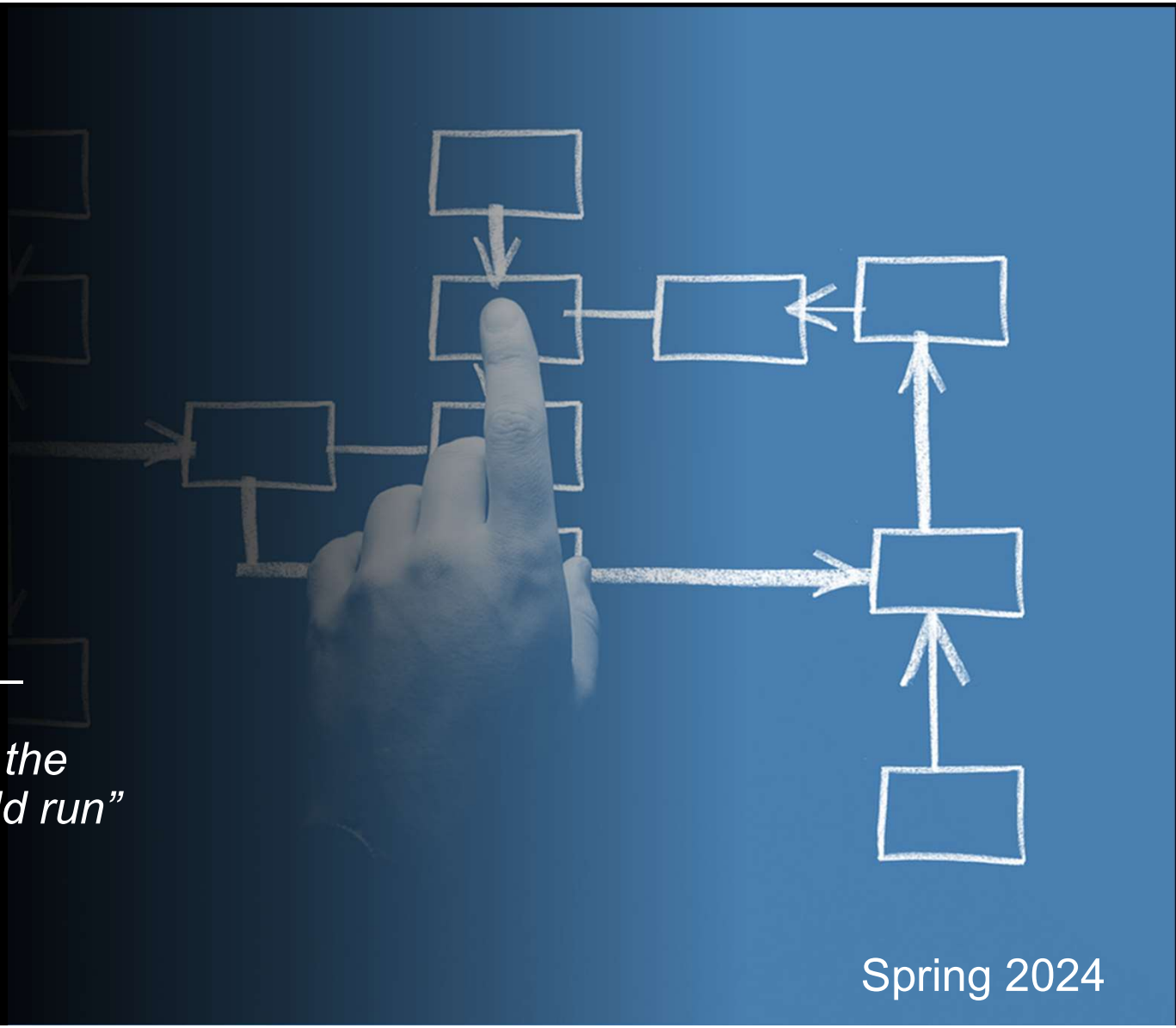
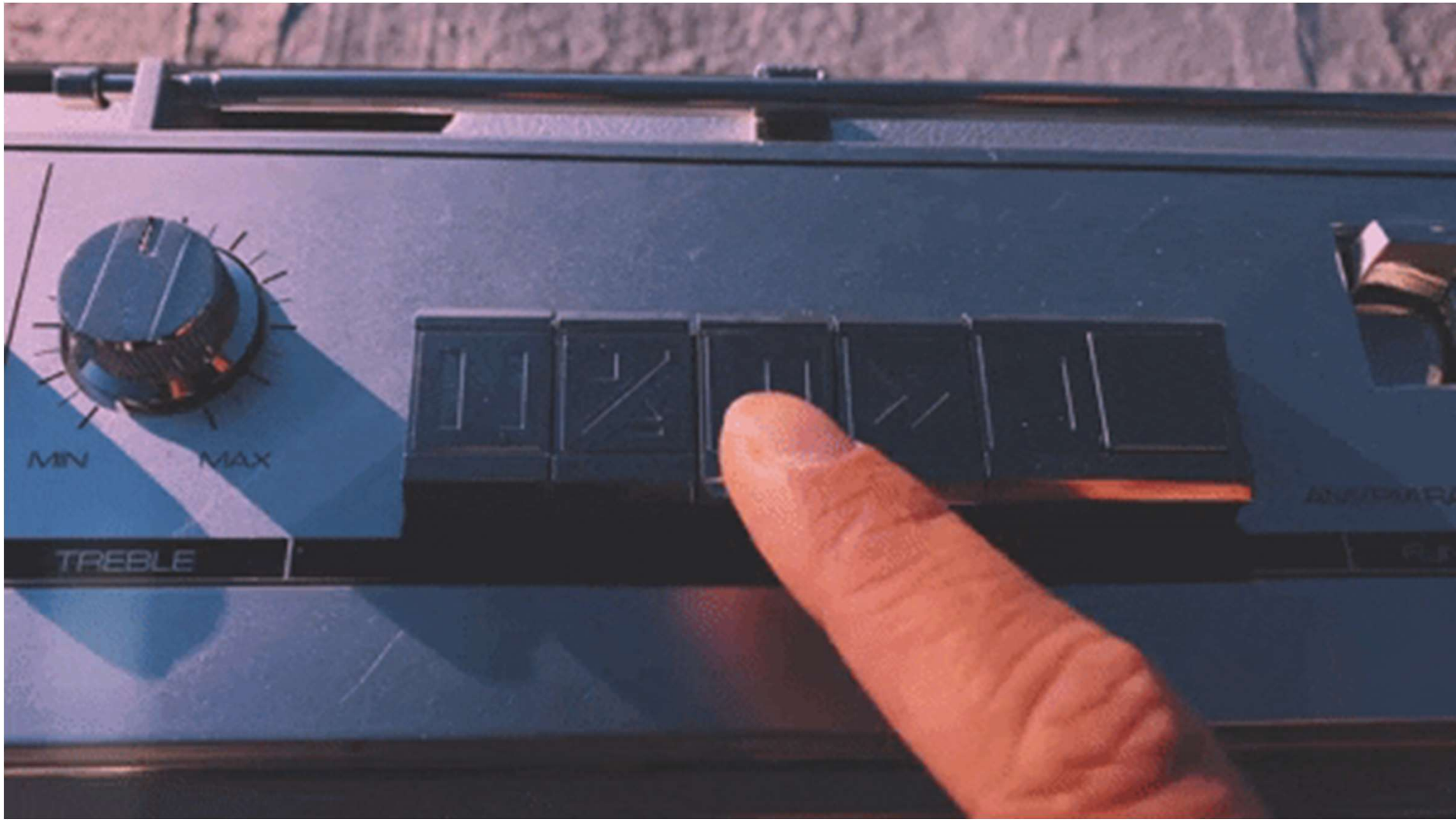
Operations Management **MLI21C617**

"Operations may not run the world, but it makes the world run"



Lecturer: Misa Bakajic

Spring 2024


MIN
MAX
TREBLE

Recap

1. Volume and variety have impact on process design
2. Processes can be mapped and analysed
3. Movement of people or work can be understood as flows
4. Throughput, WIP and CT are used to measure flow rates
5. Bottleneck is a process where congestion occurs due to a missmatch

