



Aalto University

Production systems

Production systems and organizations

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*TU-A1300 Introduction to Industrial Engineering and
Management*

The four Vs of operations management

Variation

Variety

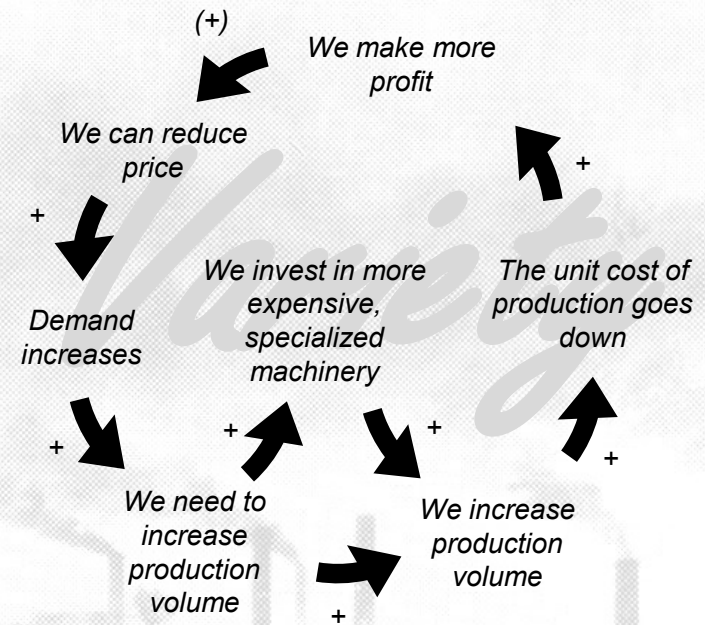
Visibility

Volume

We take economies of scale as granted, yet...

