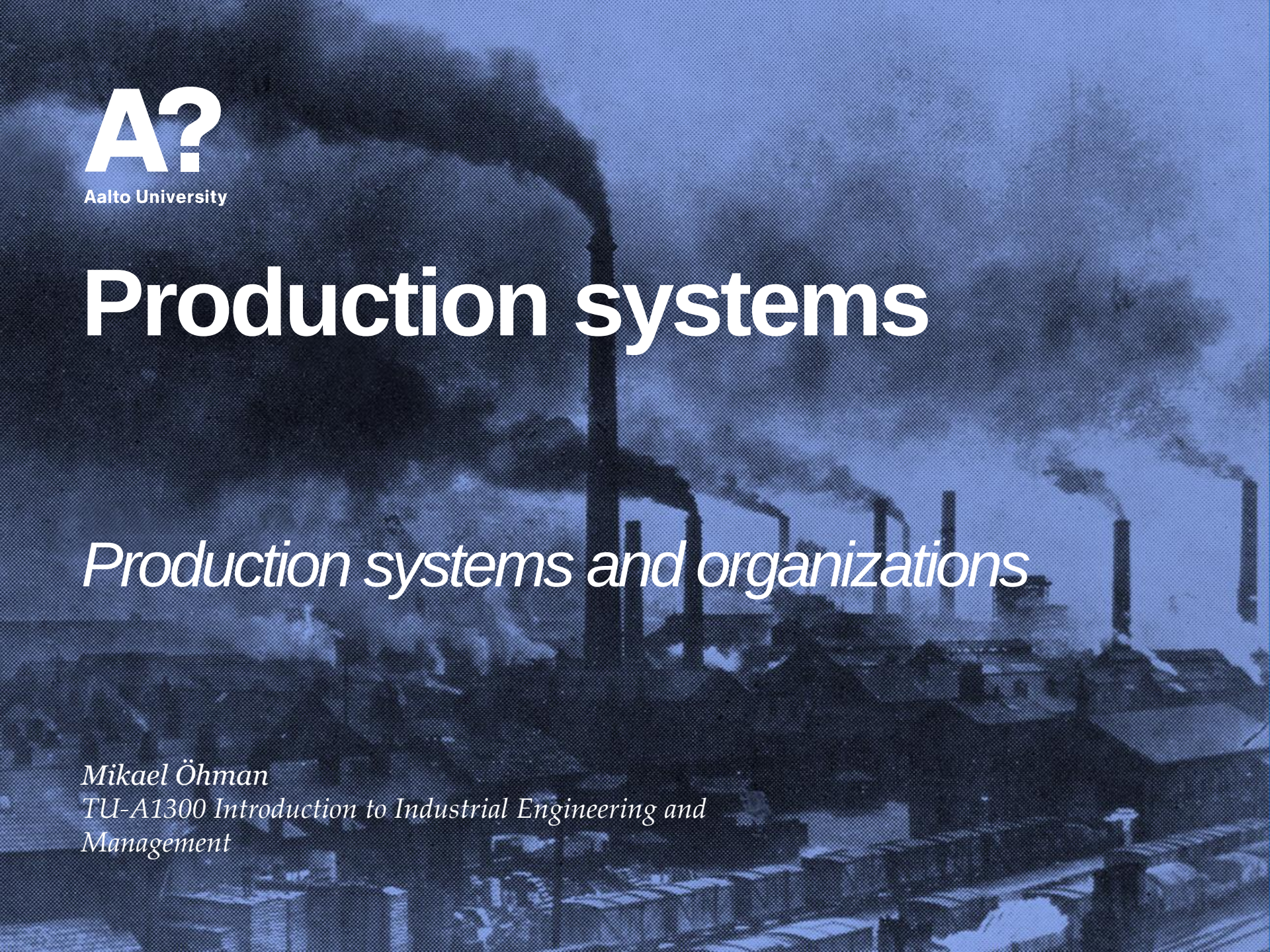


Aalto University

Production systems

Production systems and organizations

Mikael Öhman

TU-A1300 Introduction to Industrial Engineering and Management

Where are we now?