LECTURE 3 Delivering Operations

Difference between planning and control horizons

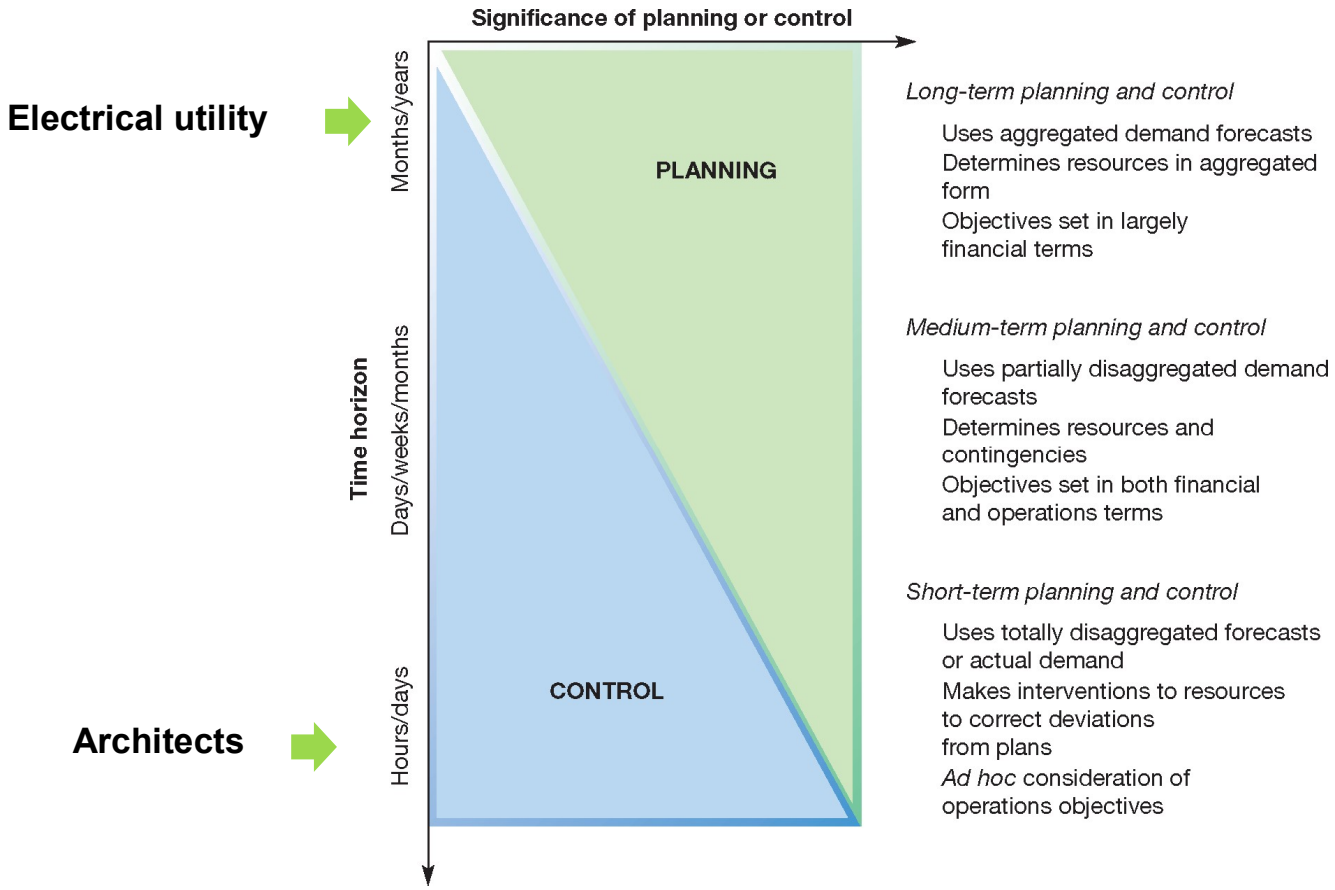
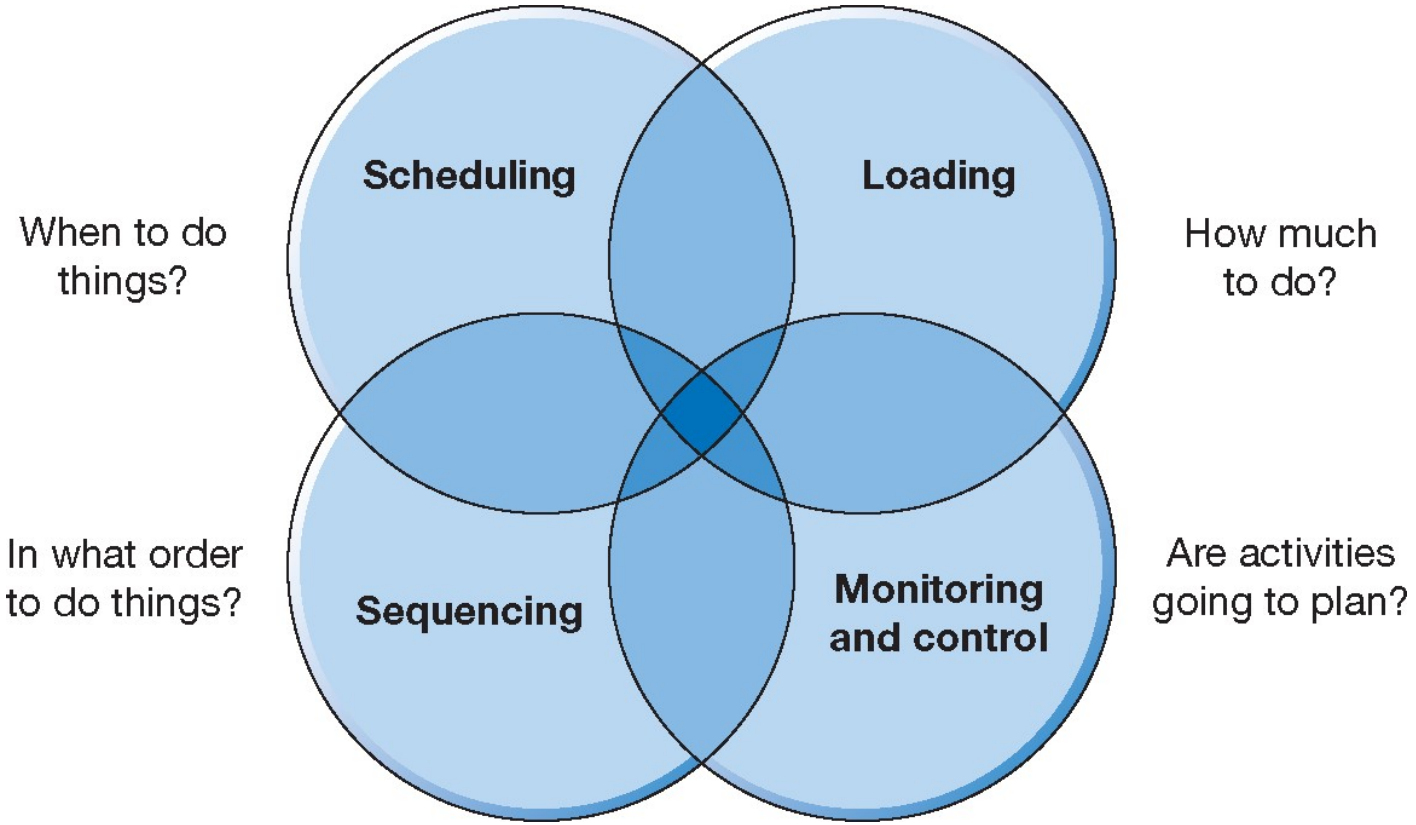


Figure 10.2

A!

