Strategies for Engineer-to-order Supply Chains: Lessons from Manufacturing and Construction

Dr Jon Gosling

Prof Mo Naim

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Logistics Systems Dynamics Group

Purpose

...achieve world class research and education excellence in the advancement of management theory and practice, specifically in the field of logistical dynamics, via business systems engineering; in so doing adding value to its members and partners.

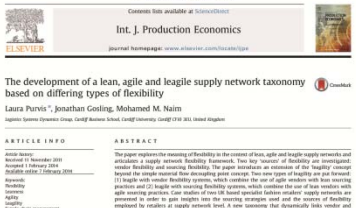
Group raison d'etre

- Brings together control theory, good operations management and industrial engineering practice, business process engineering and system dynamics simulation to form an integrated approach to logistics systems dynamics problem solving.
- Considers the implications of organisational, attitudinal, financial and technological factors when instigating business process change.
- Analyses, simplifies, integrates and optimises business processes via a generic modelling approach.


Industrial Marketing Management

A case study exploring drivers and implications of collaborative electronic logistics marketplaces

Yingli Wang, Andrew Potter, Mohamed Naim, Derek Beevor


Int. J. Production Economics

The development of a lean, agile and leagile supply network taxonomy based on differing types of flexibility

Laura Purvis, Jonathan Gosling, Mohamed M. Naim


International Journal of Production Research
Vol. 49, No. 19, 1 October 2011, 5779–5800


Journal of the Operational Research Society (2009) 60, 1149–1160

Forecasting for inventory planning: a 50-year review

AA Syntetos, JE Boylan and SM Disney


Transportation Research Part A

Transportation Research Part A

Assessing the cost and CO_2e impacts of rerouteing UK import containers

Vasco Sanchez Rodrigues, Anthony Beresford, Stephen Pettit, Syamantak Bhattacharya, Irina Harris

An analytical framework for evaluating the value of enhanced customisation: an integrated operations-marketing perspective

Harianto Wong and Daniel Eyers


Production Planning & Control, 2013
Vol. 24, Nos. 10–11, 1002–1014, http://dx.doi.org/10.1080/09537287.2012.666918

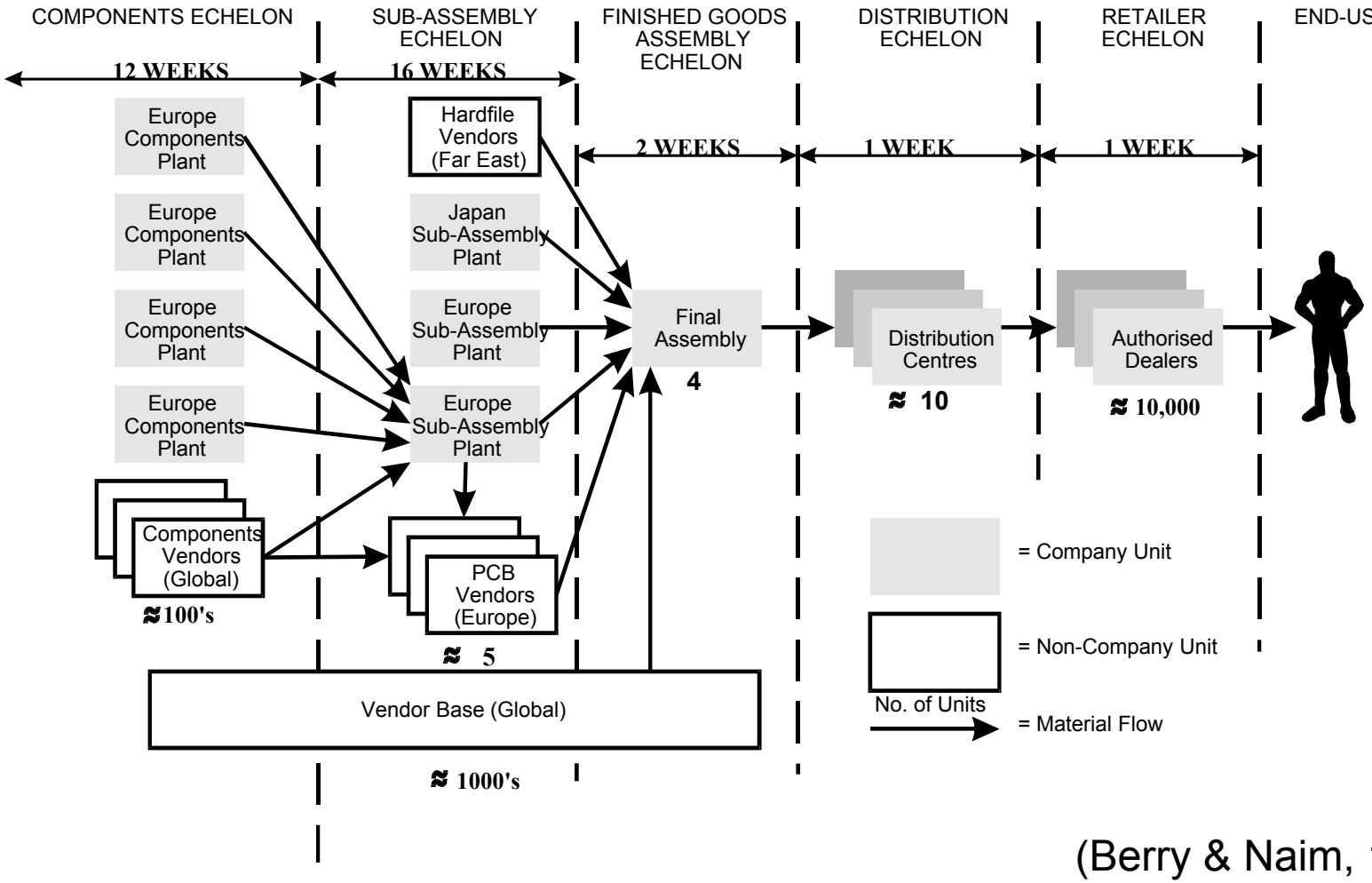
Methodology challenges associated with benchmarking healthcare supply chains

Tillmann Böhme, Sharon J. Williams, Paul Childerhouse, Eric Deakins and Denis Towill

Research Group Co-ordinator:
Dr. Andrew Potter
PotterAT@Cardiff.ac.uk

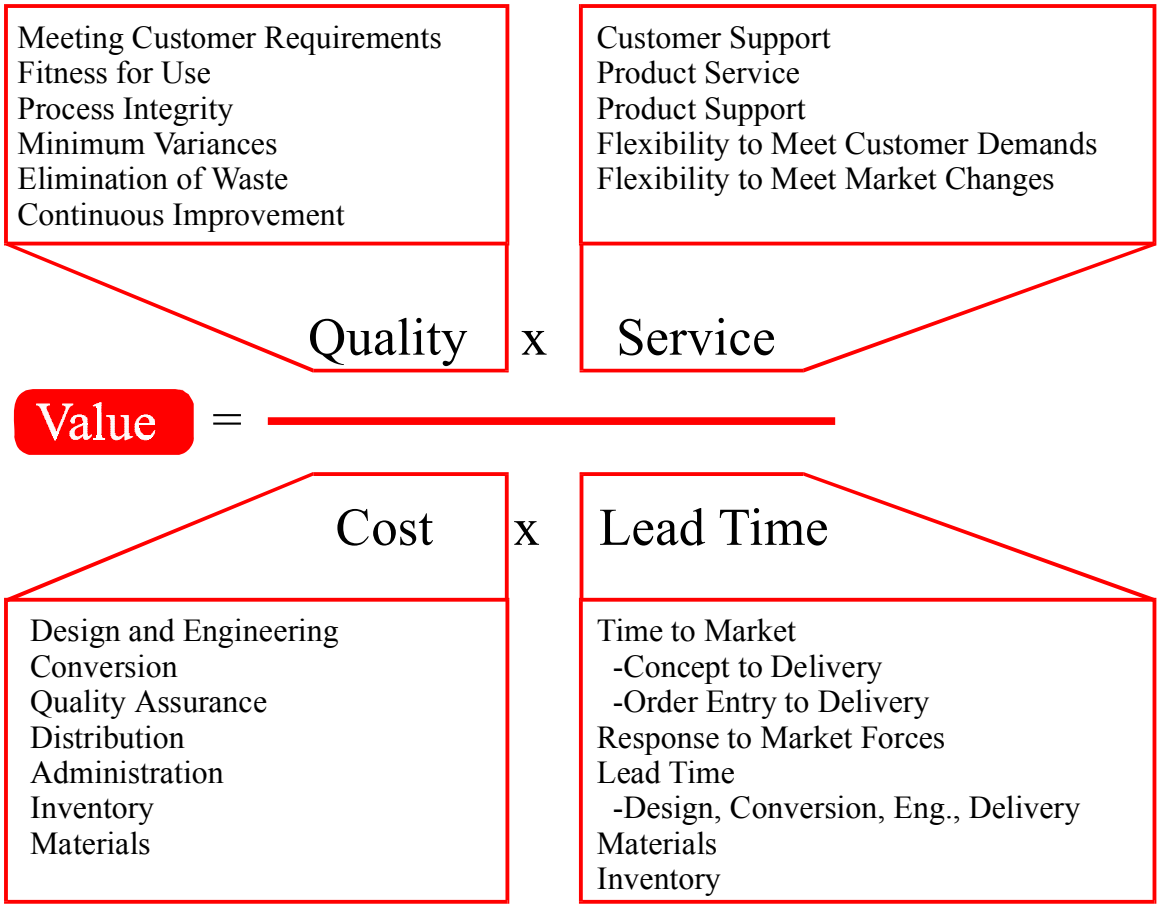
Construction as a manufacturing process (?)

