CHAPTER 16:
Scheduling & Control

Introduction

Scheduling

- Establishing the **timing** of the use of equipment, facilities & labor in an organization

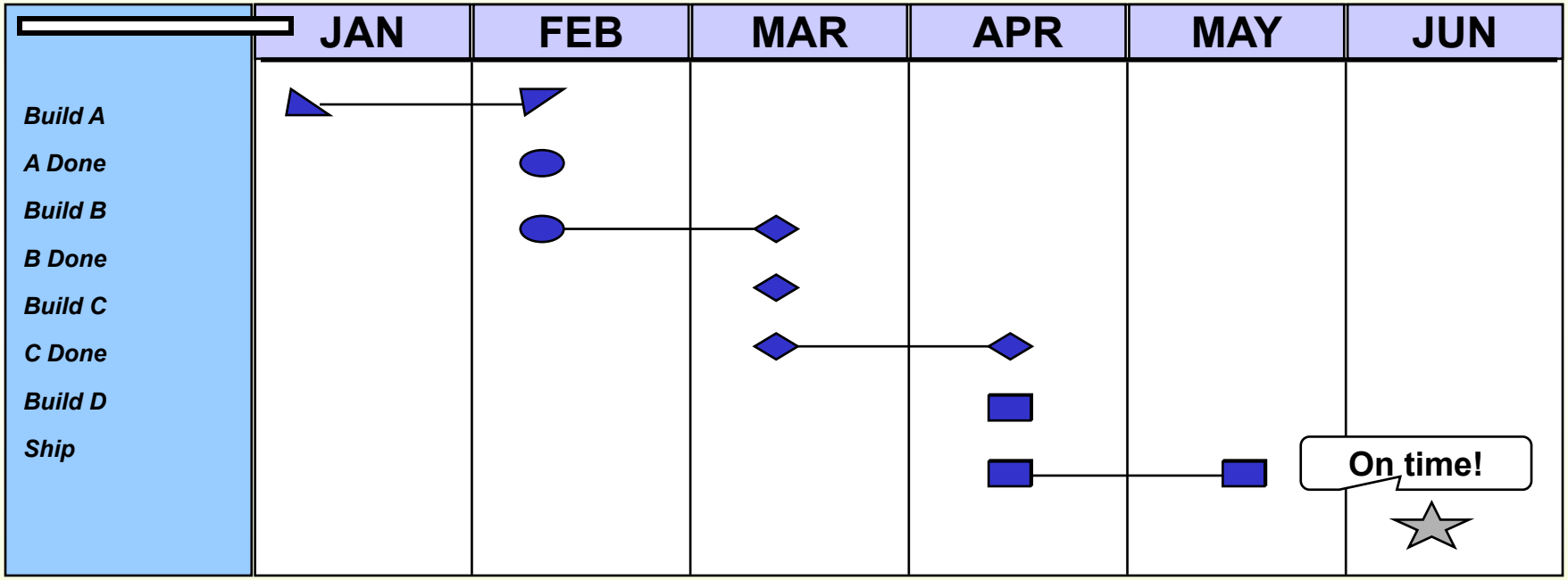
Shop Floor Control

- Execution of the schedule – Meeting customer due dates and production manufacturing plans

Objective of Scheduling

- To achieve **trade-offs** among conflicting goals, which include efficient utilization of staff, equipment and minimization of customer waiting time, inventories and production times

Scheduling Manufacturing Operations

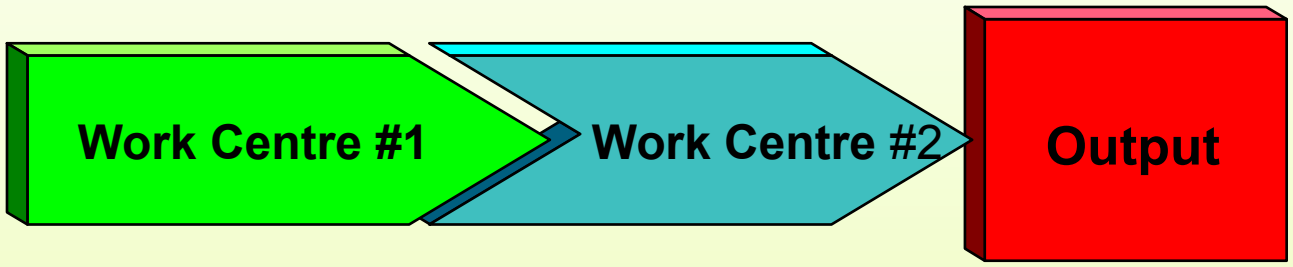


Understanding how long each step takes to fully build and ship the customer's order

Scheduling in Manufacturing

Scheduling in high volume systems (continuous flow and assembly lines) –refinery, beer, automobiles

- Goal is to obtain a smooth rate of flow of goods through the system in order to get high utilization of labor and equipment
- Any work centre stoppage brings the entire flow to a halt (line down emergency!!)



High-Volume Success Factors

- Relatively simple process and product design
- Preventive maintenance is a top priority
- Rapid repair when breakdown occurs – millwrights on shift
- Optimal product mixes – minimize number of changeovers
- Minimization of quality problems
- Reliability, timing and quality of supplies

Scheduling in Manufacturing

Scheduling in Batch volume systems

- Items are processed intermittently – some of A, then some of B, then C, then back to A, etc.