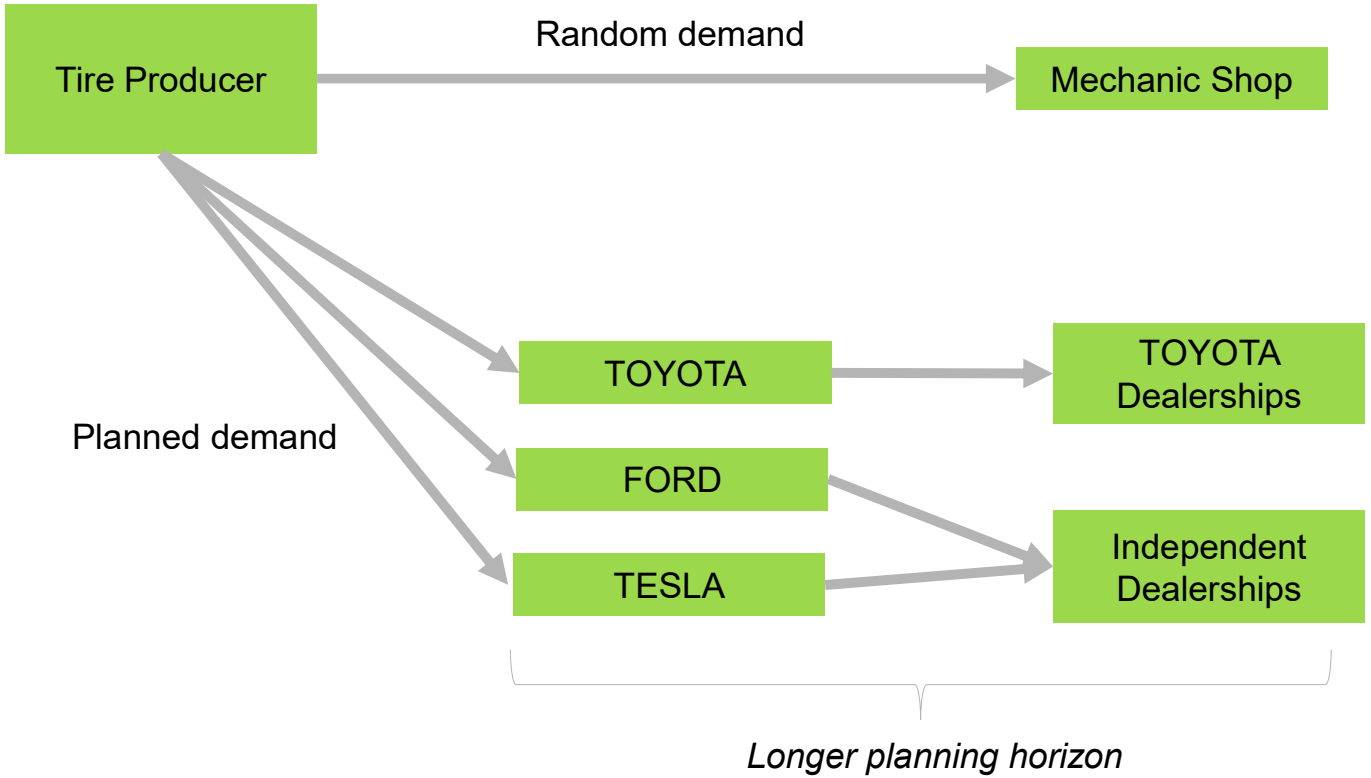
Planning and control activities



A!

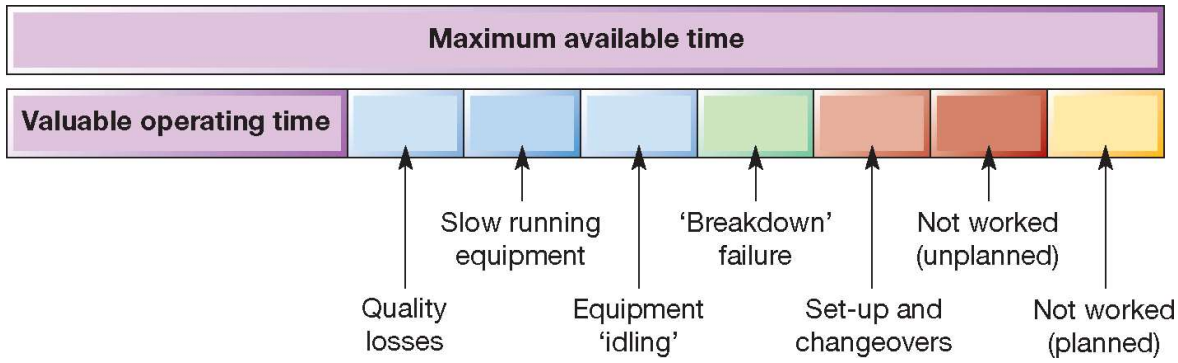
Figure 10.6

Dependent VS Independent Demand



Work Loading

- Loading is amount of work allocated to a work center (e.g. one machine)
- **Finite loading** allocated work up to a certain limit (e.g. 8 hour shift at factory)
- **Infinite loading** does not plan work according to a limit (e.g. emergency room)



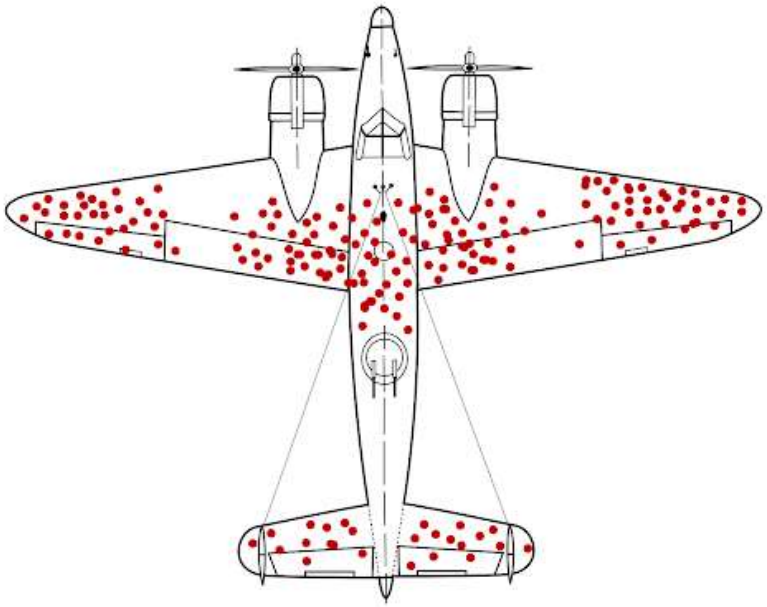
A!

1-2-4 ALL exercise

Typically, the salvageable airplanes were reinforced where the concentration of bullet holes was greatest

However, Abraham Wald drew the unusual conclusion to reinforce aircraft not where the bullets were most concentrated but instead least concentrated

Q: Why did Abraham come to such a conclusion?



Work sequencing

Key factors influencing work prioritization:

- **Physical constraints** (e.g. limits of manufacturing process)
- **Customer priority** (e.g. satisfying most “deserving” customer first)
- **Due date** (e.g. priority given to orders that are older)

- **Last in first out (LIFO)** (e.g. unloading a truck trailer)
- **First in first out (FIFO)** (e.g. processing according to arrival time)*

- **Longest operations time (LOT)** (e.g. improves flexibility at time goes on)
- **Shortest operations time (LOT)** (e.g. improves volume and flexibility of operations early)

A!

* Different from **Due date** because orders can have short or long due dates

Aalto University
School of Business

Analyzing operations

Root Cause Analysis (RCA)

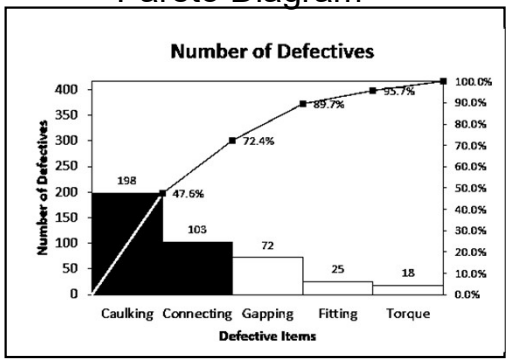
A logic based conceptual tool that aimed at identifying the underlying cause of a problem within a process

- Systematic approach for investigating events
- Identify and categorize root-causes
- Tool for understanding:
  - What happened?
  - How it happened?
  - Why it happened ?