Personal Computer global supply chain



(Berry & Naim, 1996)

Supply Chain Focus on Total Customer Value



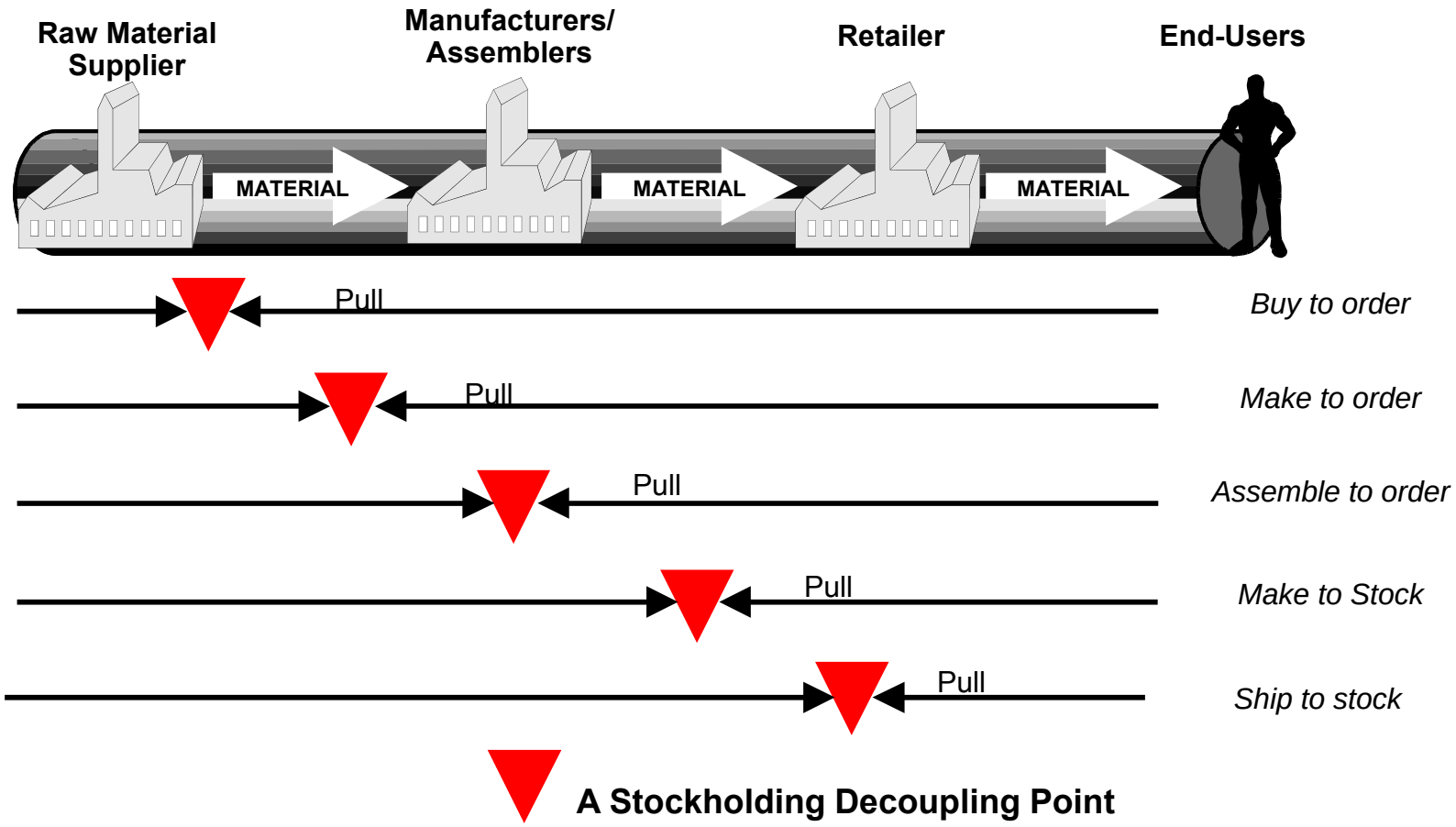
(Johansson et al., 1990)

Some definitions

- Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place.
- Leanness means developing a value stream to eliminate waste, including time, and to ensure a level schedule
- A supply chain is a system whose constituent parts include material suppliers, production facilities, distribution services and customers linked together via a feedforward flow of materials, a feedback flow of information and flows of cash and resources
- The decoupling point separates the part of the supply chain oriented towards customer orders from the part of the supply chain based on planning

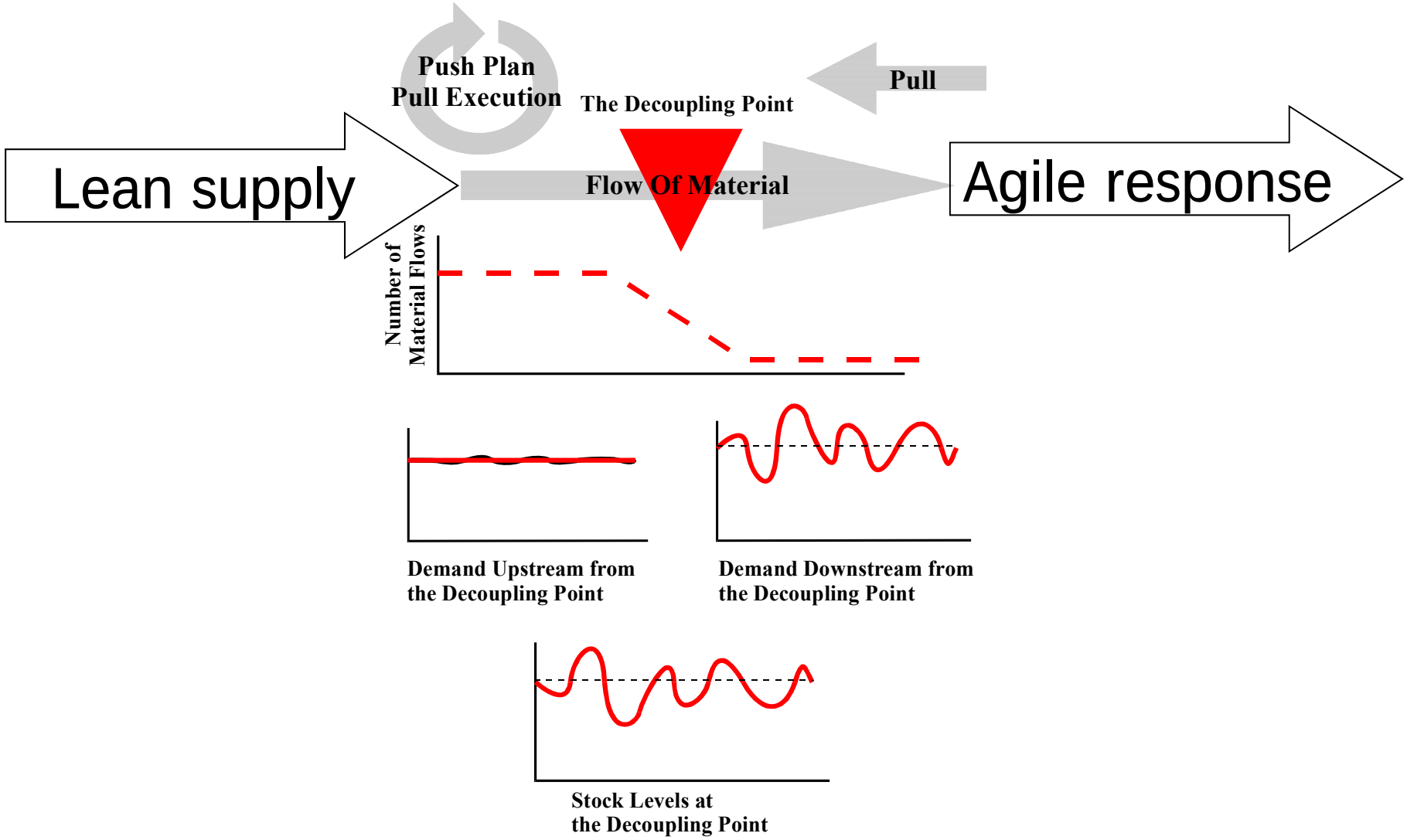
(Naylor, Naim and Berry, 1999)

