Intelligent Control

Mass Customisation
Research Centre
Nottingham University

Intelligent Control in Automotive order fulfilment

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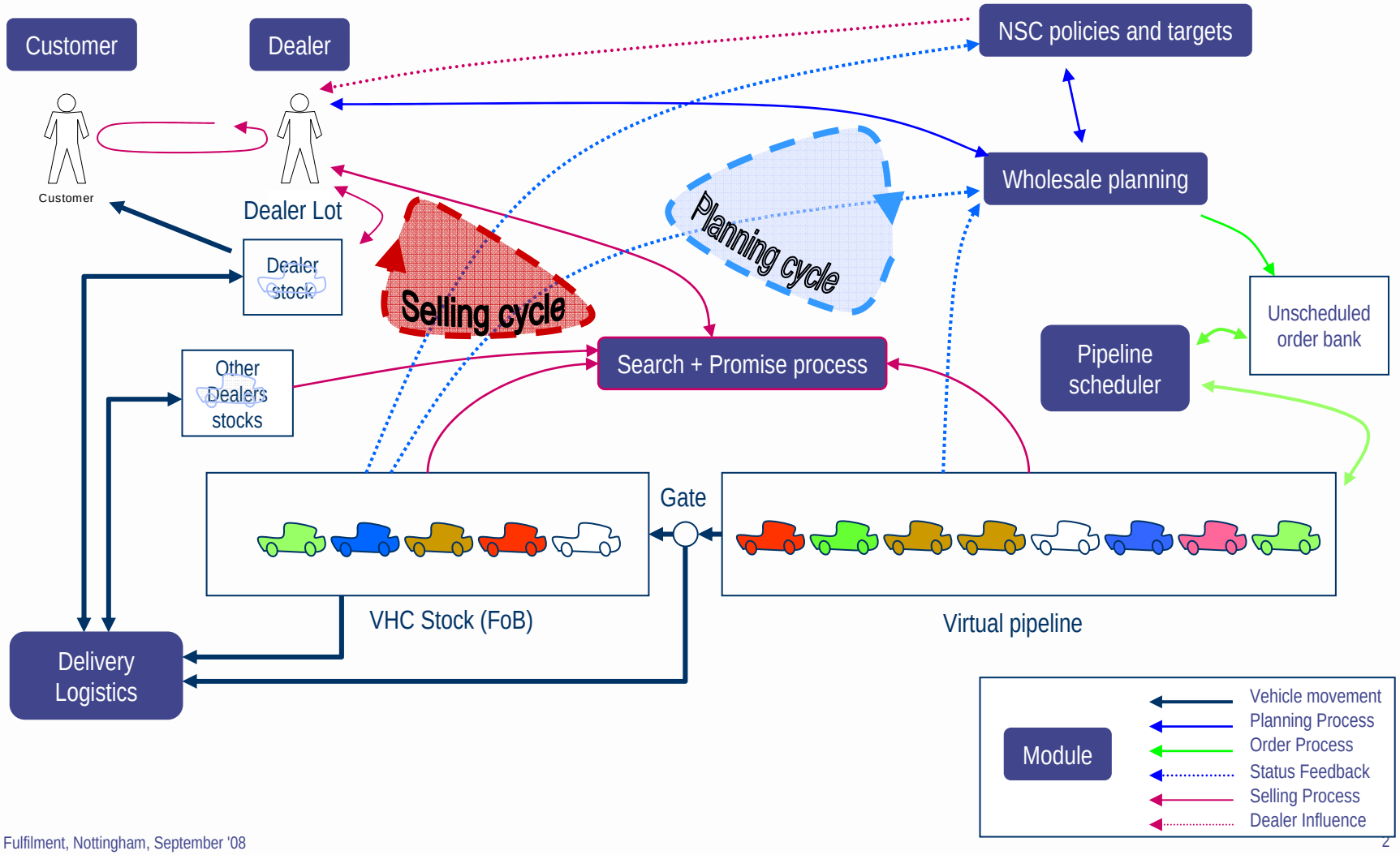
New Ideas in Order Fulfilment, Nottingham, September 2008