1. Lecture
Industrial engineering and management as a science

4. Lecture
The production process and production control

Business Model Canvas

2. Lecture
Value as the foundation of business

3. Lecture
Production systems and organizations

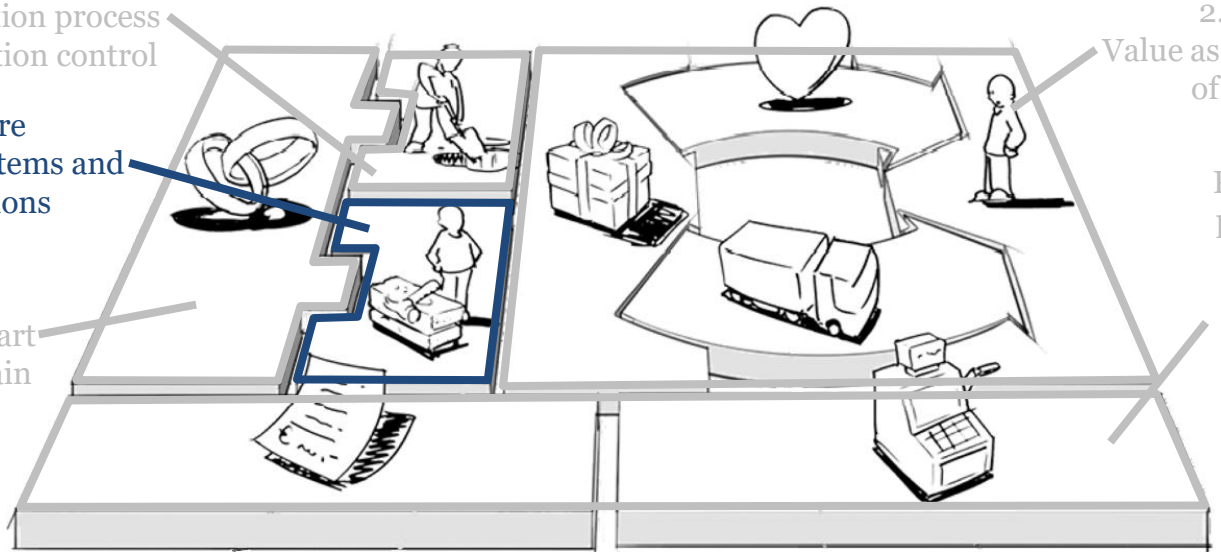
6. Lecture
Projects and recap / preparation for PE1

5. Lecture
Production as part of the value-chain

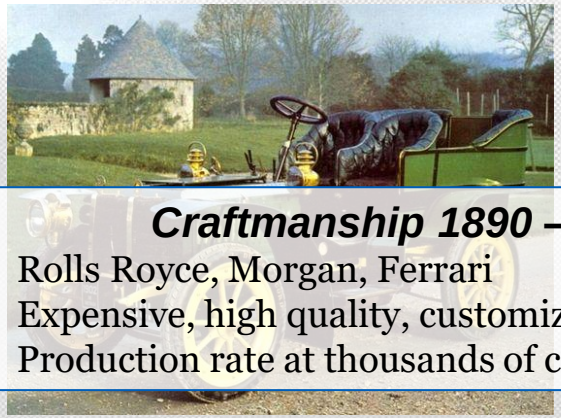
7. Lecture
Accounting and profitability

8. Lecture
Investments

9. Lecture
Recap / preparation for PE2



Evolution of the automobile industry



Craftmanship 1890 –

- Rolls Royce, Morgan, Ferrari
- Expensive, high quality, customized products
- Production rate at thousands of cars per year

Mass production 1910 –

- Ford
- Standardized product and process, cheaper product
- Production rate at hundreds of cars per day

Product assortment 1920 –

- GM
- Specialization, leveraging the supply chain
- Greater product variety

Just-in-time 1980 –

- Toyota
- Production control, supplier collaboration
- More customization, high quality