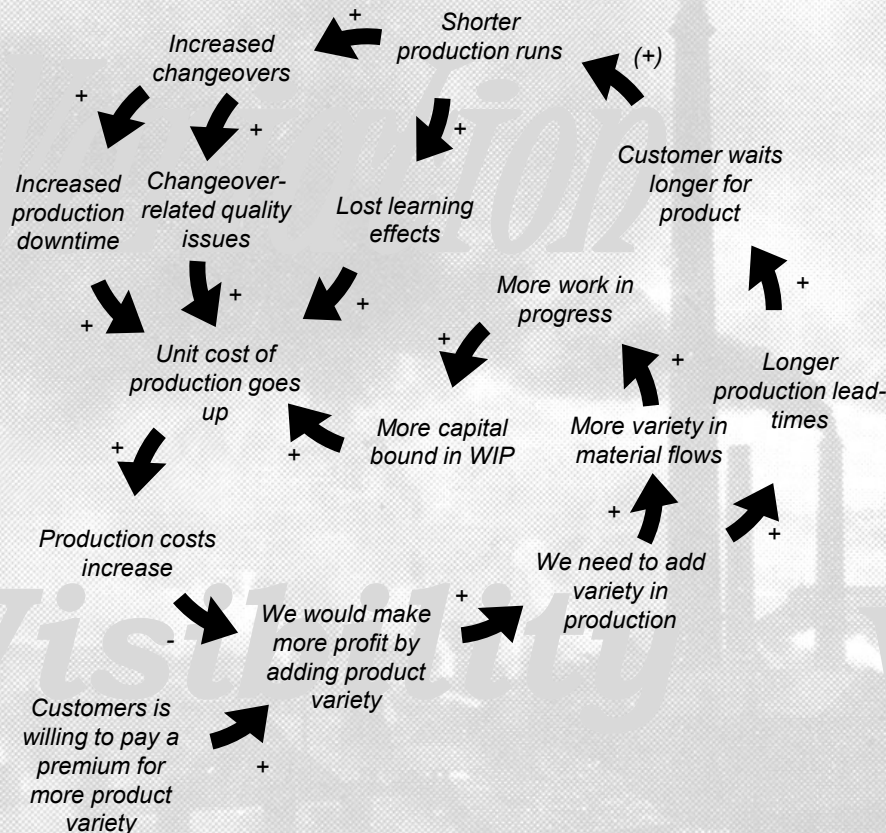
... they depend on

- **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

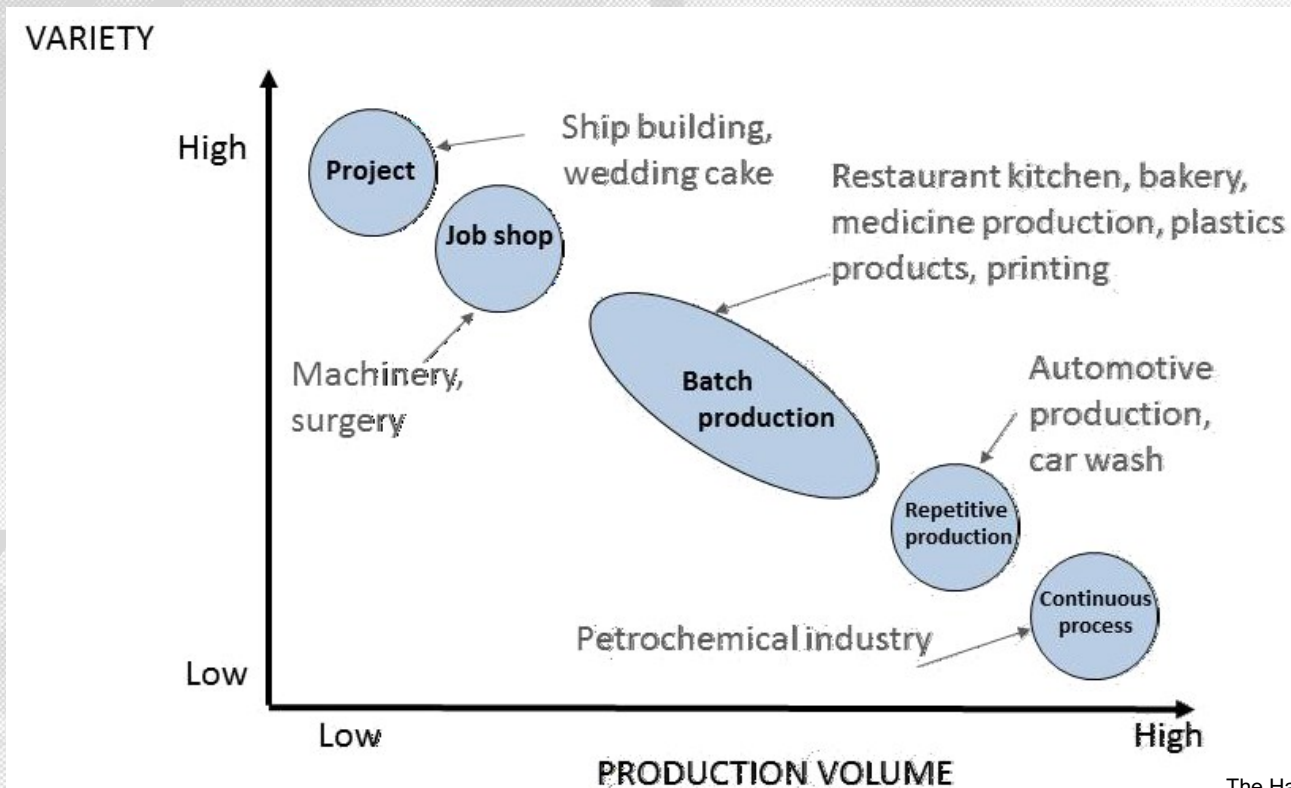