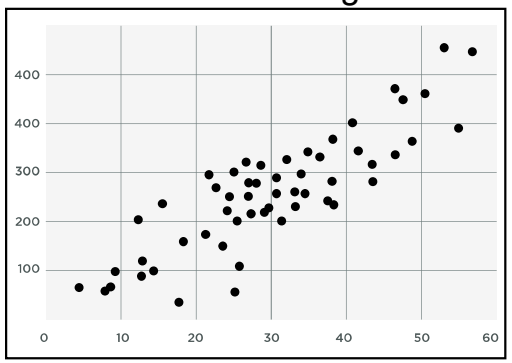
A!

Popular root cause analysis methods

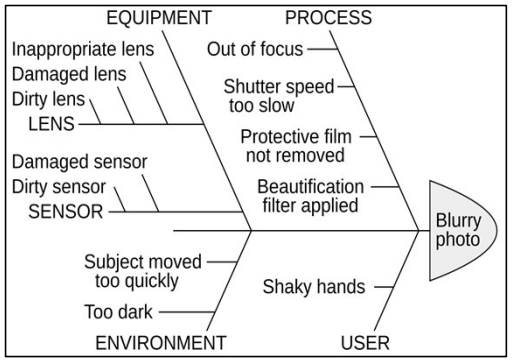
Pareto Diagram



Scatter Plot Diagram



Ishikawa / Fishbone Diagram



5 Whys Method - Separate symptoms and root causes

Problem: Our customer received the order one day late

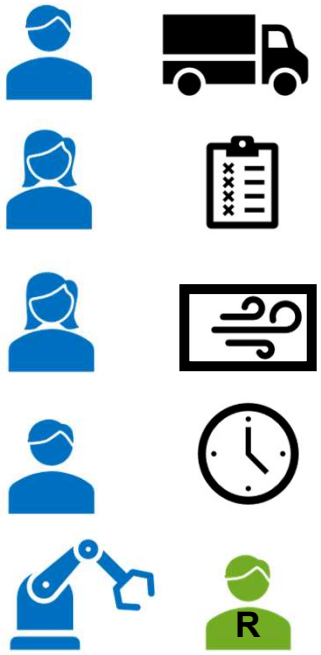
WHY • Our truck did not leave on time

WHY • Customer order was not ready

WHY • Had to wait for paint to dry

WHY • Started painting later than planned

WHY • Paint spray machine was broken



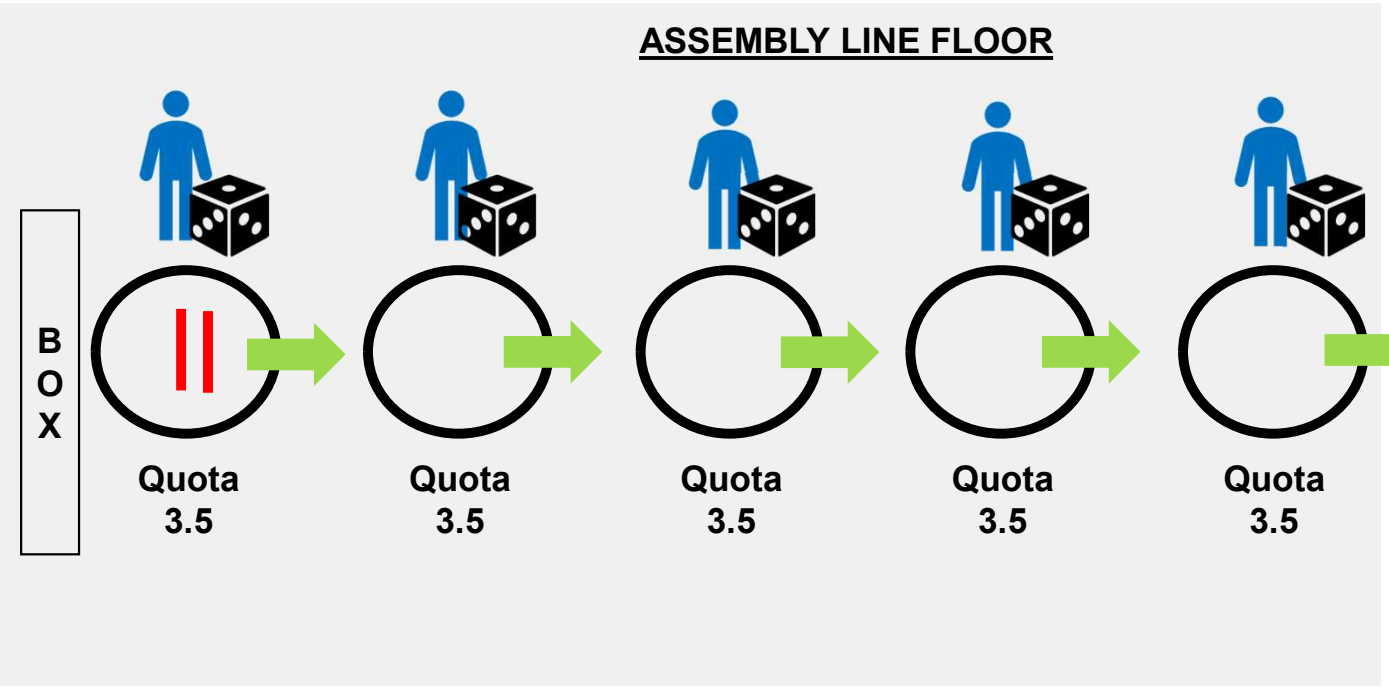
Theory of Constraints

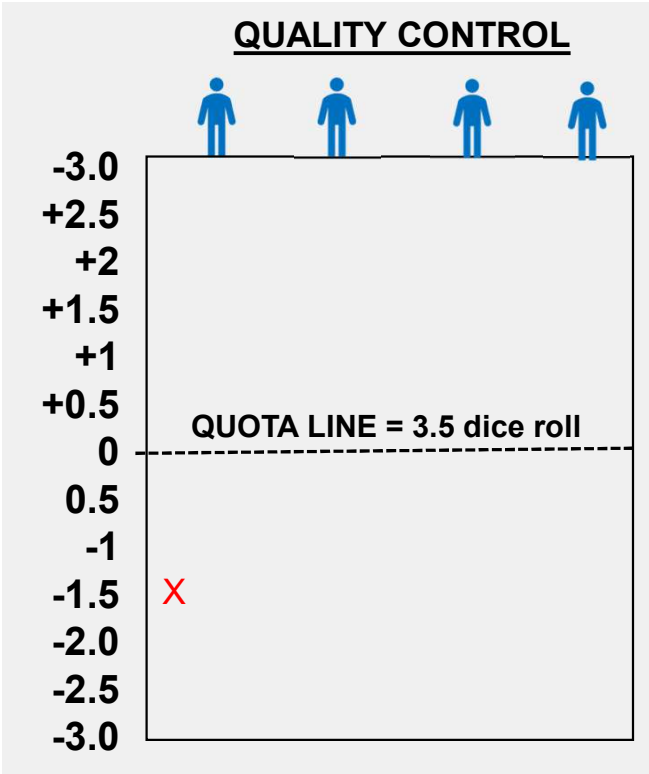
- Management approach popularized by E. M. Goldratt in 1984 book *The Goal*
- Views operations as set of interdependent process (systems perspective)
- Identifying constraints within the system and iteratively finding bottleneck
- Key assumption of TOC is that organizations can be measured and controlled by variation on three measures:

1. **Throughput** – rate at which the system generates money (order to pay)
2. **Operational expense** – money needed by system to turn inventory into profit
3. **Inventory** – money system has invested for things needed for generating sales