Supply Chain Strategies



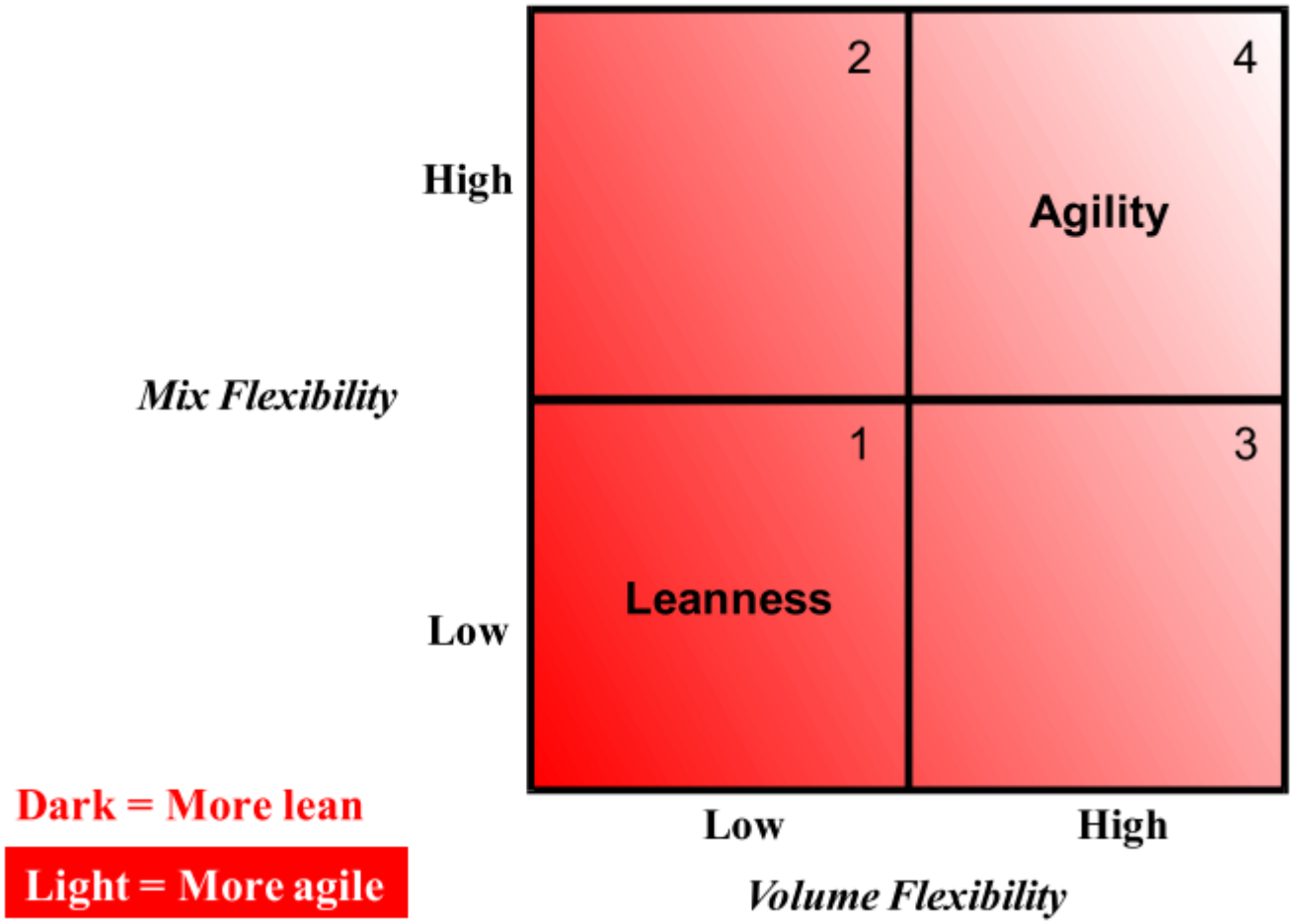
(Hoekstra & Romme, 1992)

Impact of the Supply Chain Decoupling Point



(Naylor, Naim and Berry, 1999)

The Role of Flexibility



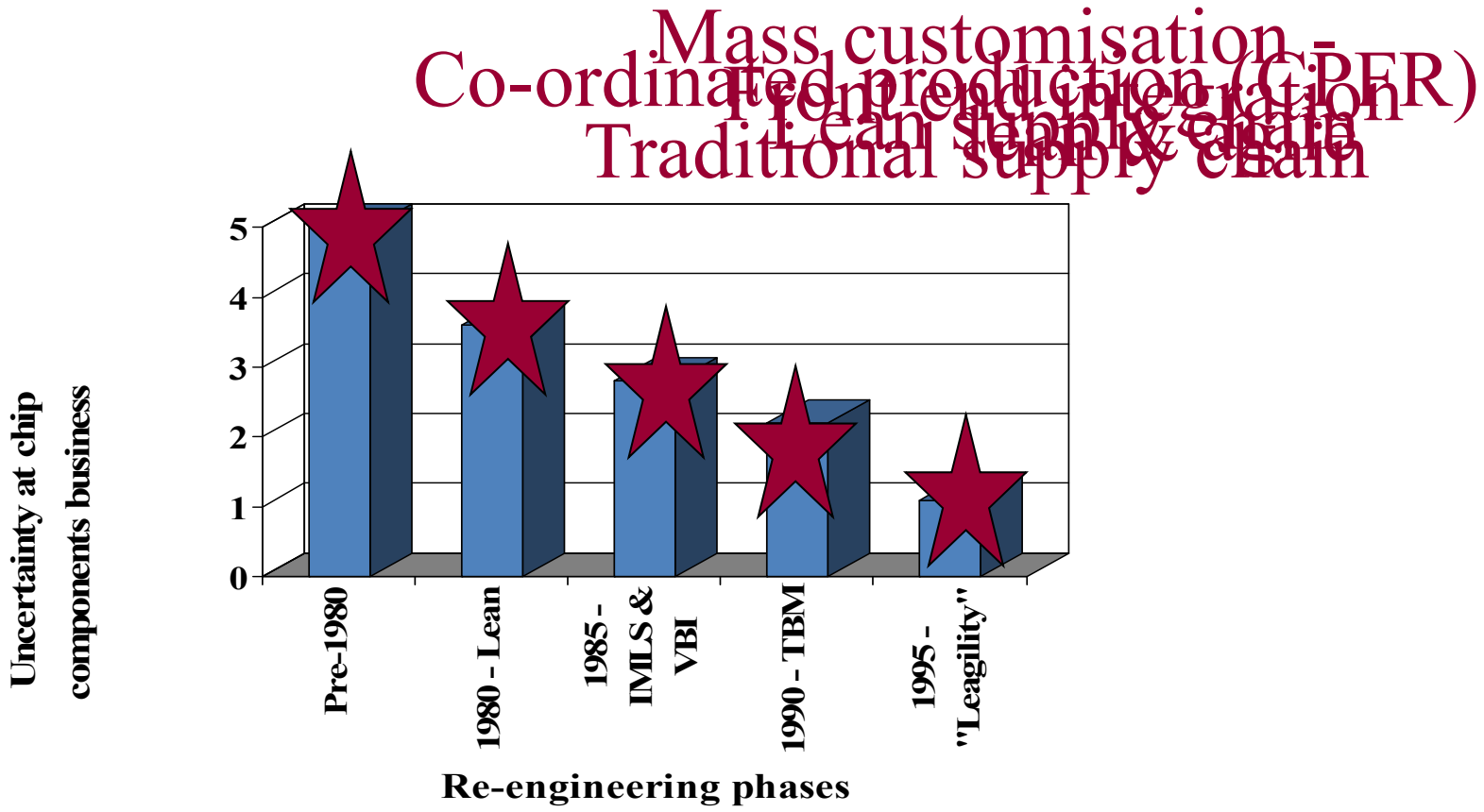
(Purvis, Gosling and Naim, 2014)