The four Vs of operations management

Variation

Variety

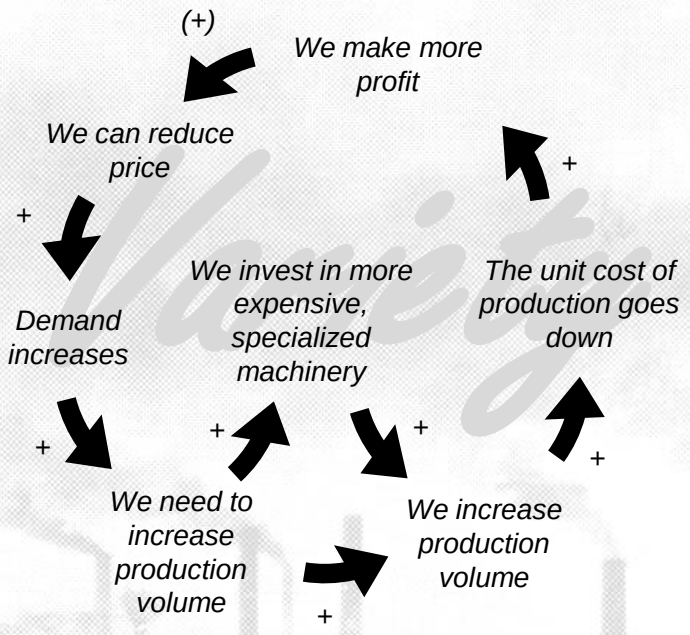
Visibility

Volume

We take economies of scale as granted, yet…

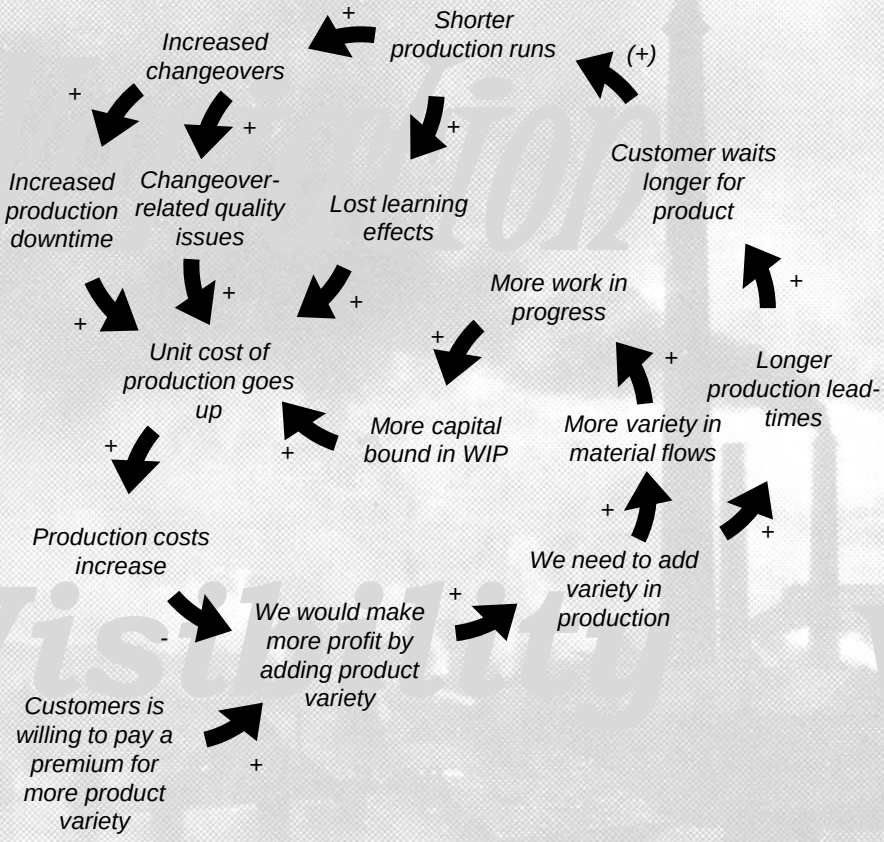
… they depend on

- **The nature of production resources**
  - Specialized technology scales
  - Humans not so much
    - *Poor economies of scale in services*
- **The nature of the product**
  - Simple structure scales
  - Complex structures require standardization
    - *Standardization begins from tools*
- **The nature of the process**
  - Variety limits specialization and introduces changeovers
    - *Variety is poison!*