Goldratt's Dice Game or Match-Bowl Experiment

NEED Volunteers: 5 X Workers and 1 X Quality Checker



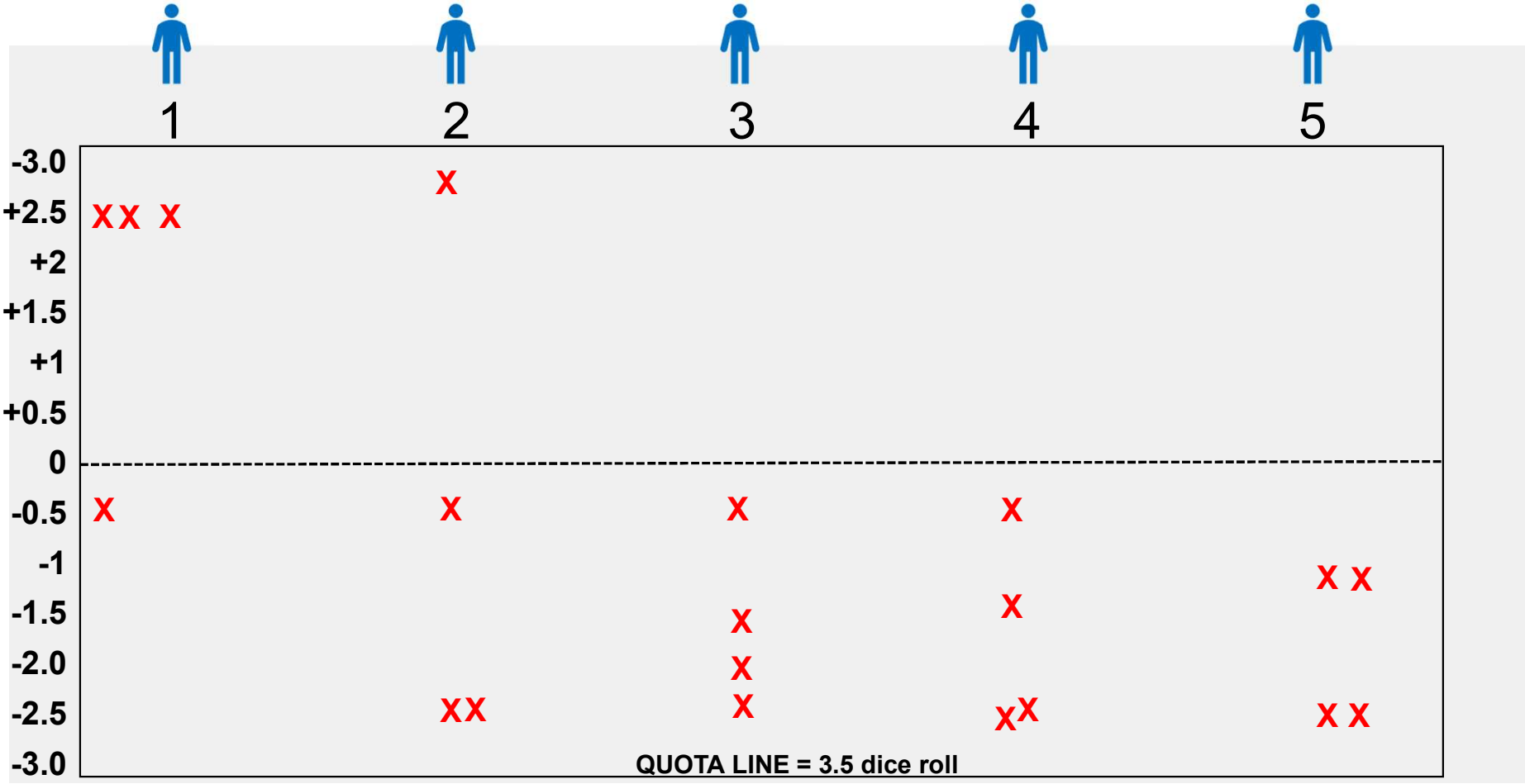


Worker Instructions:
Each player rolls dice and gives same number of toothpicks to the next worker in line. The next player rolls the dice and does the same, if they roll higher than they have they simply place what they have on hand (no negatives allowed).

Expected dice average: 1+2+3+4+5+6 / 6 = 3.5 represents the expected output of each station.

QC Instructions:
Place X on graph above for each quantity passed by each person using formula (n – 3.5 = X). This will indicate if the amount is over or under the quota (3.5 average of all numbers on dice).

QUALITY CONTROL



QC Instructions:

Place X on graph above for each quantity passed by each person using formula (n – 3.5 = X). This will indicate if the amount is over or under the quota (3.5 average of all numbers on dice).

Implications of the dice game

Dependent Events: These are events where the outcome of one event affects the probability of the next. In a production line, this means each step relies on the one before it. If one step is slow, it delays the next step, and so on.

Statistical Fluctuations: These are small, random variations that occur in any process. For example, a worker might take slightly longer than usual to complete a task, or a machine might have a minor hiccup.

When these two factors come together, it creates a ripple effect. A delay in one step due to a fluctuation can cause delays in all subsequent steps. This can throw off the entire production schedule and make it difficult to achieve the ideal output

Constraints

A constraint is anything that prevents the system from achieving its goal.

Can be internal to the system, when market demand exceeds what system can deliver

Can be external to the system when system can produce more than market demand

A!