Linking operations to marketing

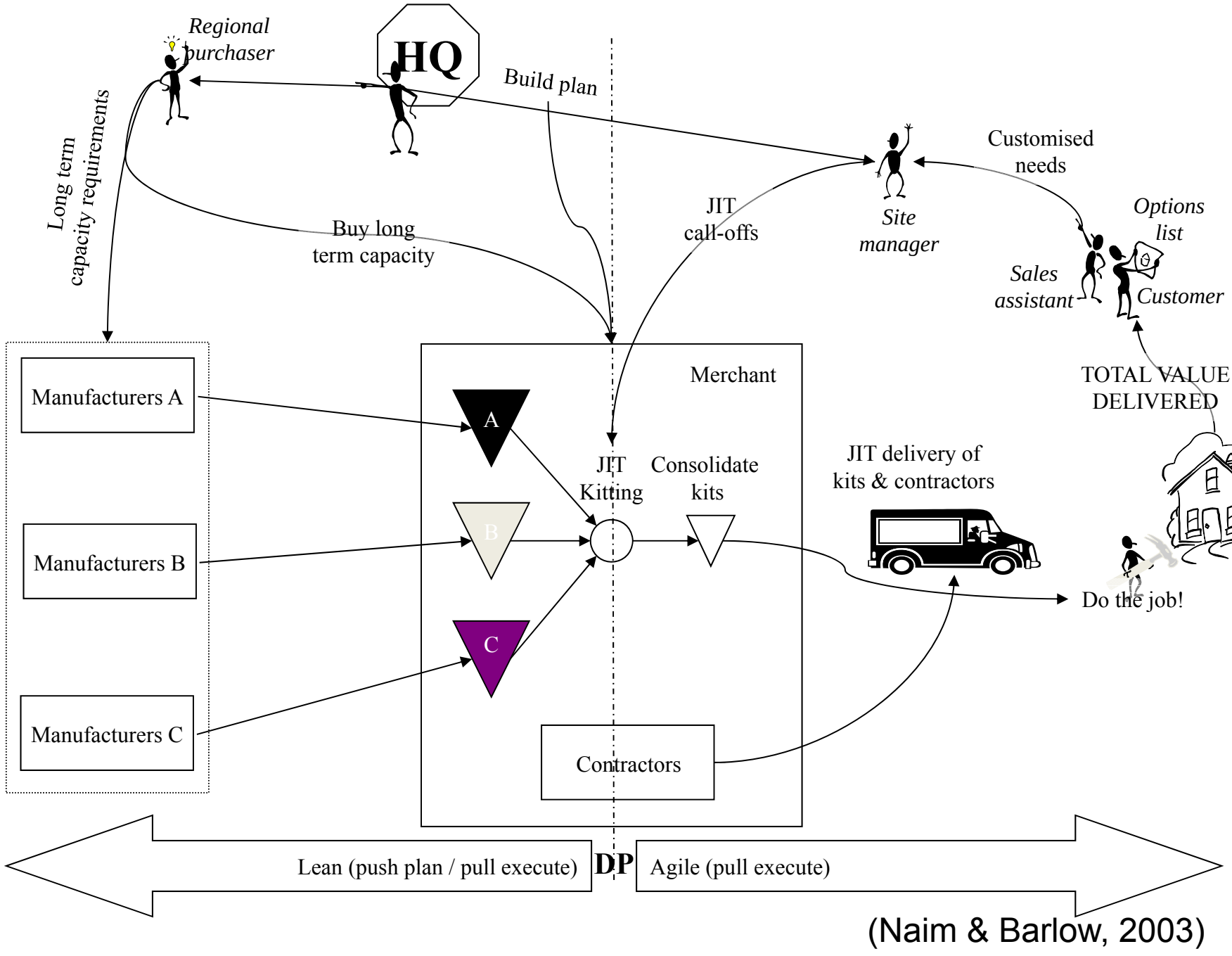
Metric	Agile	Lean
Lead Time	MQ	MQ
Service	OW	MQ
Costs	MQ	OW
Quality	MQ	MQ

(Naylor, Naim and Berry, 1999)

Uncertainty reduction in a PC supply chain

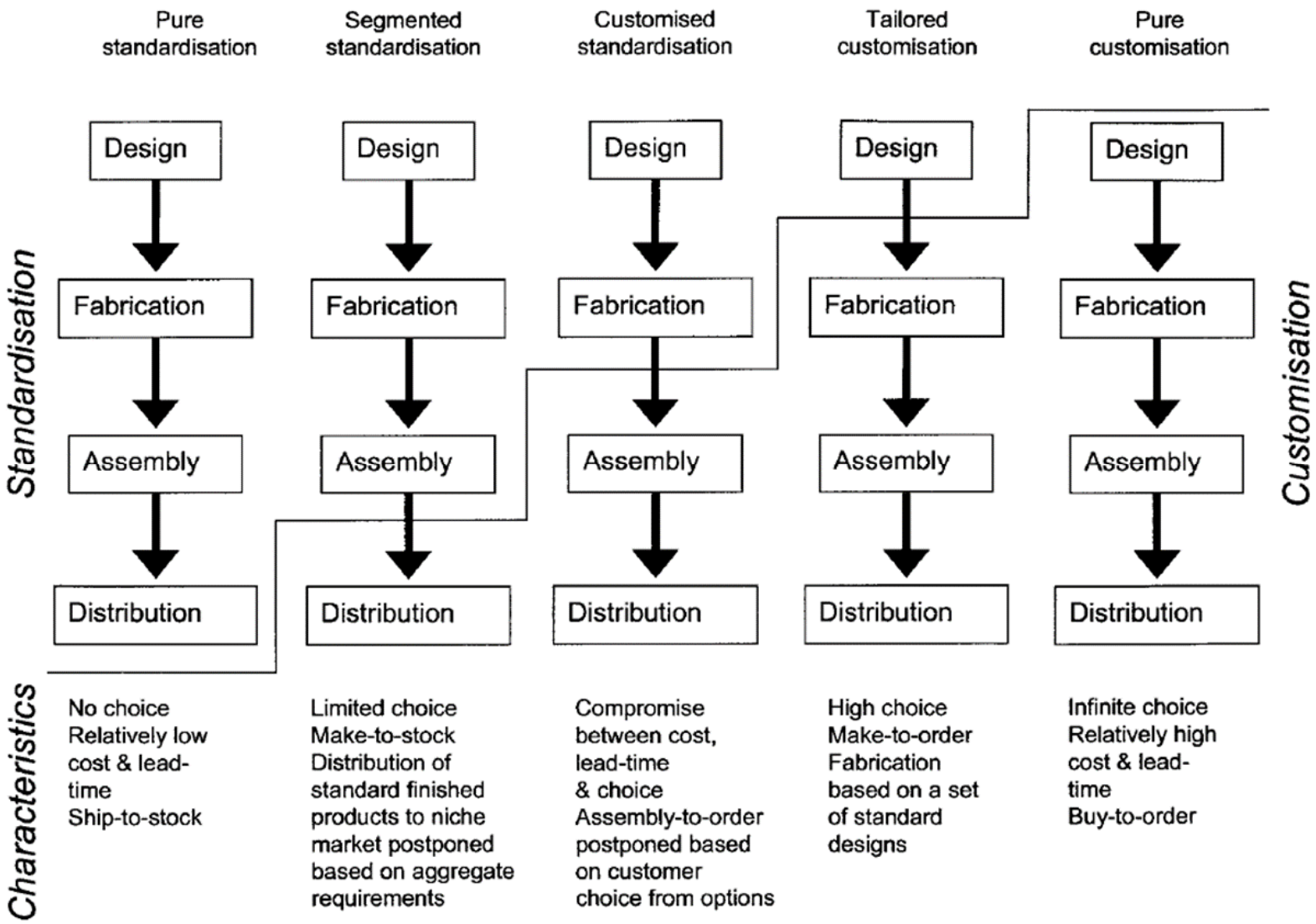


(Berry & Naim, 1996)