Volume

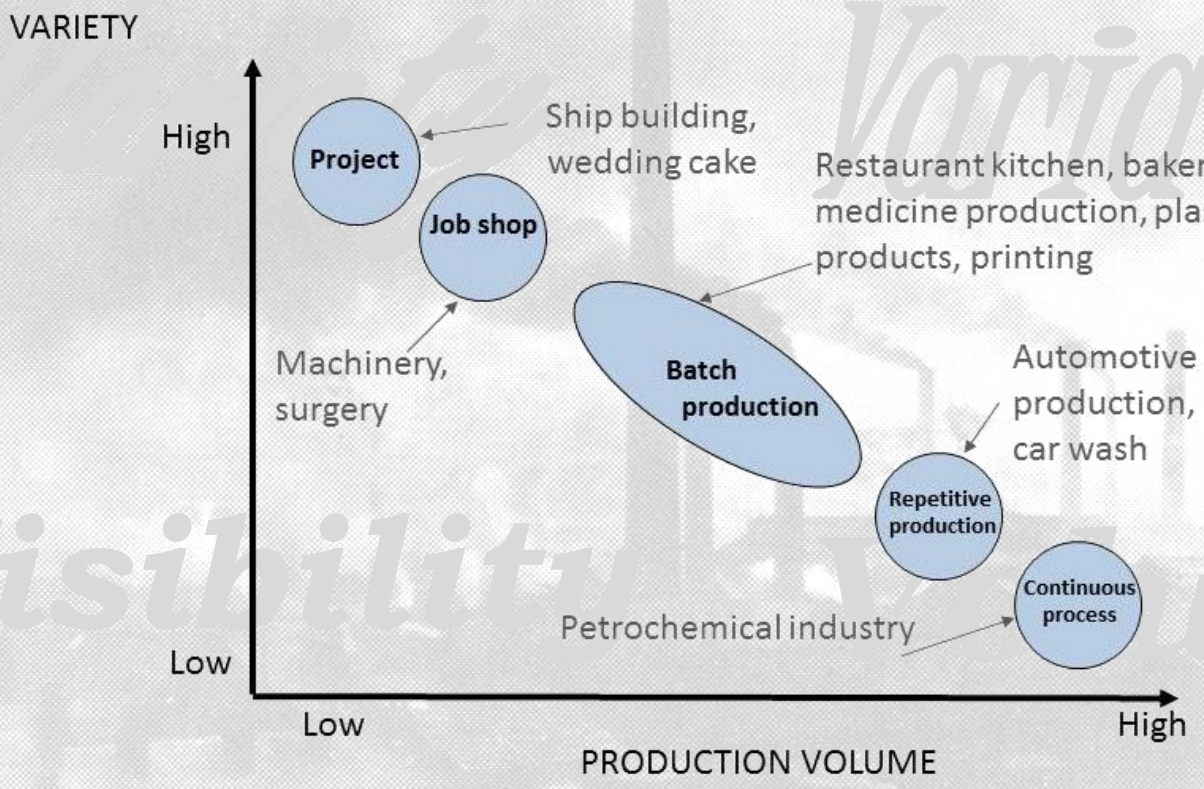
Variety requires flexible production resources



Variety

"You can have the model T in any color, as long as it's black"

