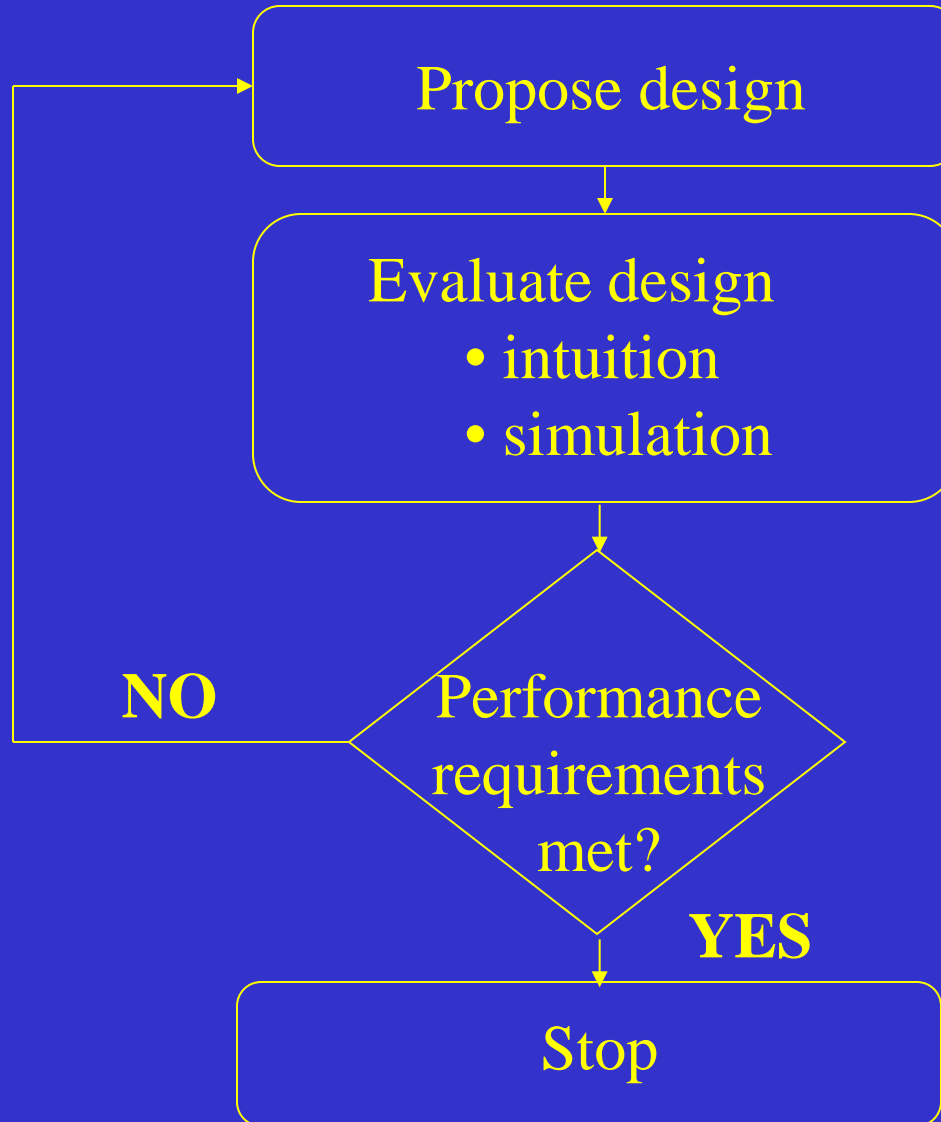


Characteristics of Different Assembly Systems

Table 5.2	Stationary Parts		Moving Parts	
	Stationary Workplace	Moving Workplace	Stationary Workplace	Moving Workplace
Area Requirement	high	high	low	medium
Work Content at each Workplace	high	medium	low	medium
Cost of System	low	medium	high	high

Academic Versus Industrial Perspectives

- industrial practice favors *trial and error*



Academic Versus Industrial Perspectives

- **academic literature** favors:
 - simpler, abstract problem representations
 - decomposition into subproblems