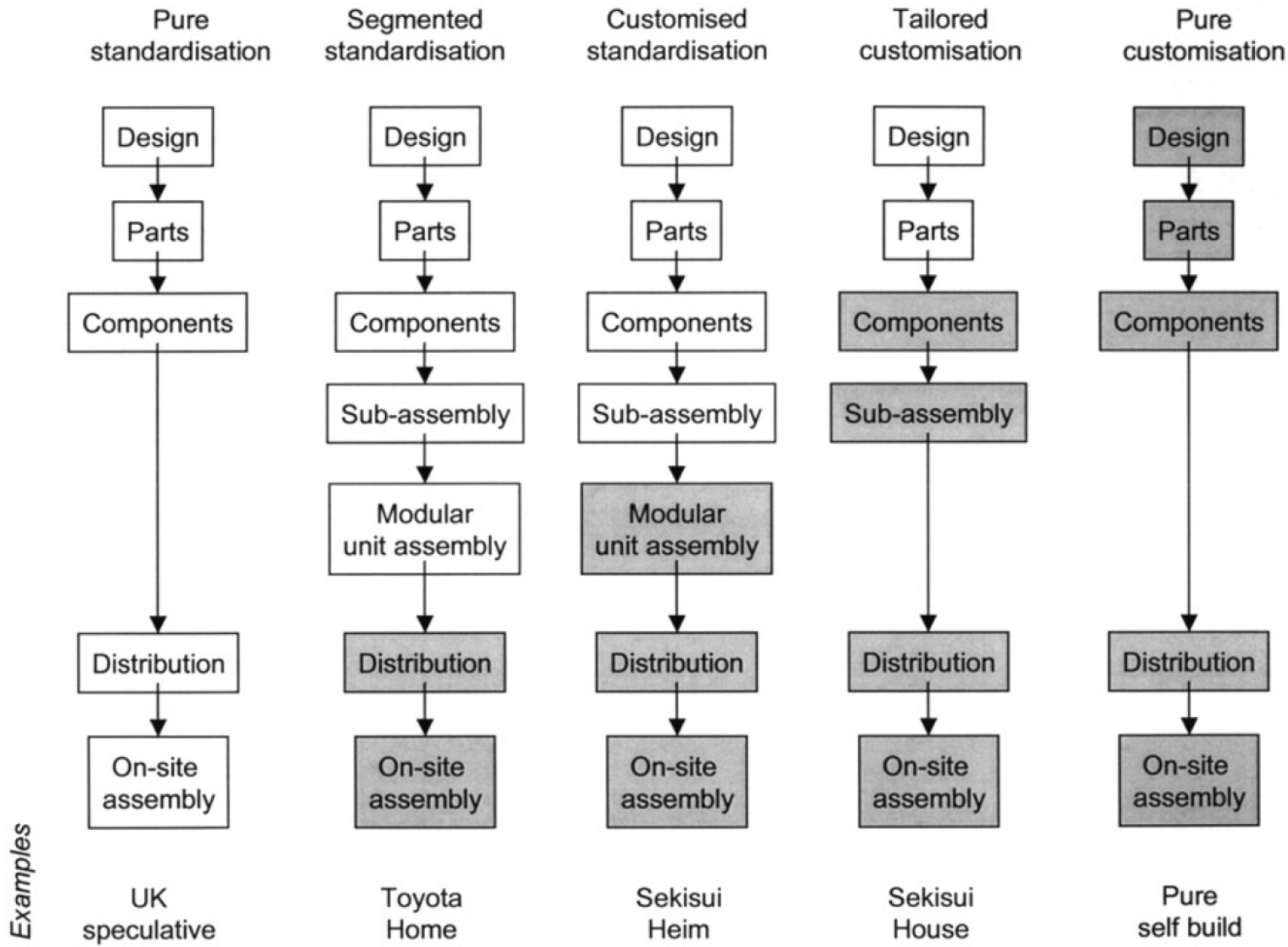
(Naim & Barlow, 2003)

Customisation vs. standardisation

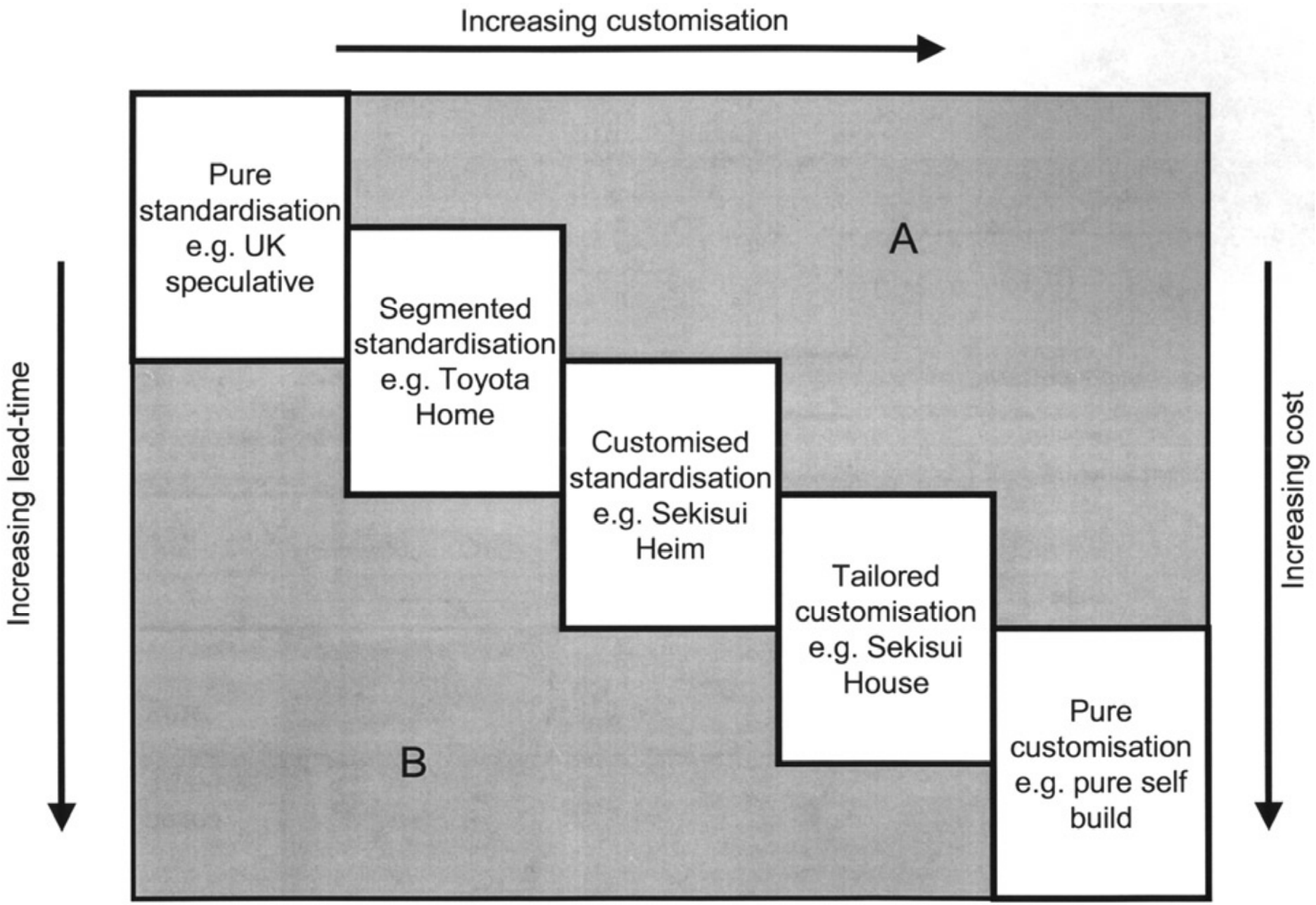


(Lampel & Mintzberg, 1996)

House building supply chain strategies



(Barlow et al., 2003)



(Barlow et al., 2003)

Construction as a manufacturing process?