Automotive Order Fulfilment



Research topics

- Multi-mode fulfilment model
  - Open Pipeline
- Impact of variety
  - 2 to 1,000,000+
- Operating policies
  - What mix to hold in stock?
  - How to share among dealers?
- Flexibility
  - Supply chain responsiveness
  - Inter-Dealer trading
- Customer behaviour
  - Willingness to compromise
  - Willingness to wait
- Stakeholder perspectives

Fulfilment process

A Customer enters, requesting a product

Stock and pipeline are searched. Finished products and orders are scored, e.g.

Score = spec difference + lead time

The lowest score vehicle/order is allocated to the customer.

The customer awaits delivery. Metrics are updated when the product is handed over

Key Metrics:

>Customer compromise

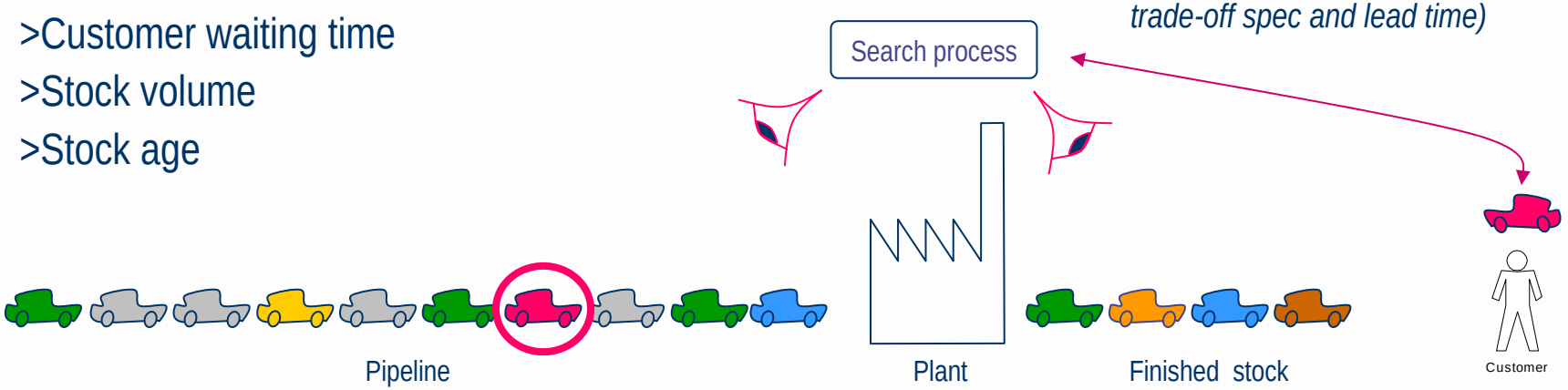
>Customer waiting time

>Stock volume

>Stock age

'Exact Match' search

(Can change search rule to trade-off spec and lead time)