Control in resource transformation

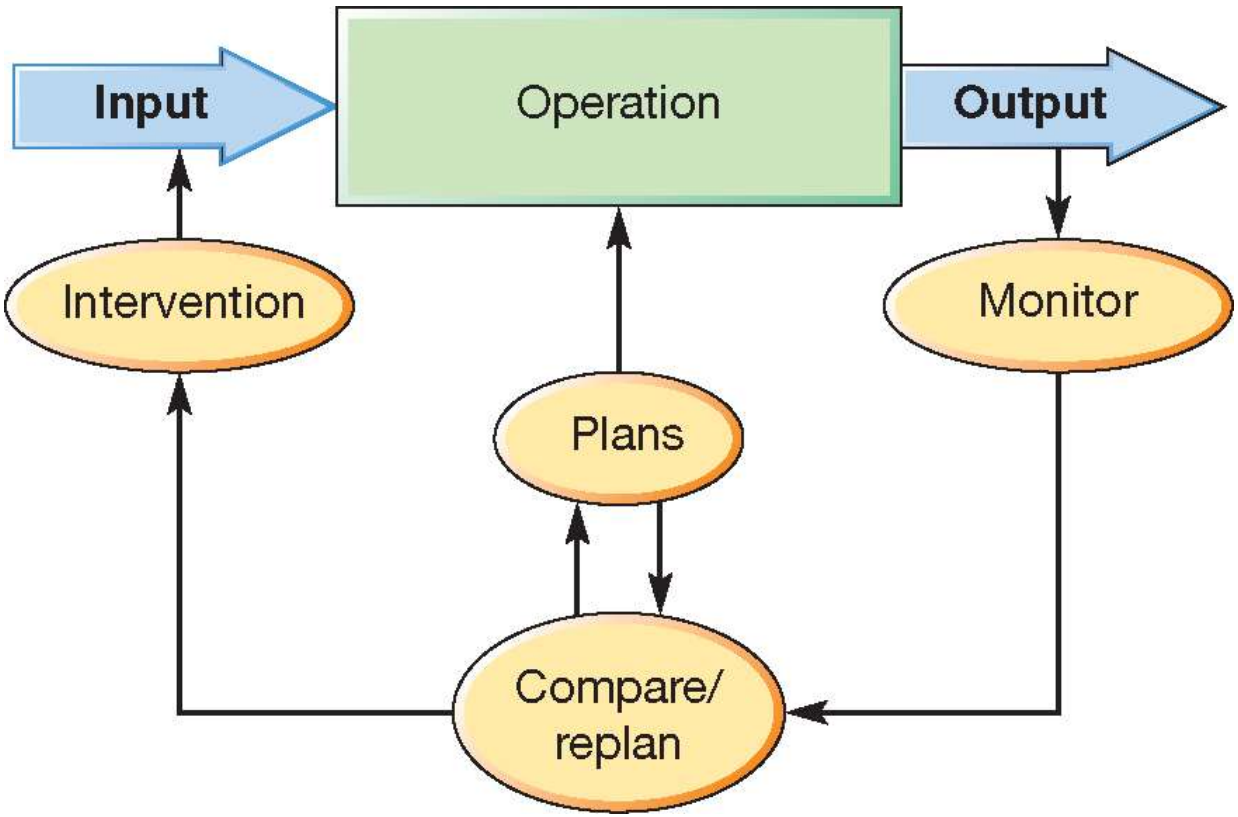
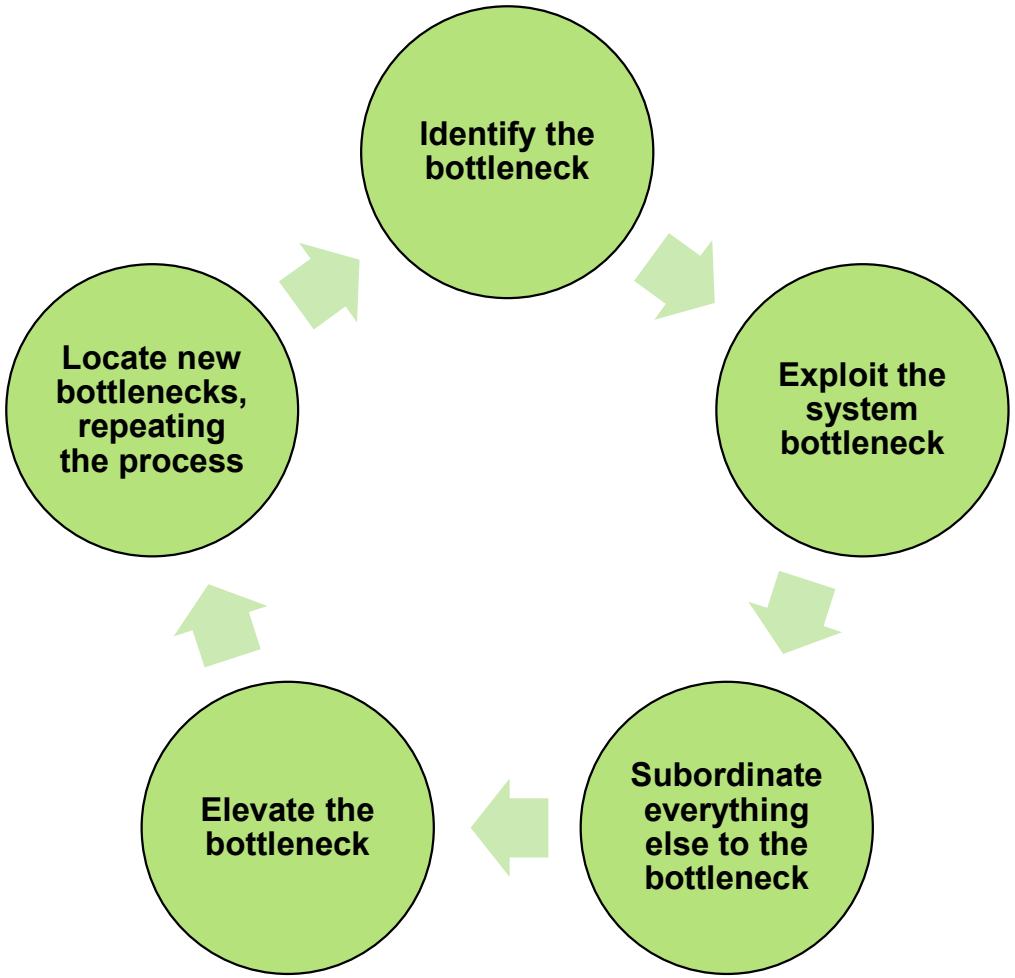


Figure 10.15

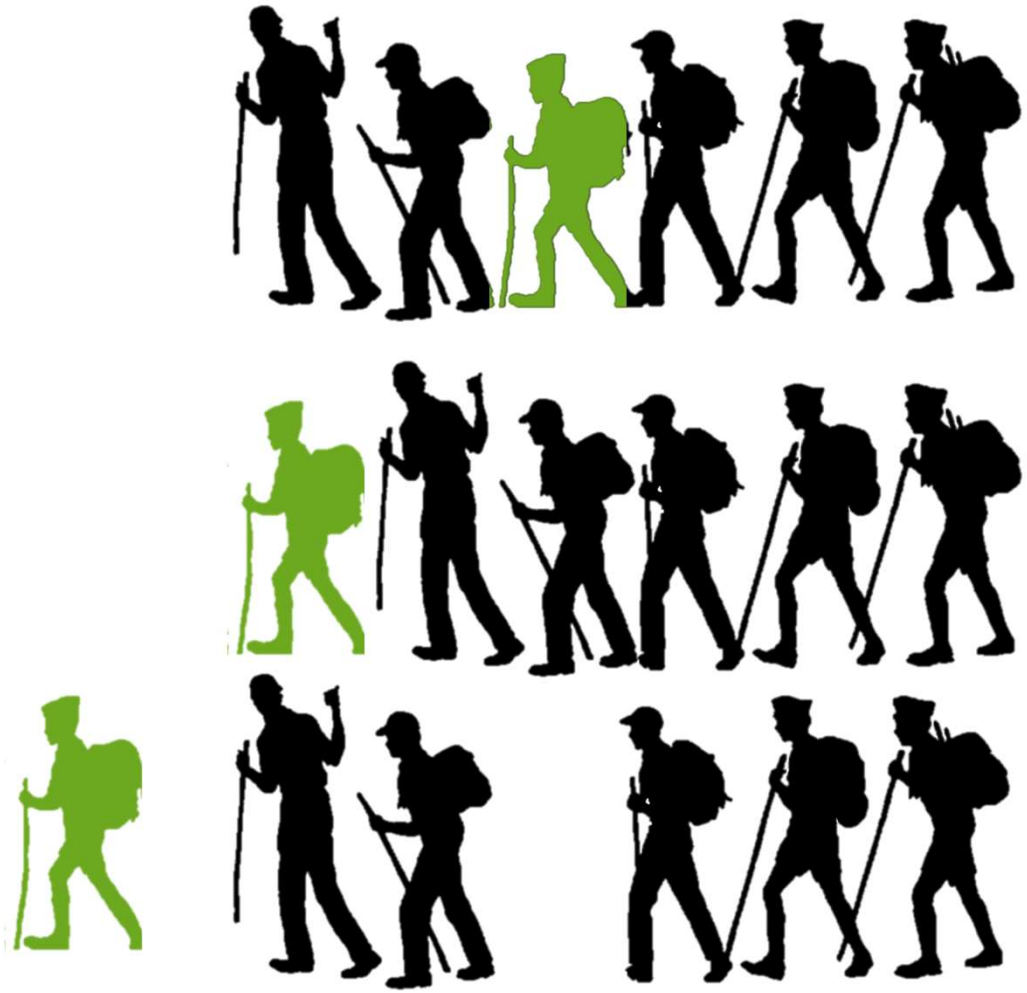
A!

The Five Focusing Steps



A!

Identify
Exploit
Subordinate
Elevate
Repeat



A!

The drum – setting the rhythm of the operation

The **“Drum”** is the constraint. The speed at which the constraint runs sets the “beat” for the process and determines total throughput.