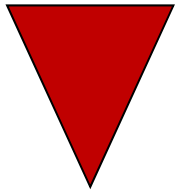
or

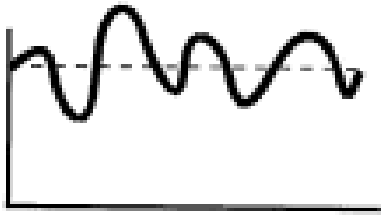
Manufacturing as a construction process?

Why we think ‘engineering-to-order’ is a useful term?

CODP Basic Concept

Demand Upstream from the Decoupling Point





Demand Downstream from the Decoupling Point

- Logic of Aggregation

Typically Means

- Standard Work Processes / Products
- Resources Easy to Forecast

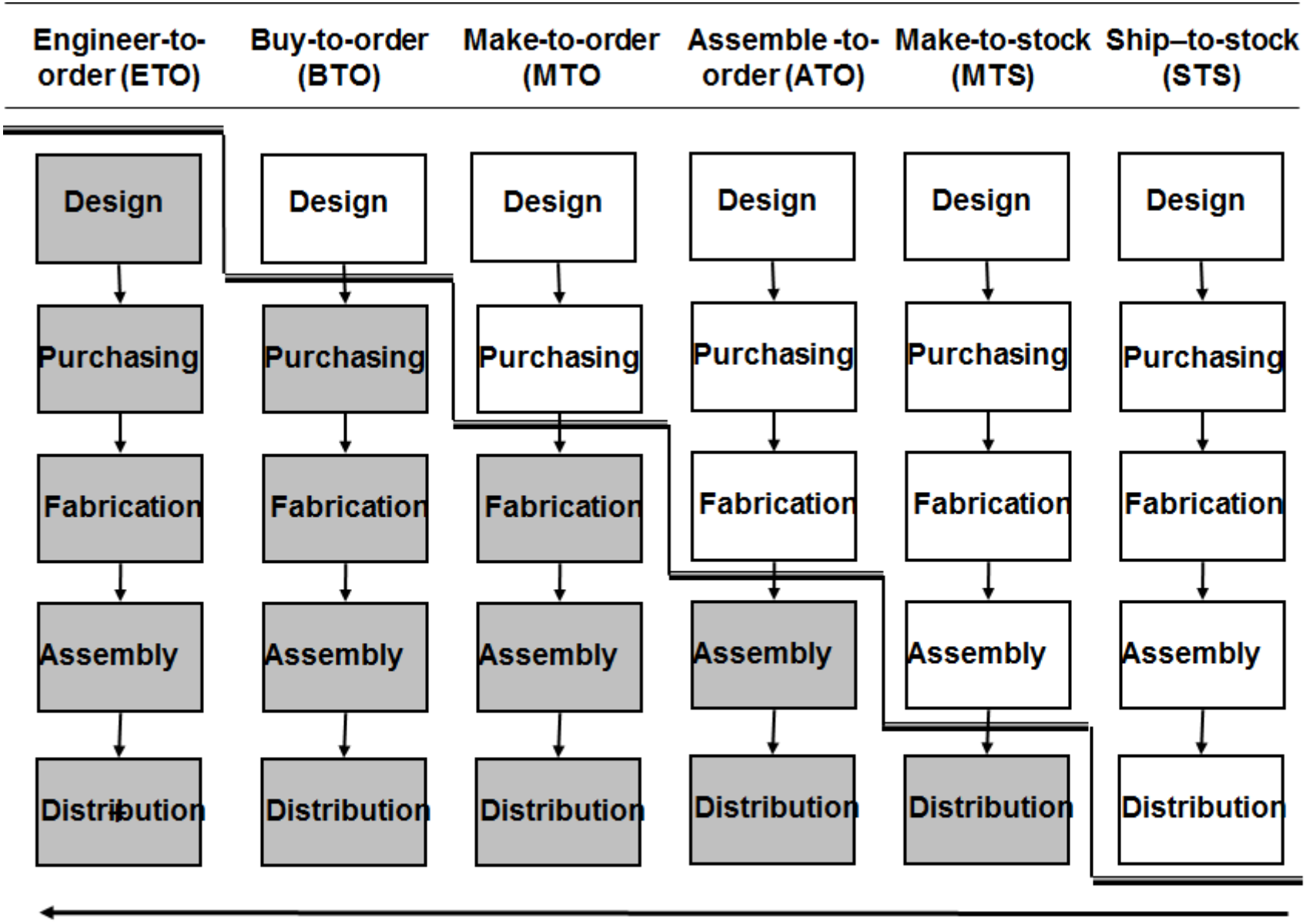