Three issues:

a) Run size (batch sizes 100, 50, 20, 10 etc.)
b) Sequence – ABCABC, ABAC, ABABABC
c) Timing of Batches – When to release to production

Scheduling Low-Volume Systems (Job Shops)

Job Shop scheduling

- Scheduling for low volume systems with many variations in customer requirements

Loading

- The assignment of jobs to work centers will depend upon specific requirements of each customer
- There will be times some work centers have no work to do – shift resources to the busy work centers

Loading

Infinite loading

- Computer schedules jobs exactly as per customer required dates. Computer does not take into account work center capacity limitations in any given period – show the “true picture of demand”

Finite loading

- Computer schedules into work centers to no more than allowable period capacity. Once capacity limit reached, automatically schedule next orders forward into the next available period

Loading

Forward scheduling

- Scheduling ahead, starting from the start date of a job or when the work center is next available to start the job – minimize down time between jobs within the WC

Backward scheduling

- Scheduling by working backwards from the due date, to determine the latest possible start date. Do not worry about down time between jobs in WC's

Sequencing

Sequencing:

- Determine the order in which jobs at a work centre will be processed

Priority Rules:

- Rules used to select the order in which jobs will be processed

Performance Measures:

- Job flow time
- Job flow lateness (customer due date)

Priority Rules

- FCFS - first come, first served
- SPT - shortest processing time
- SRPT - shortest remaining processing time
- EDD - earliest due date
- Rush - emergency

Scheduling

Why Scheduling can be difficult:

- An operation must deal with variability
- There is no method for identifying the optimal schedule

Things a scheduler can do to achieve good scheduling results:

- Setting realistic due dates
- Focusing on bottle neck operations
- Considering lot splitting for large jobs

Scheduling Services

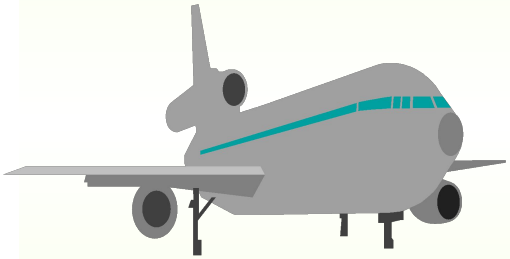
Appointment systems
- Controls customer arrivals for service

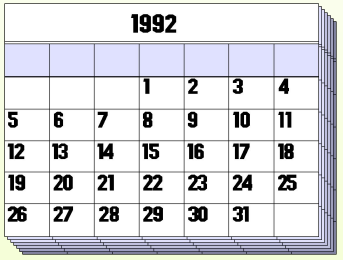
Scheduling the workforce
- Manages capacity for service

Cyclical scheduling for full time staff
- Full time employees must be assigned to work shifts and have days off

Scheduling part time employees
- Used to meet peak demands

Scheduling multiple resources
- Hospitals must schedule surgeons, operating room staffs, admissions, etc





Service Operation Problems

- Cannot store or inventory services ahead of time
- Customer service requests can be random
- Scheduling service involves:
  - Customers
  - Workforce
  - Equipment

Extra Slides

- Not covered during class lecture

What is Maintenance

Maintenance

- Activities that maintain facilities and equipment in good working order so that a system can perform as intended

Breakdown maintenance

- Reactive approach; dealing with breakdowns or problems when they occur

Preventive maintenance

- Proactive approach; reducing breakdowns through a scheduled program of lubrication, adjustment, cleaning, inspection, and replacement of worn parts

Maintenance Reasons

- Reasons for keeping equipment running:
  - Avoid production disruptions – “Factory down”
  - Maintain high quality
  - Avoid missed customer delivery dates

Breakdown Consequences

- Production capacity is reduced
  - Orders are delayed
- No production
  - Overhead continues
  - Cost per unit increases
- Quality issues
  - Product may be damaged
- Safety issues
  - Injury to employees
  - Injury to customers

Preventive Maintenance

- Preventive maintenance:
  - goal is to reduce the incidence of breakdowns or failures in the plant or equipment to avoid the associated costs
- Preventive maintenance is periodic
- Preventive maintenance schedule
  - According to calendar
  - After predetermined number of hours

Predictive Maintenance

- Predictive or condition based maintenance
  - Maintenance activities based on historical data and ongoing monitoring
- Reliability centered maintenance
  - Program to reduce the effect of each major cause of failure problem for equipment functions
- Total productive maintenance (TPM)
  - JIT approach where workers perform preventive maintenance on the machines they operate

Breakdown Maintenance

- How to deal with breakdowns?
  - Standby or backup equipment that can be quickly put into service
  - Inventories of spare parts that can be installed as needed
  - Operators who are able to deal with emergencies and perform at least minor repairs
  - Repair people (millwrights) who are well trained and readily available to diagnose and correct problems with equipment

Replacement

Trade-off decisions

- Cost of replacement vs. cost of continued maintenance
- New equipment with new features vs. maintenance
- Installation of new equipment may cause disruptions
- Training costs of employees on new equipment
- Forecasts for demand on equipment may require new equipment capacity

When is it time to replace the machine?