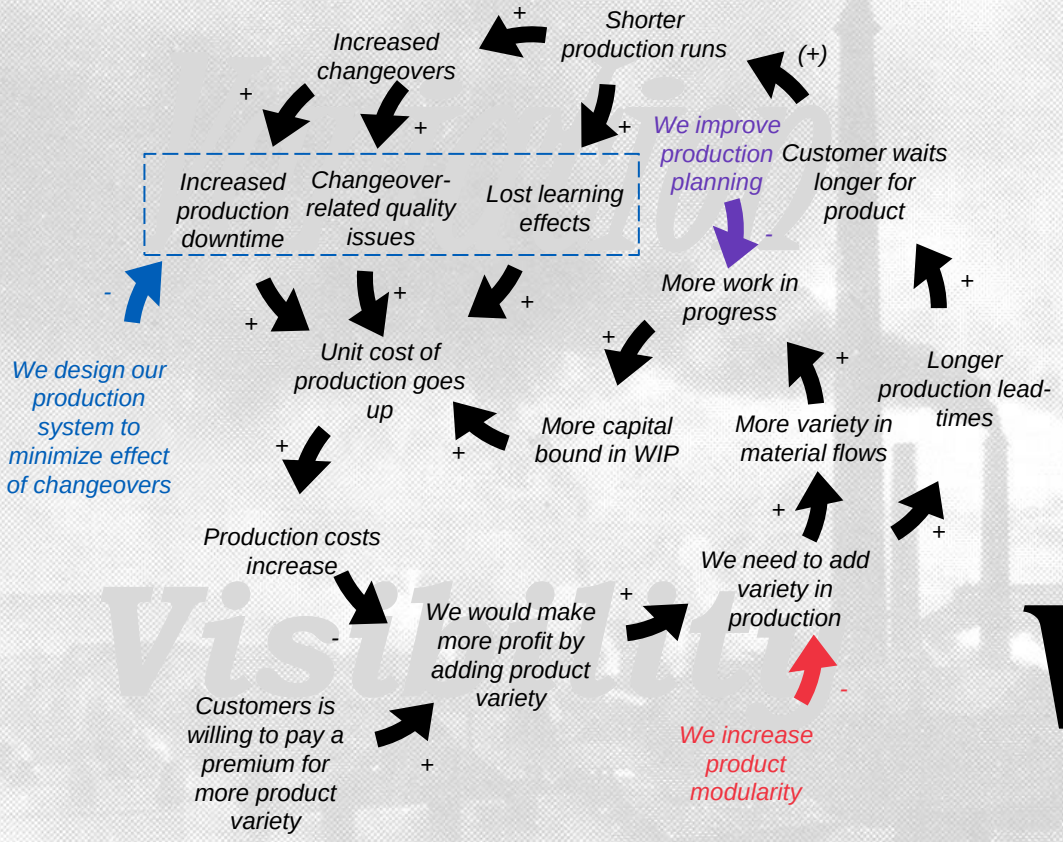
Efficiency and flexibility form a fundamental tradeoff in production



The Hayes and Wheelwright-matrix

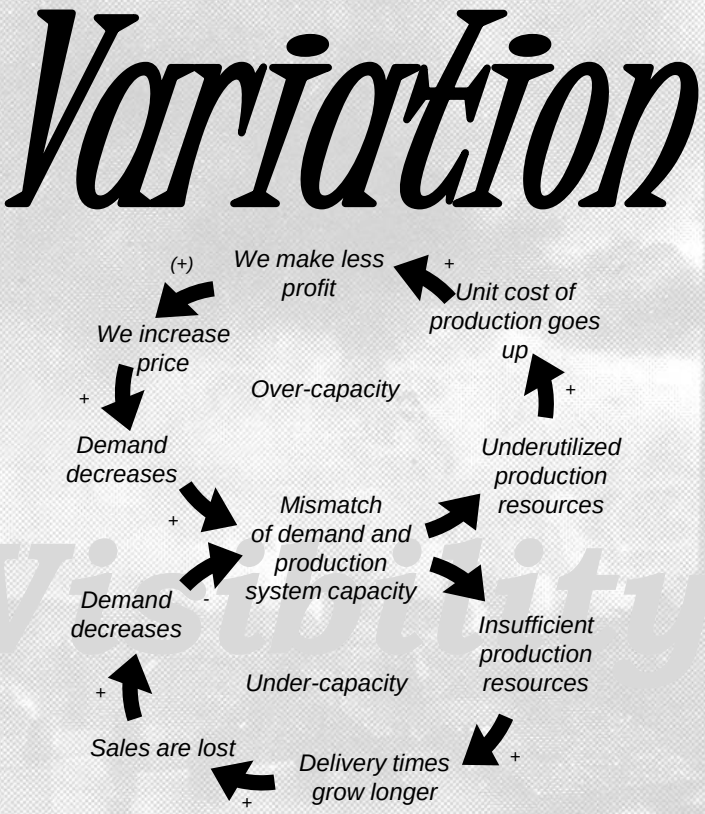
http://www.logistiikanmaailma.fi/en/logistics/production/production-types/

So can we have the cake and eat it at the same time?