Variety requires flexible production resources



Variety

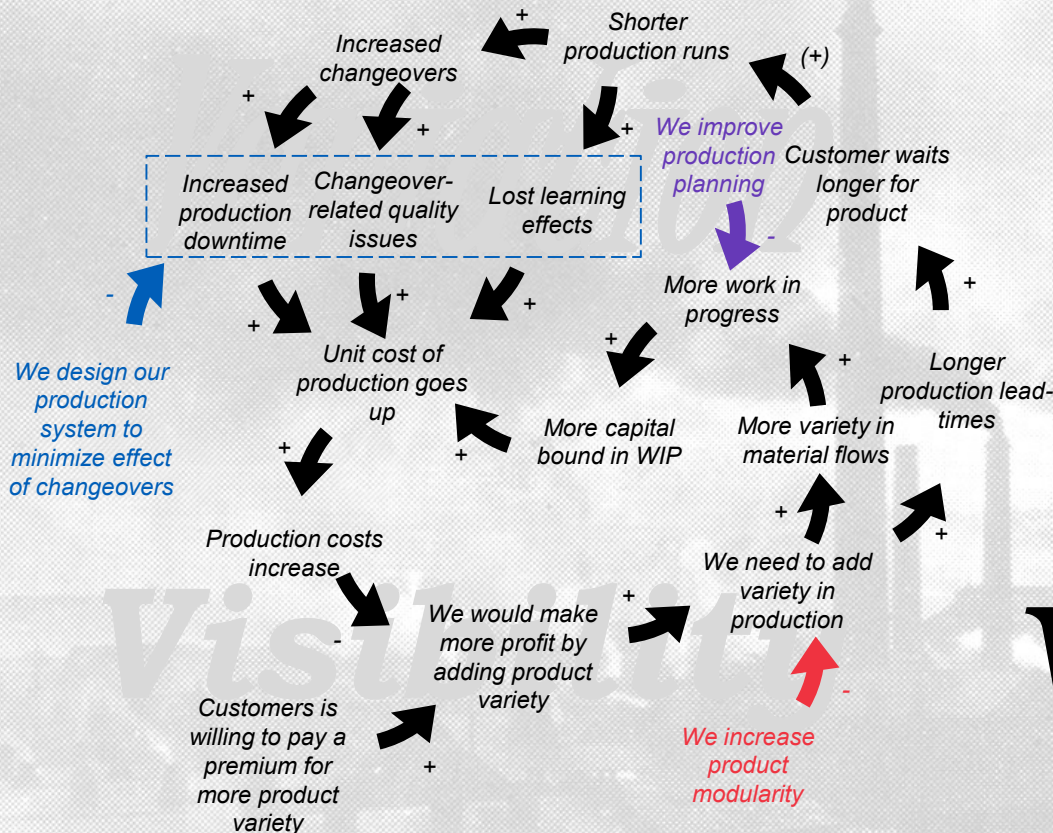
“You can have the model T in any color, as long as it’s black”