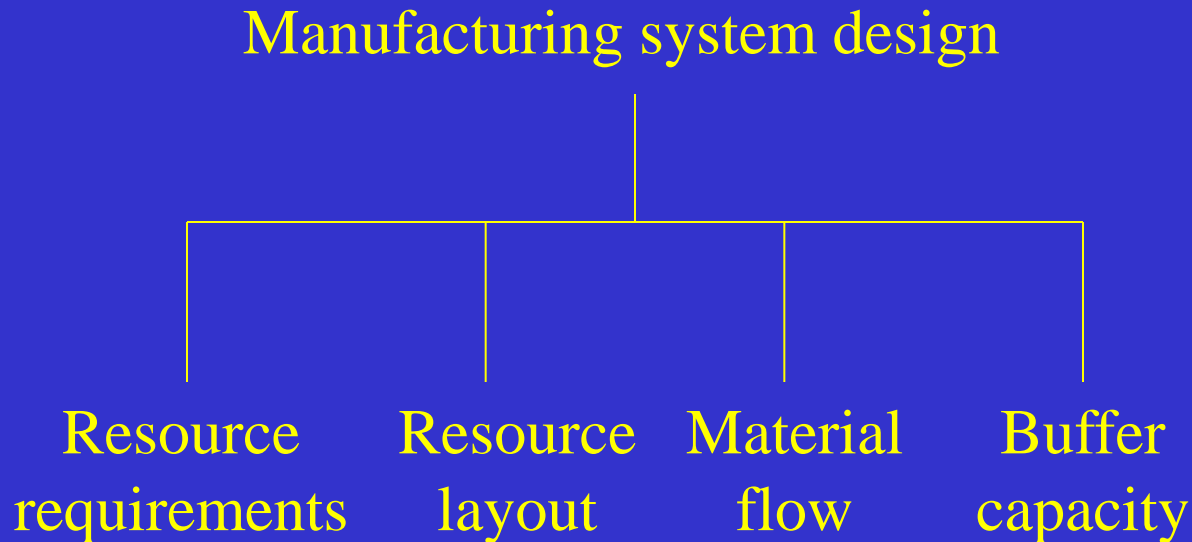


Fig 5.10

Manufacturing Systems: Theory and Practice

The Operation of Manufacturing Systems

Manufacturing Systems Operation

The task of planning the material and information flows of a manufacturing system

Long-Term Planning

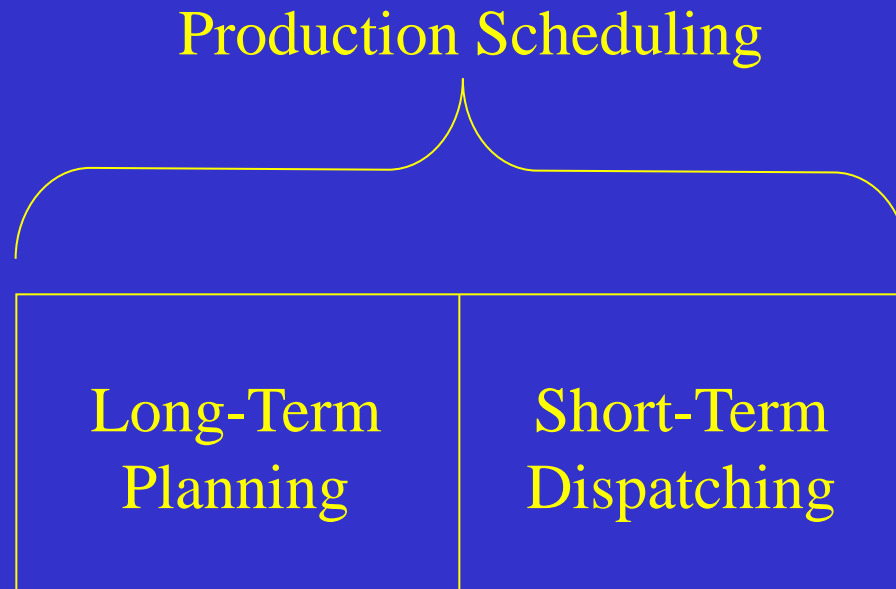
- dictates flow of materials into manufacturing system
- determines work load
 - when to produce
 - what quantities to produce
- aggregate timing of production