Buffers – mitigating demand

1. Constraint Buffer: immediately before the constraint; protects the constraint

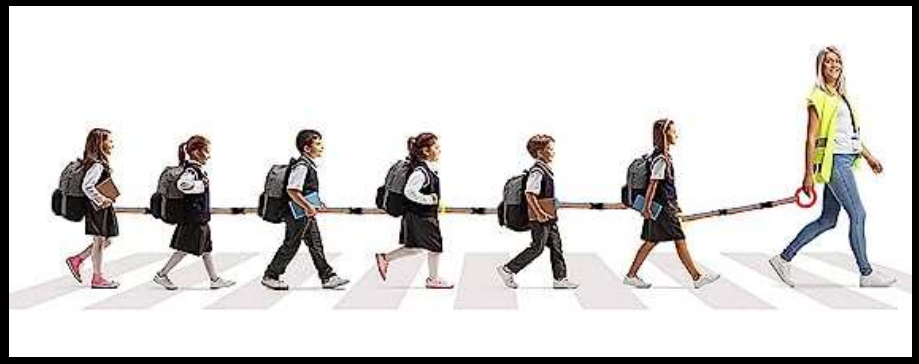
2. Customer Buffer: at the very end of the process; protects the shipping schedule

Rope – pulling inventory

The **“Rope”** is a signal generated by the constraint indicating that some amount of inventory has been used.

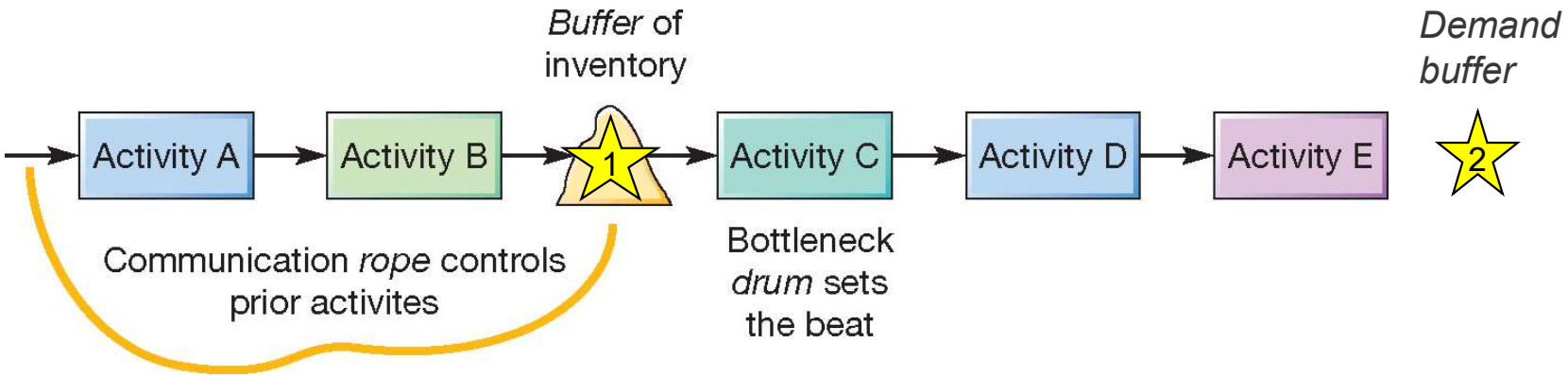
This in turn triggers an identically sized release of inventory into the process.

The role of the rope is to maintain throughput without creating an accumulation of excess inventory.



A!

The drum, buffer, rope concept



A!

Figure 10.17

Aalto University
School of Business

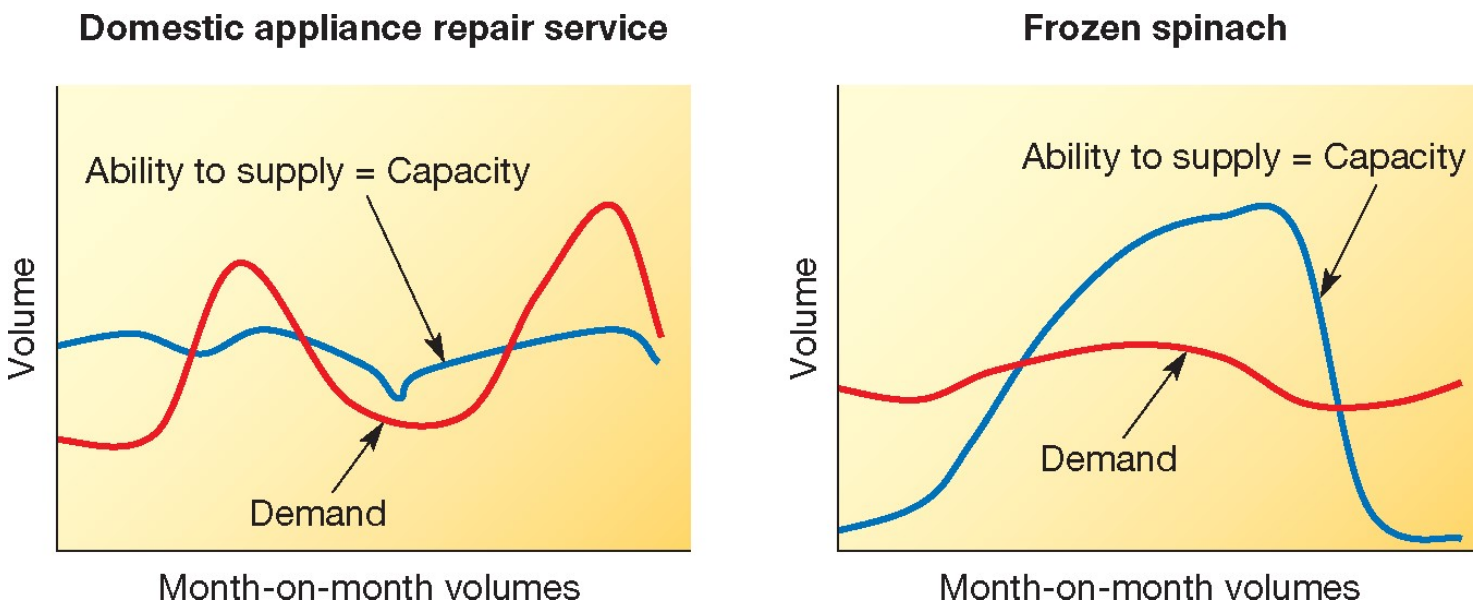
Capacity Management

Design capacity, effective capacity and actual output

A!

Figure 11.7

Volatility in demand versus volatility in capacity



A!