Efficiency and flexibility form a fundamental tradeoff in production



The Hayes and Wheelwright-matrix

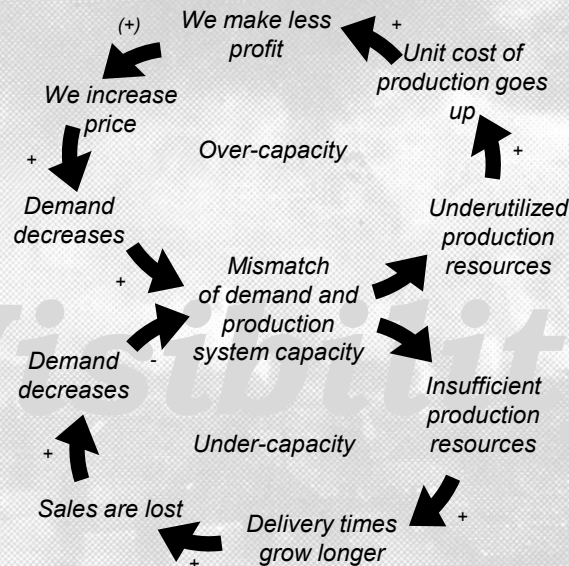
So can we have the cake and eat it at the same time?



Variety & Volume

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

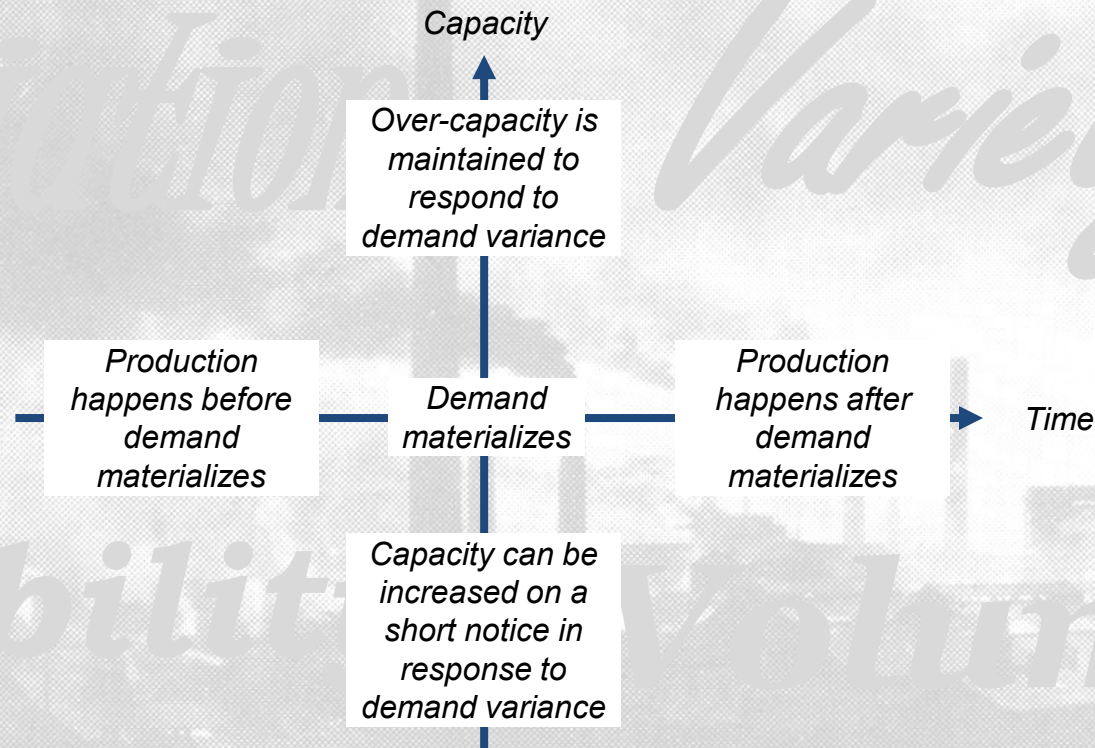
Variation



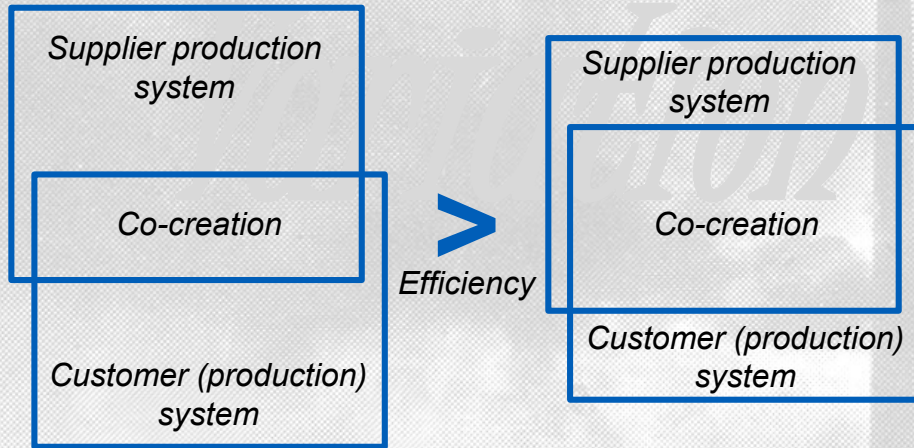
... depends on

- **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...

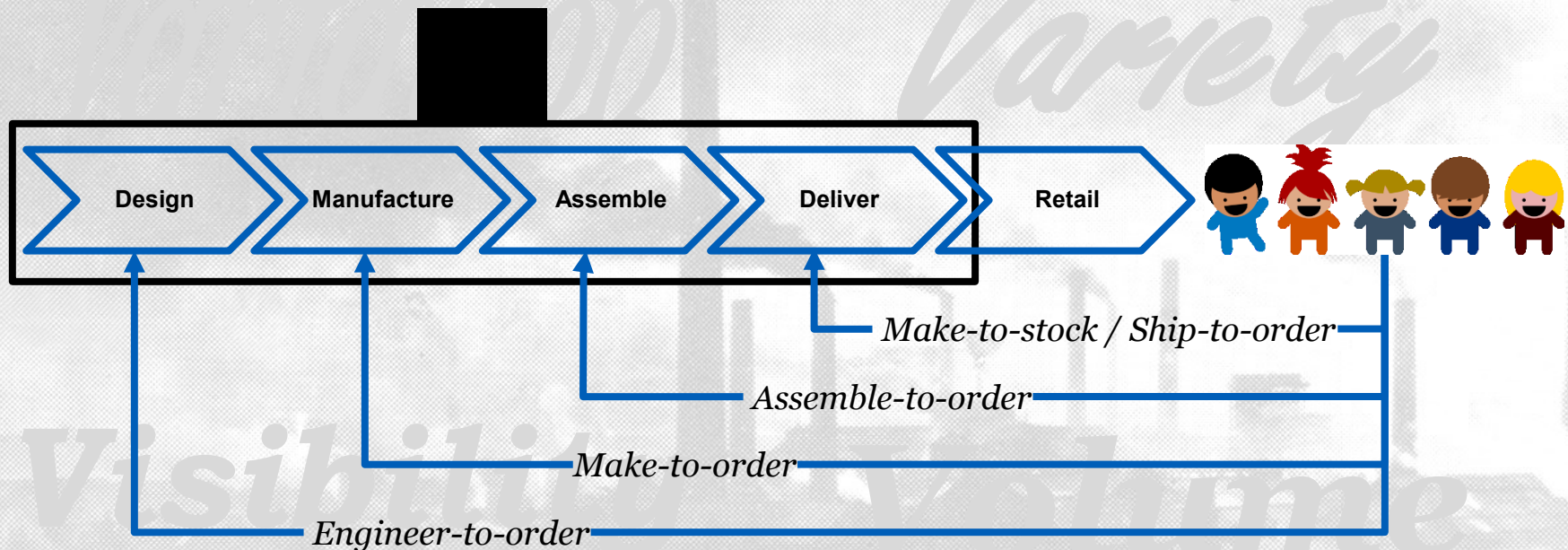


... or is it?

- **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

Visibility

The order penetration point (OPP) is a related concept



A word on production flow



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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