Perhaps 2 months of production

Perhaps Fewer than in the Pipeline

Sold

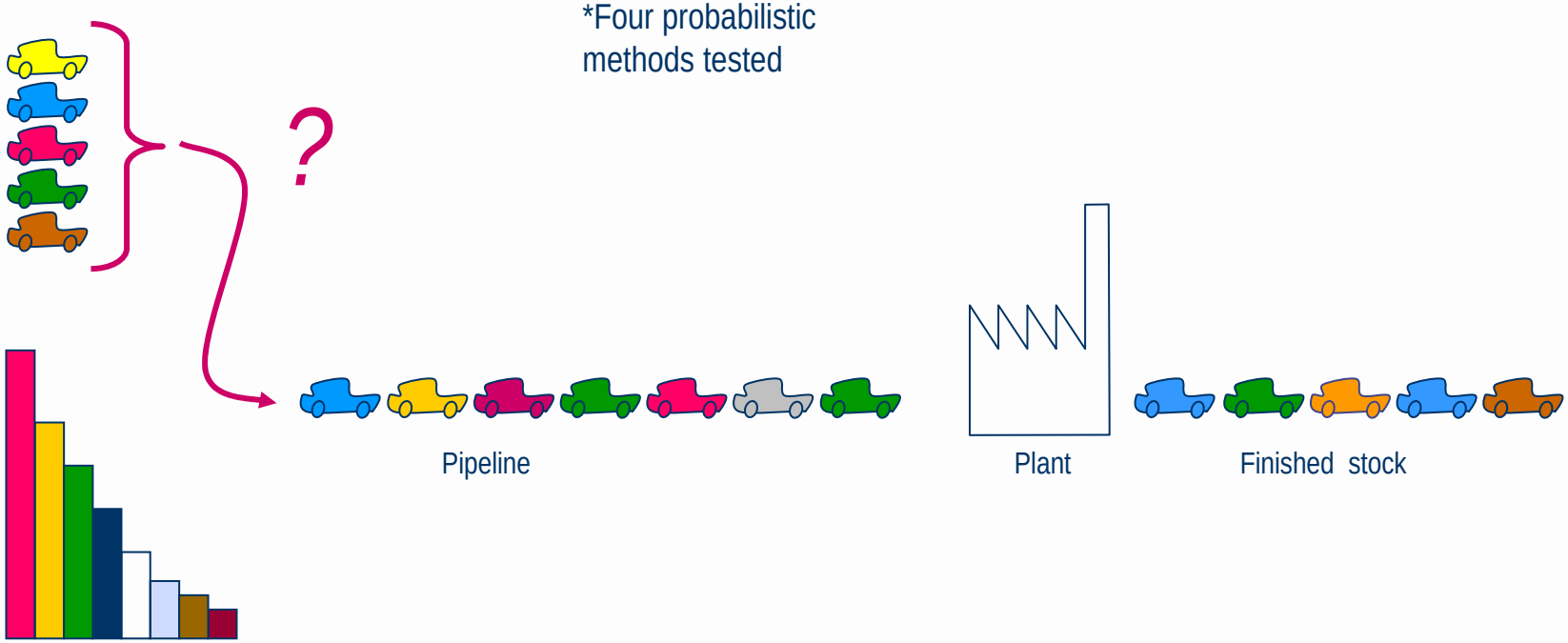
Selecting the next product to feed into the Pipeline

Random selection from Producer's distribution (No knowledge of stock & pipeline)

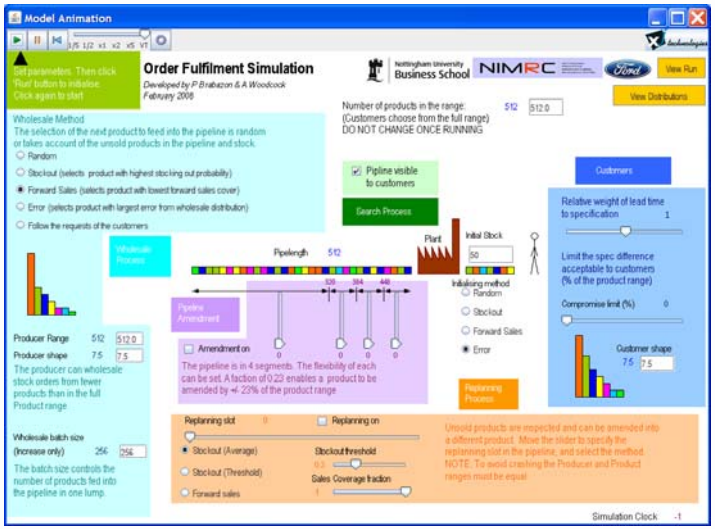
Select the Product requested by the previous customer

Count each product in stock and pipeline → Compare to target distribution* → Select most under-represented product → Feed that product into the start of the pipeline