Figure 11.9

Demand management plan

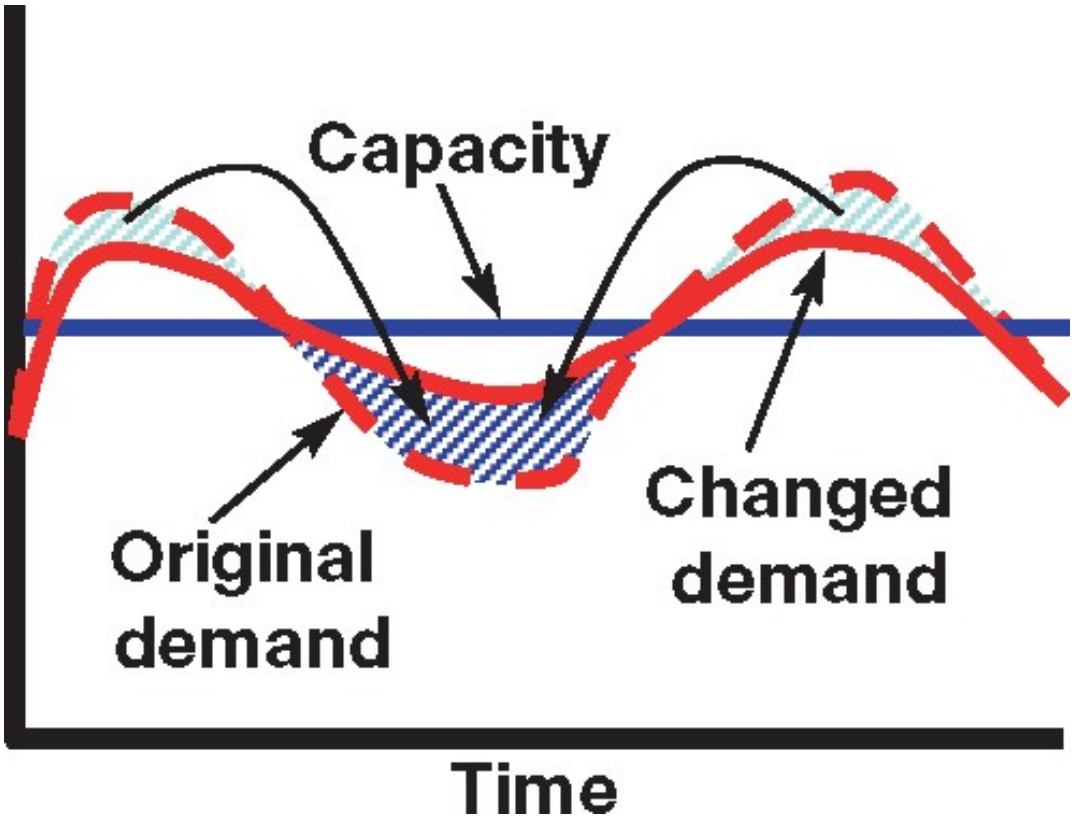


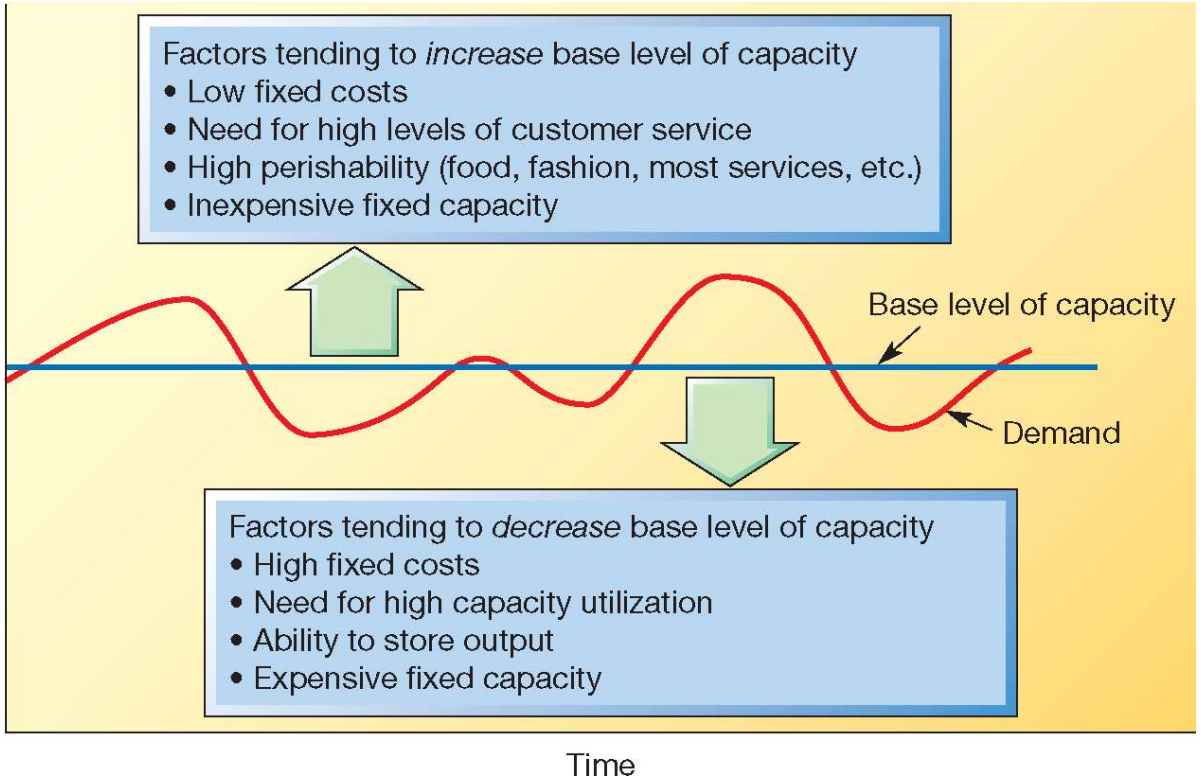
Figure 11.10

A!

Base level of capacity should reflect the relative importance of the operation's performance objectives

Base capacity set according to:

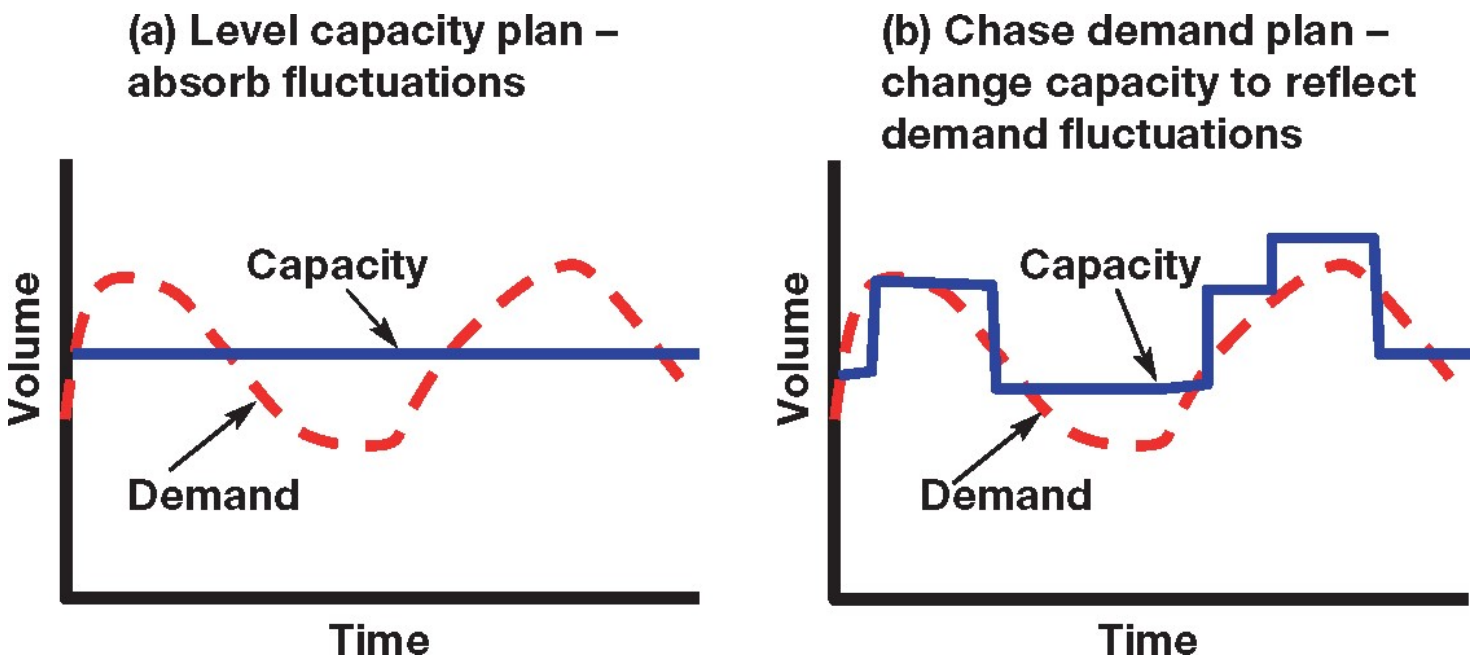
- Operations performance goals
- Perishability of operation's outputs
- Variability in supply or demand



A!

Figure 11.11

(a) ‘Level’ capacity plan versus (b) ‘Chase’ capacity plan



A!

Figure 11.13

Extending the buffer analogy

- Inventory is a buffer against manufacturing uncertainty
- Marketing is a buffer against uncertainty of future sales (demand)
- R&D is a buffer against future market uncertainty
- Procurement is a buffer against raw material disruptions
- Etc.

All related to enhancing the ability of the firm to match capacity and demand!

A!

References

- Krajewski, L. J., Malhotra, M. K. & Ritzman, L. P. 2019. Operations management: Processes and supply chains. Twelfth edition. Global edition. Harlow, England: Pearson.

- Slack, N., Brandon-Jones, A. & Burgess, N. 2022. *Operations management*. Tenth edition. Harlow, England ; New York: Pearson.

Kiitos
aalto.fi