Variety & Volume

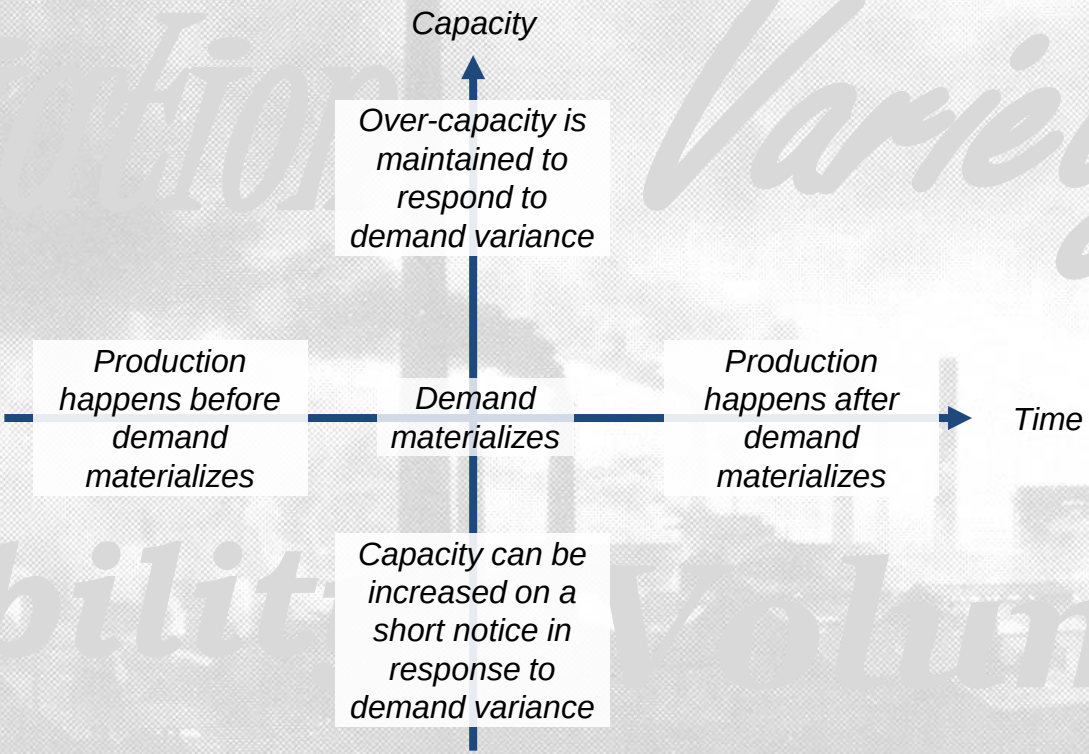
Varying demand is challenging for any production system. Dealing with it…