Manufacturing Systems Operation

Short-Term Planning

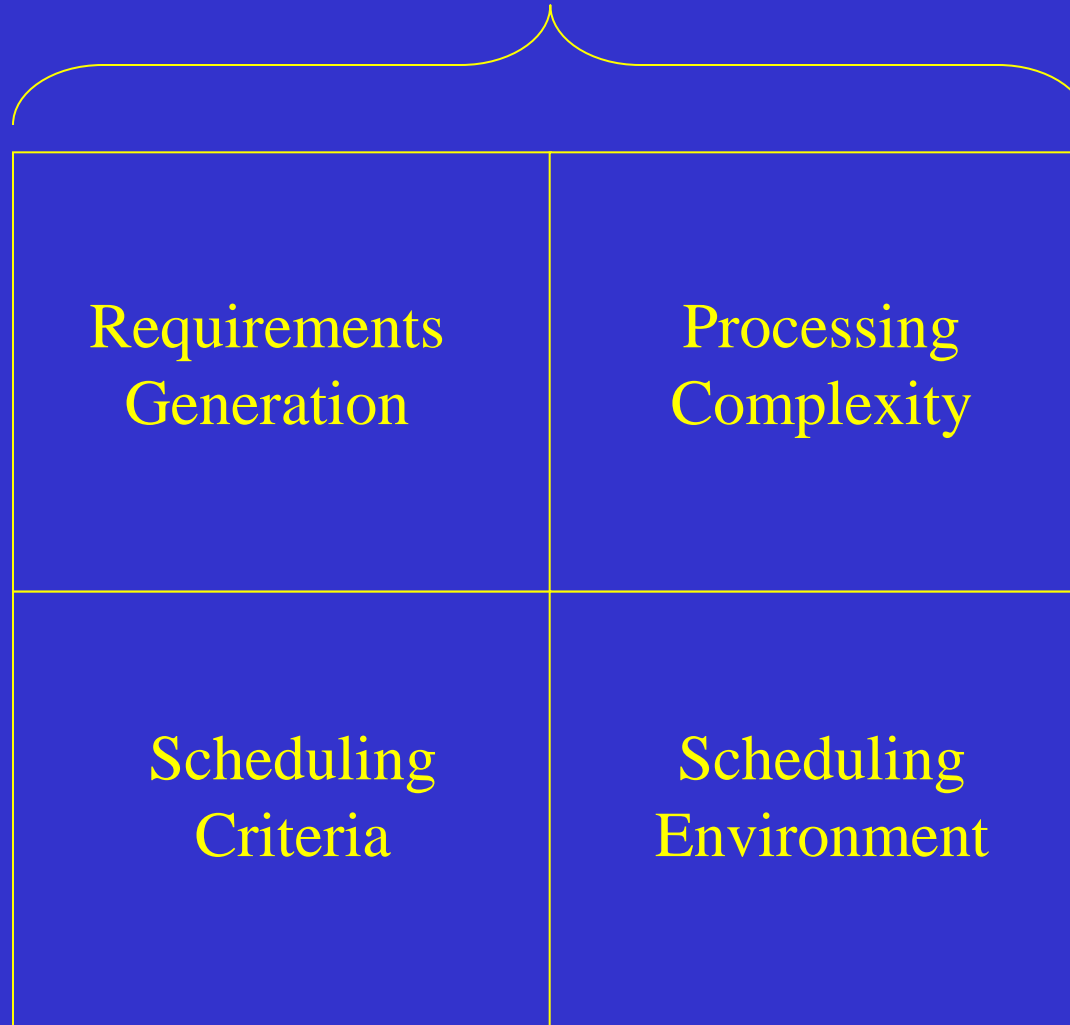
- dictates flow of materials **within** and **out of** manufacturing system
- resolves resource contention
- detailed assignment of operations to production resources

Production Scheduling



Production Scheduling - Academic Perspective

Production Scheduling Problem



Requirements Generation

Open Shop

- all job by customer request
- no inventory

Closed Shop

- customer requests serviced from inventory
- jobs come from inventory replenishment decisions

Deterministic Requirements

Stochastic Requirements

Scheduling Criteria

Schedule Costs

- setups and changeovers
- production and overtime
- inventory holding
- stock out
- expediting
- schedule generation and monitoring

Schedule Performance Measures

- utilization
- percentage of late jobs
- tardiness ($\max \{0, \text{completion time} - \text{due time}\}$)
- flowtime ($\text{completion time} - \text{arrival time}$)