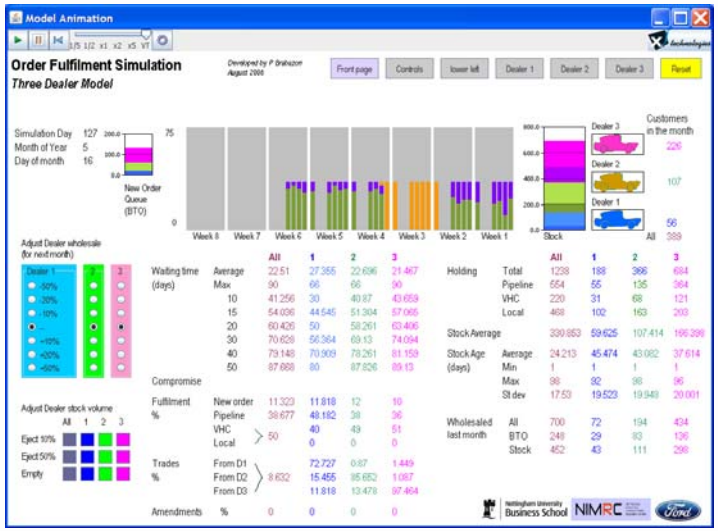
*Four probabilistic methods tested



Interactive simulation models



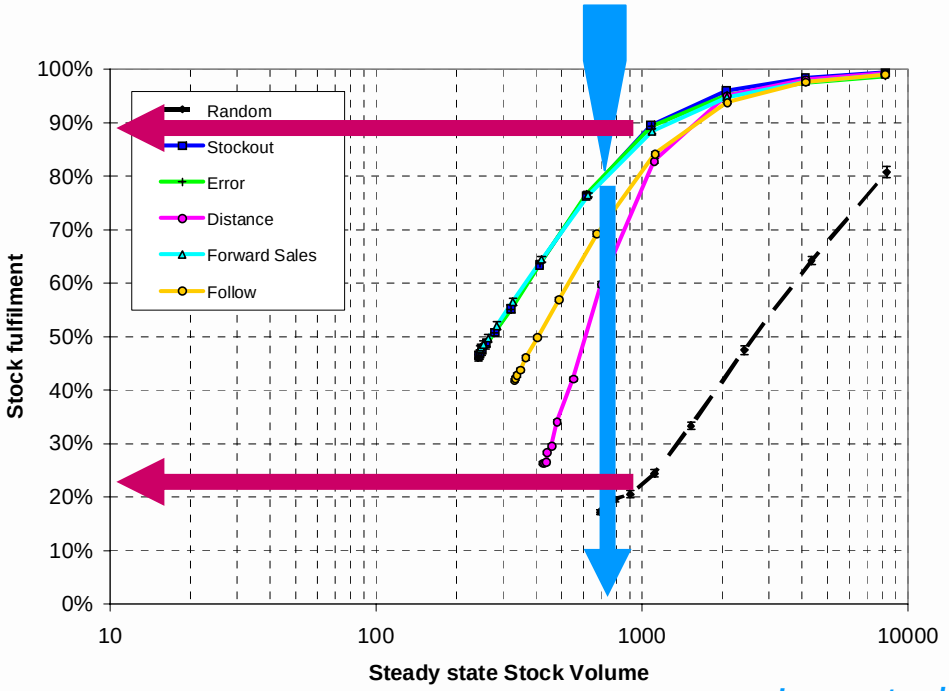
- Single Dealer Model



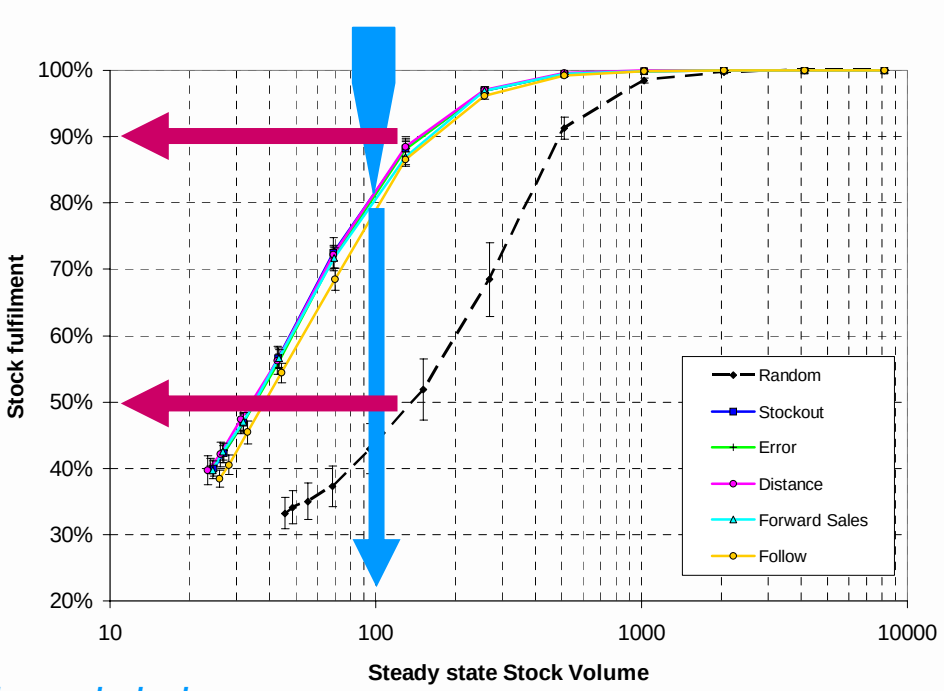
- Three Dealer Model