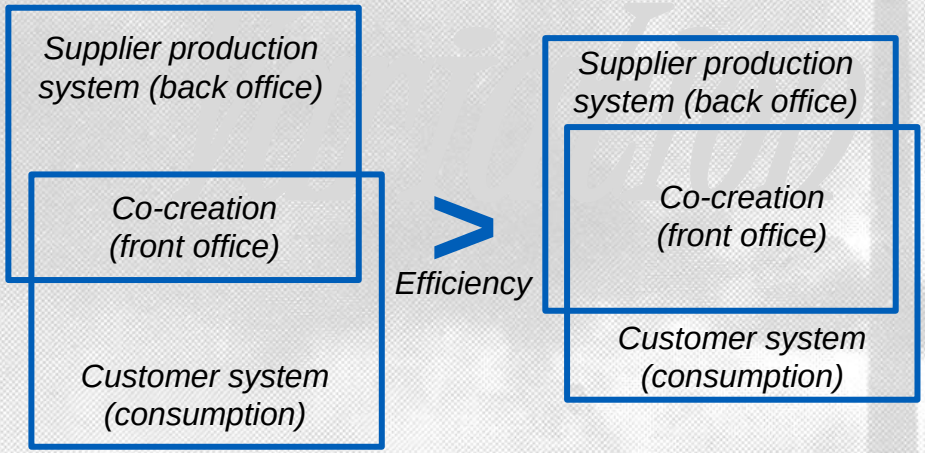
… depends on

- **Type of production resources**
  - Human labor (especially low skilled) can be considered capacity flexible
- **Value of that which is produced**
  - Inventories are good as long as they capital costs are reasonable
- **Production system specialization**
  - Harder to produce complementary products (with respect to demand variation) in highly specialized systems
- **Demand urgency**
  - In some production systems over-capacity is acceptable

Coping with varying demand through buffers



When the customer is involved, efficiency is but a dream…

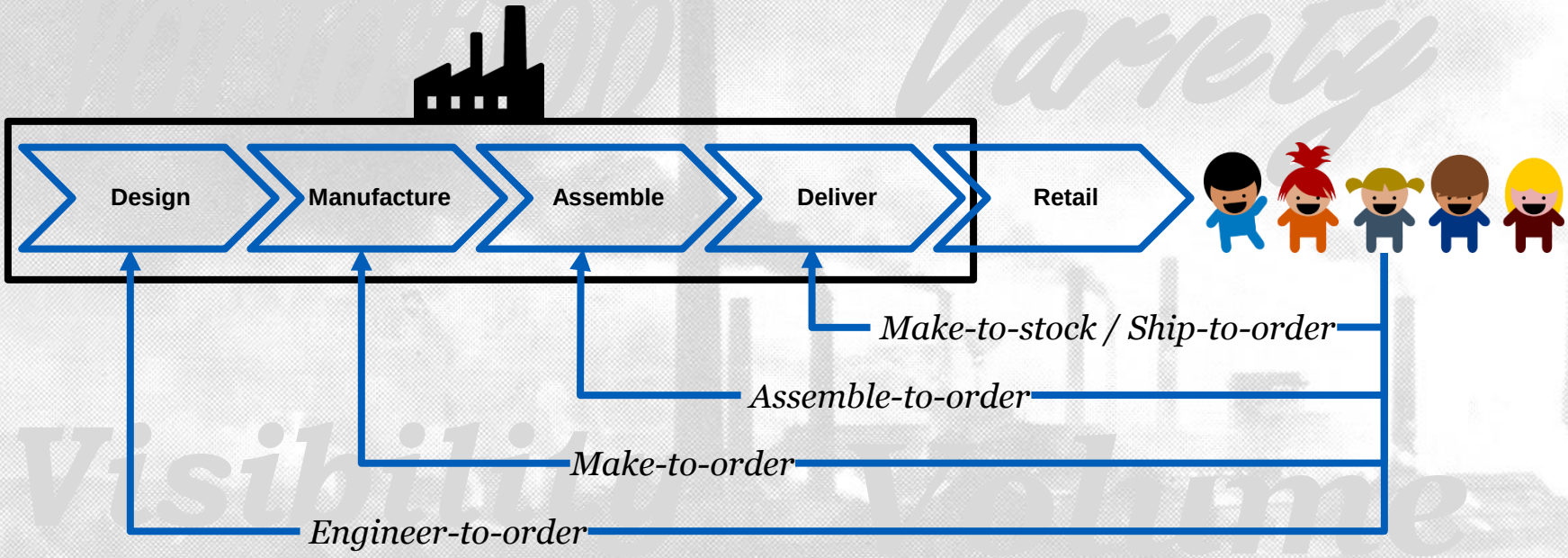


Visibility

… or is it?

- **Efficiency is not a sufficient measure when customer is part of the production**
  - The customer experience may have a greater impact on profit than production costs
- **Production systems can be divided into two parts**
  - The part where the customer is involved focuses on delivering the experience
  - The other part focuses on efficiency
  - The interface between the two parts is crucial considering efficiency

The order penetration point (OPP) is a related concept



Production system capacity

- **The lowest capacity resource determines production system capacity**
  - i.e. the bottleneck
- **In higher variety systems, the bottleneck may change depending on what is produced**
  - A production planning nightmare

Variety