Processing Complexity

- One-stage, one processor (facility)
- One-stage, parallel processors (facilities)
- Multistage, flow shop
- Multistage, job shop

n	/	m	/	A	/	B
Number of jobs		Number of machines		Flow pattern		Performance measure

Flow Pattern A:

F: flow Shop

- machine order for all jobs the same

P: Permutation flow shop

- machine order same for all jobs
- each machine processes jobs in same order

G: general job shop

Scheduling Environment

Static

- finite set of fully specified jobs

Dynamic

- initial set of known jobs
- additional jobs arrive in future time periods according to known probability distributions

Manufacturing Operation- Industrial Perspective

Fig 6.2



Time

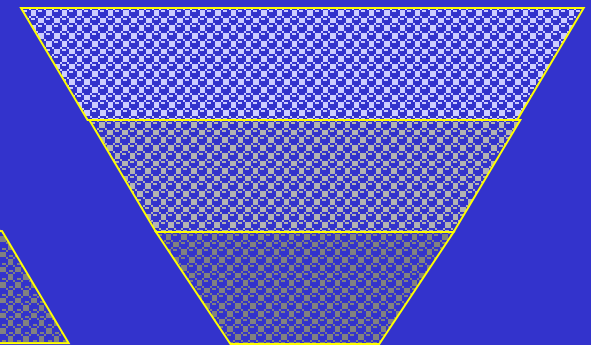
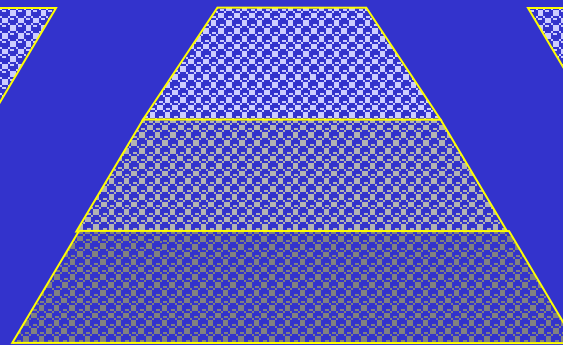
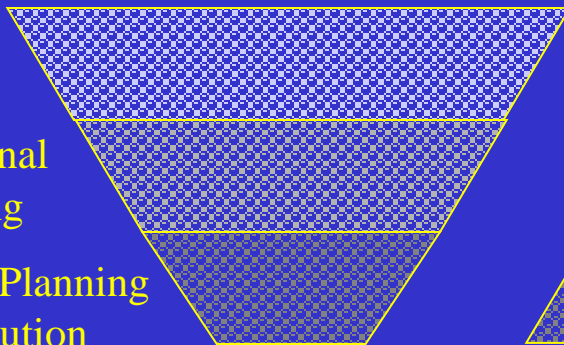
Number

Impact

Strategic
Planning

Operational
Planning

Detailed Planning
and Execution



Manufacturing Operation - Industrial Perspective

Strategic Planning

- marketing plan
 - entry into new market
 - forecasts of dollar and unit sales
 - distribution channels
- financial plan
 - cash flow
 - capital expenditure
- manufacturing plan
 - manufacturing system structure
(e.g., flow line, cellular system, job shop)
 - acquisition of manufacturing capacity
 - annual production targets for each product line

Manufacturing Operation - Industrial Perspective

Operational Planning

- master production scheduling

⇒ periodic production targets for specific products

- material requirements planning

⇒ procurement schedule for individual components

- capacity planning

⇒ projections of capacity requirements

Funding

- This educational material has been developed in the teaching duties of the respective educator.
- The project «**Open Academic Courses at the University of Patras**» has funded only the reformation of the education material.
- The Project is implemented within the context of the Operational Programme “Education and Lifelong Learning” (EdLL) and is co-funded by the European Union (European Social Fund) and national resources.



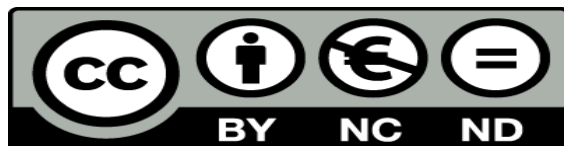
Reference Note

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