Illustrative results: Stock Fulfilment

Customers fulfilled with Exact Match



Customers trade-off specification and lead time

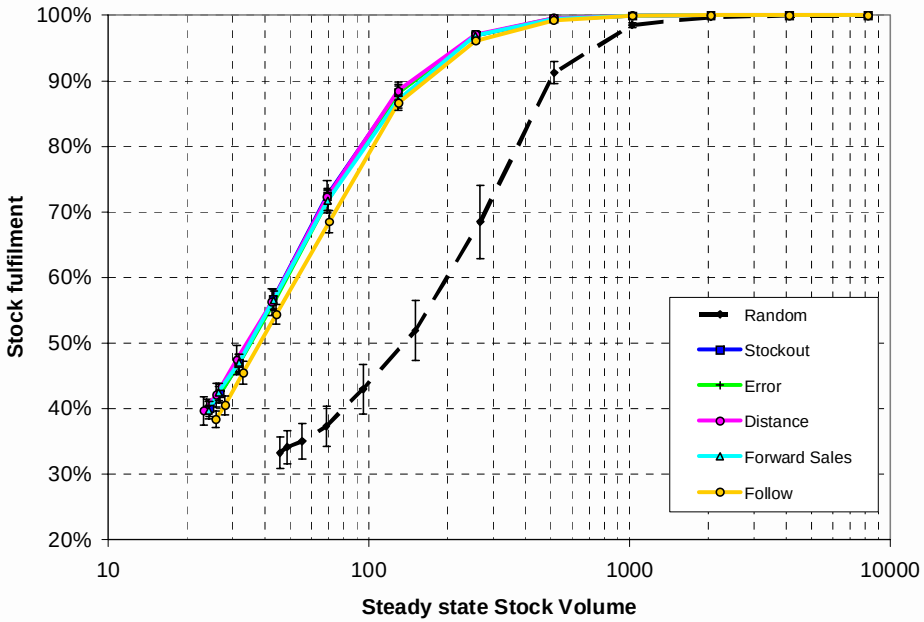


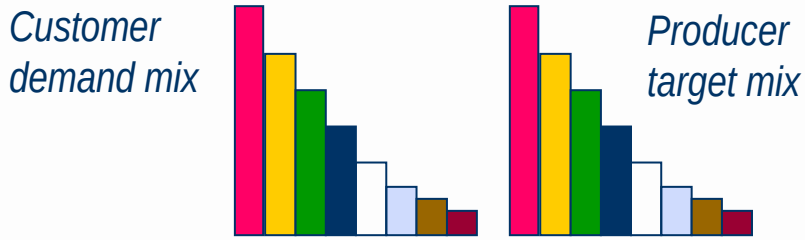
Less stock needed when customers compromise