Decoupling Point

- Logic of the Specific

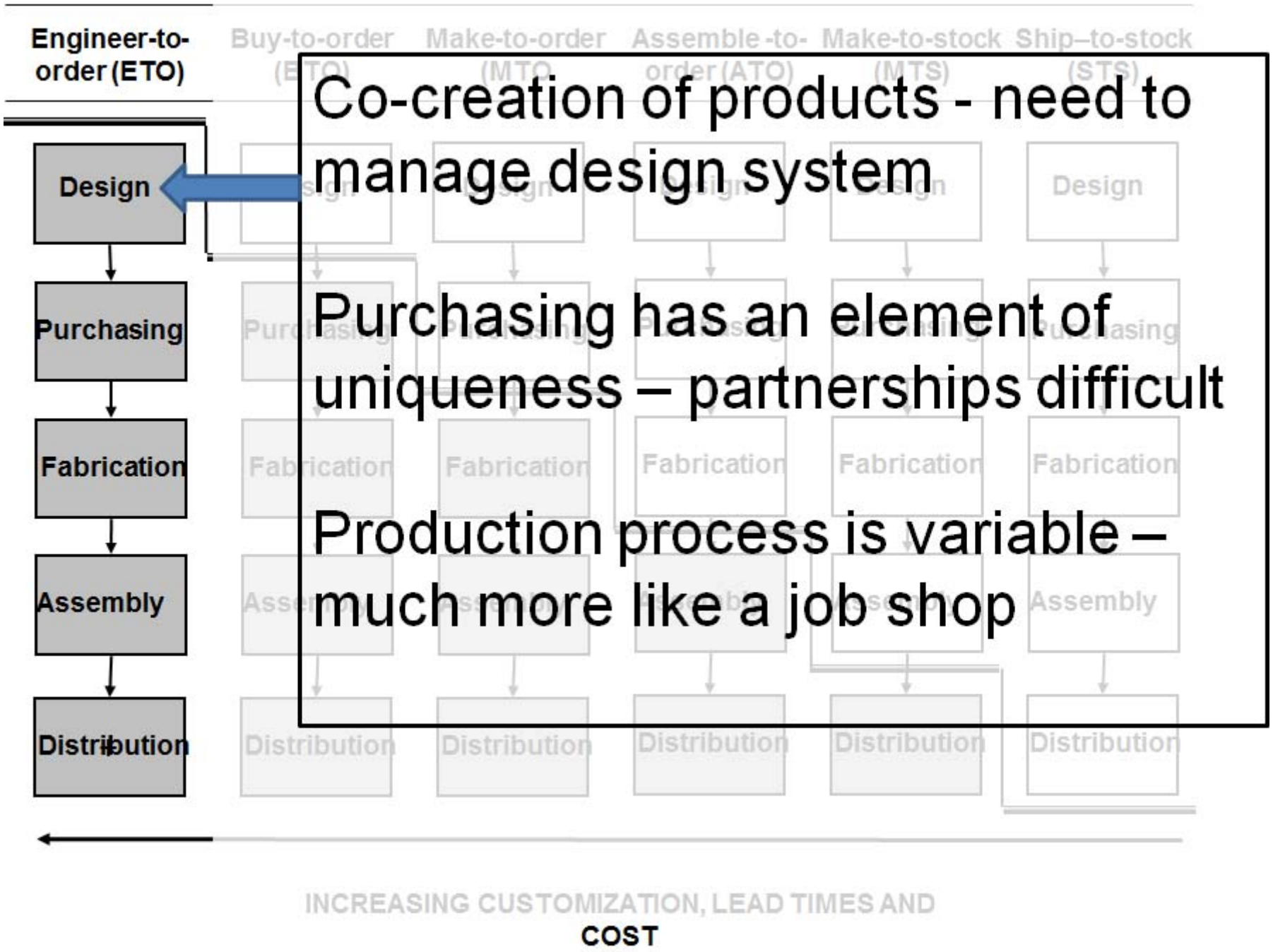
Typically Means

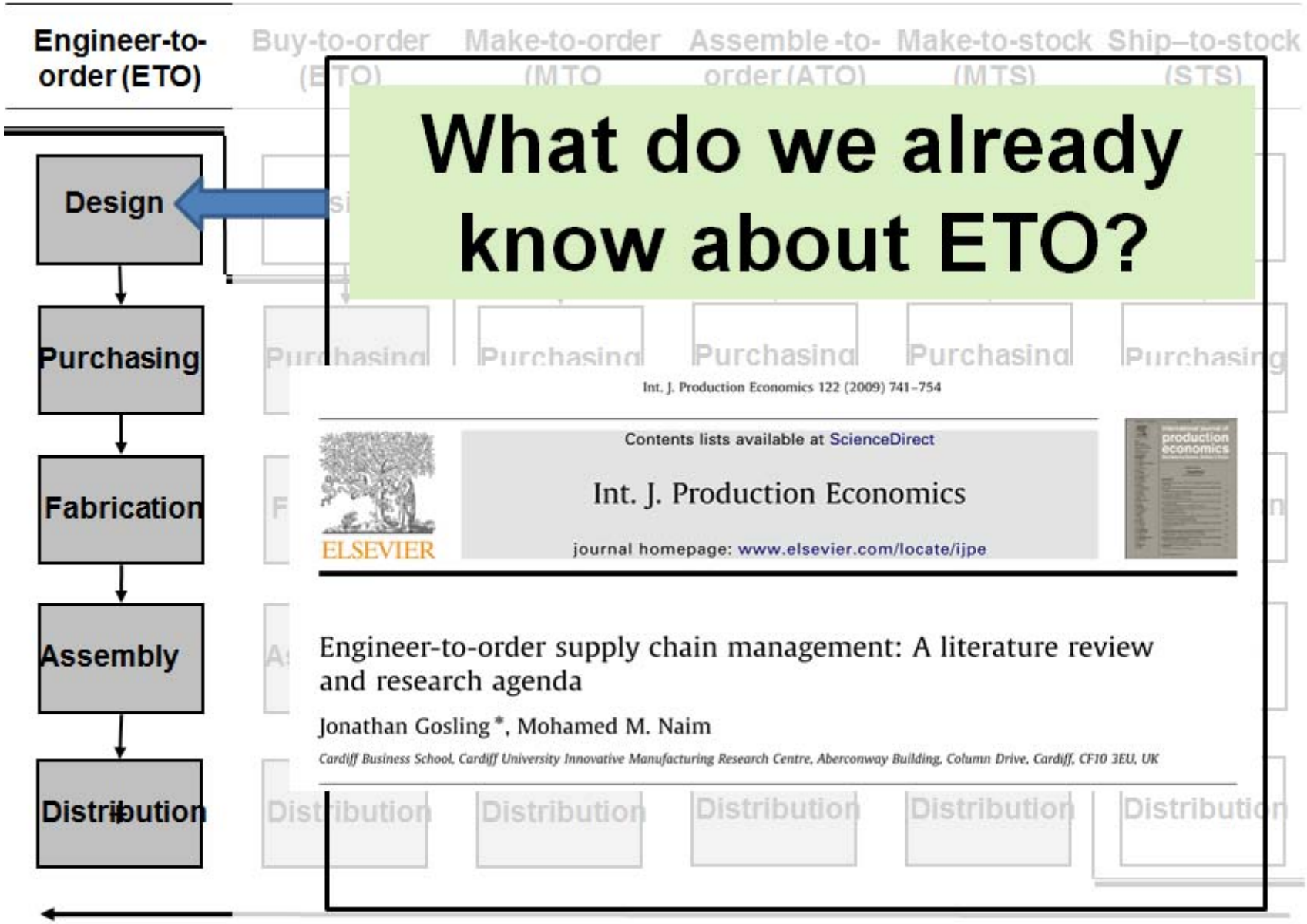
- Variety in Work Processes / Products
- Flexible Resources May Be Required

Adapted from Hoekstra and Romme (1990) and Christophe and Towill (2003) Naylor et al (1999) Lampel and Mintzberg 1(996)

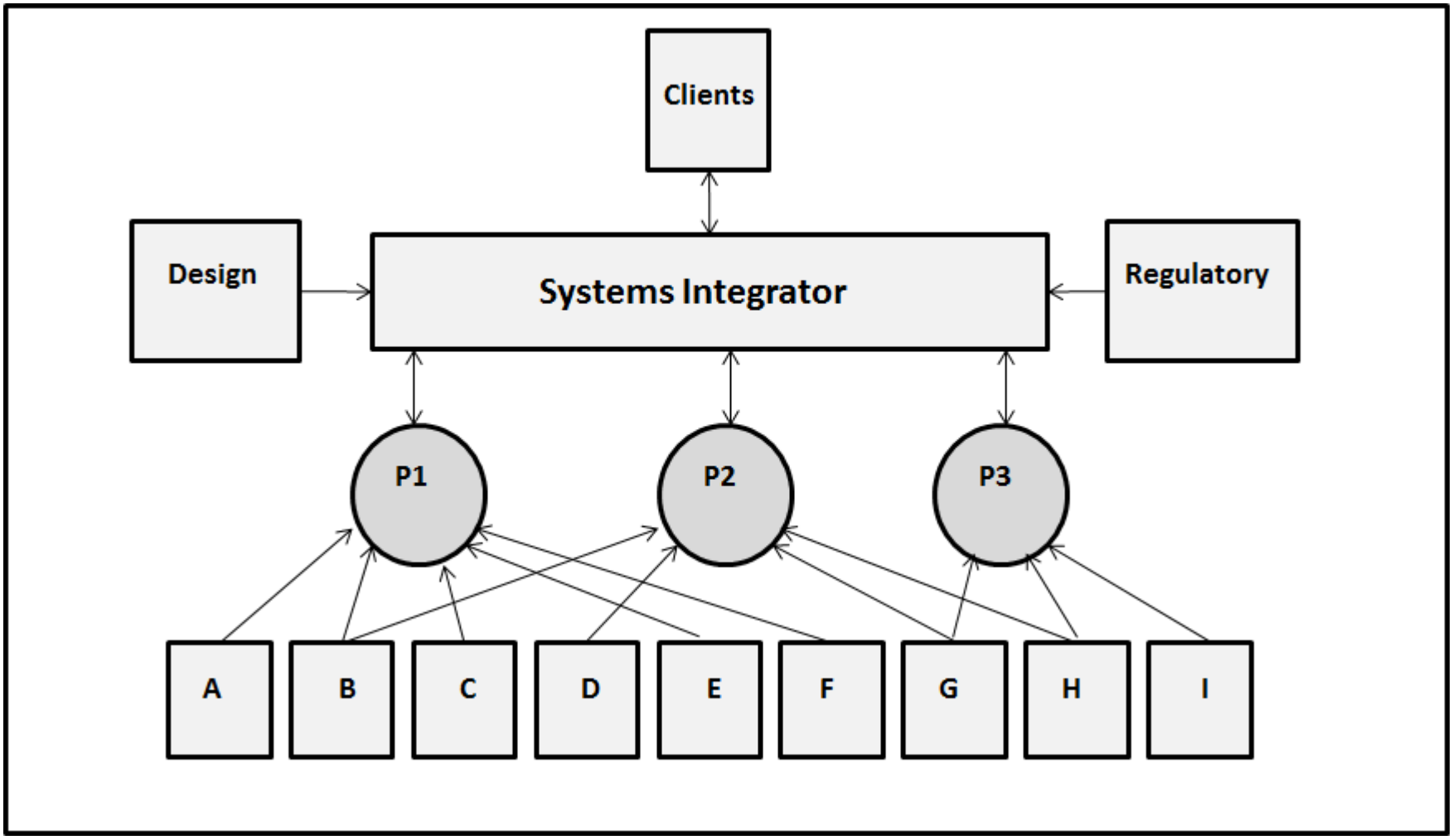


Adapted from Gosling et al (2007); Mintzberg (1996)