Substantial improvement in fill rate with probabilistic methods

Illustrative results

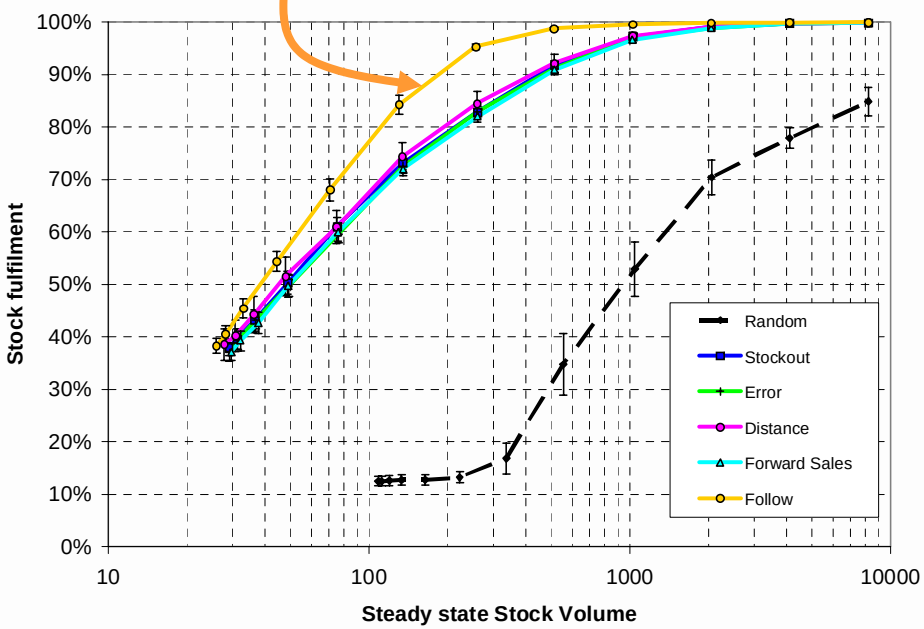
Accurate picture of customer demand mix

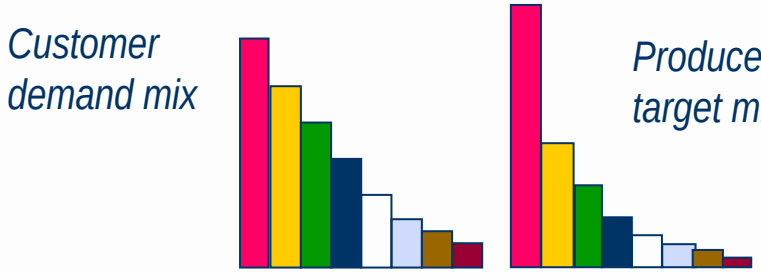




Inaccurate estimate of customer demand mix

Immune to error when follow the last customer





Relevant articles

- Brabazon / Woodcock / MacCarthy (2008) ***Configuring an open pipeline fulfilment system - a simulation study in an automotive context.*** International Mass Customization Meeting, Copenhagen, 2008
- Brabazon / Woodcock / MacCarthy (2008) ***Intelligent pipeline control - a simulation study in the automotive sector***. Fifteenth International Working Seminar on Production Economics, March 3-7, 2008, Congress Innsbruck, Innsbruck, Austria.
- Brabazon / MacCarthy (2006) ***Fundamental behaviour of Virtual-Build-to-Order systems.*** International Journal of Production Economics, 104 (2) 514-524
- Brabazon / MacCarthy (2005) ***Review of order fulfilment models for Catalogue Mass Customization.*** International Mass Customization Meeting, Klagenfurt, 2005
- Brabazon / MacCarthy (2004) ***Virtual-Build-to-Order as a Mass Customization Order Fulfilment Model***. Concurrent Engineering Research and Applications, 12 (2) 155-165.

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