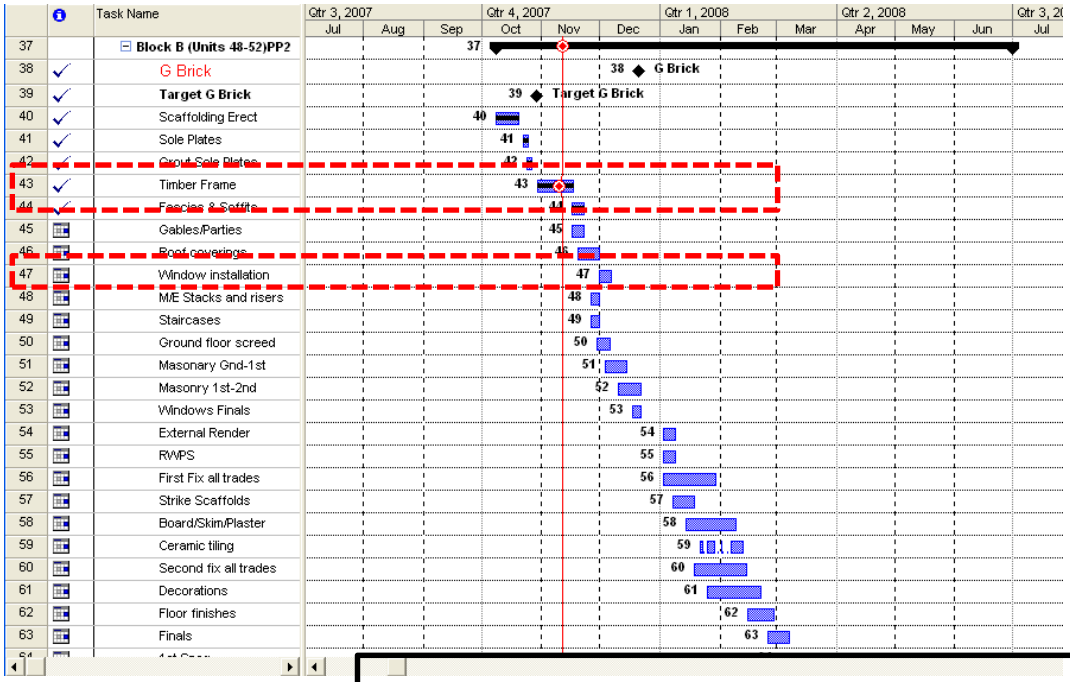

Engineer-to-order (ETO)
Buy-to-order (ETO)
Make-to-order (MTO)
Assemble-to-order (ATO)
Make-to-stock (MTS)
Ship–to-stock (STS)
Design
Purchasing
Fabrication
Assembly
Distribution
Co-creation of products - need to manage design system
Purchasing has an element of uniqueness – partnerships difficult
Production process is variable – much more like a job shop
INCREASING CUSTOMIZATION, LEAD TIMES AND COST

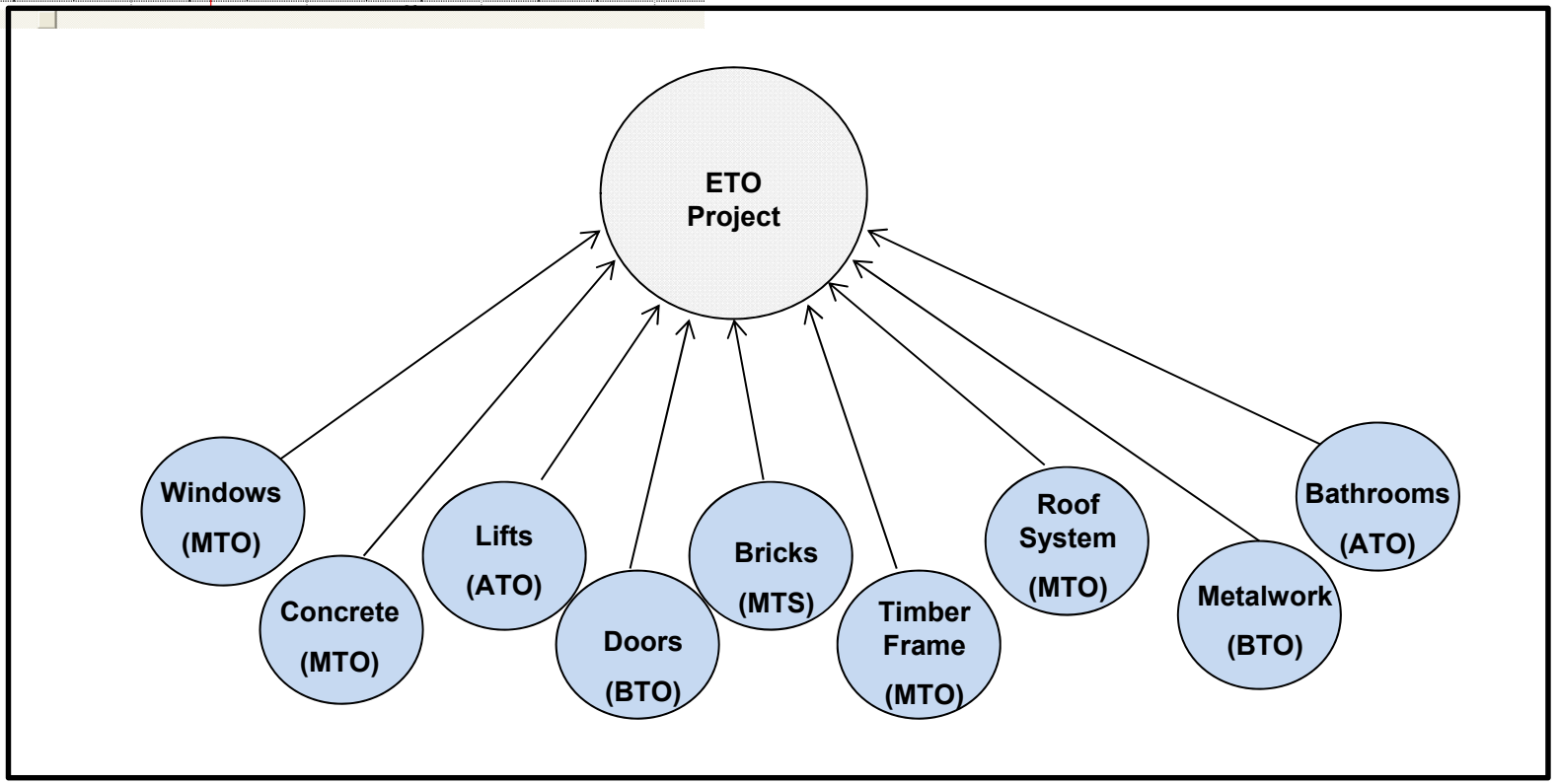

Engineer-to-order (ETO)
Buy-to-order (ETO)
Make-to-order (MTO)
Assemble-to-order (ATO)
Make-to-stock (MTS)
Ship–to-stock (STS)
Design
Purchasing
Fabrication
Assembly
Distribution
What do we already know about ETO?
Int. J. Production Economics 122 (2009) 741–754
Contents lists available at ScienceDirect
Int. J. Production Economics
journal homepage: www.elsevier.com/locate/ijpe
ELSEVIER
Engineer-to-order supply chain management: A literature review and research agenda
Jonathan Gosling *, Mohamed M. Naim
Cardiff Business School, Cardiff University Innovative Manufacturing Research Centre, Aberconway Building, Column Drive, Cardiff, CF10 3EU, UK
INCREASING CUSTOMIZATION, LEAD TIMES AND COST

A system with levels

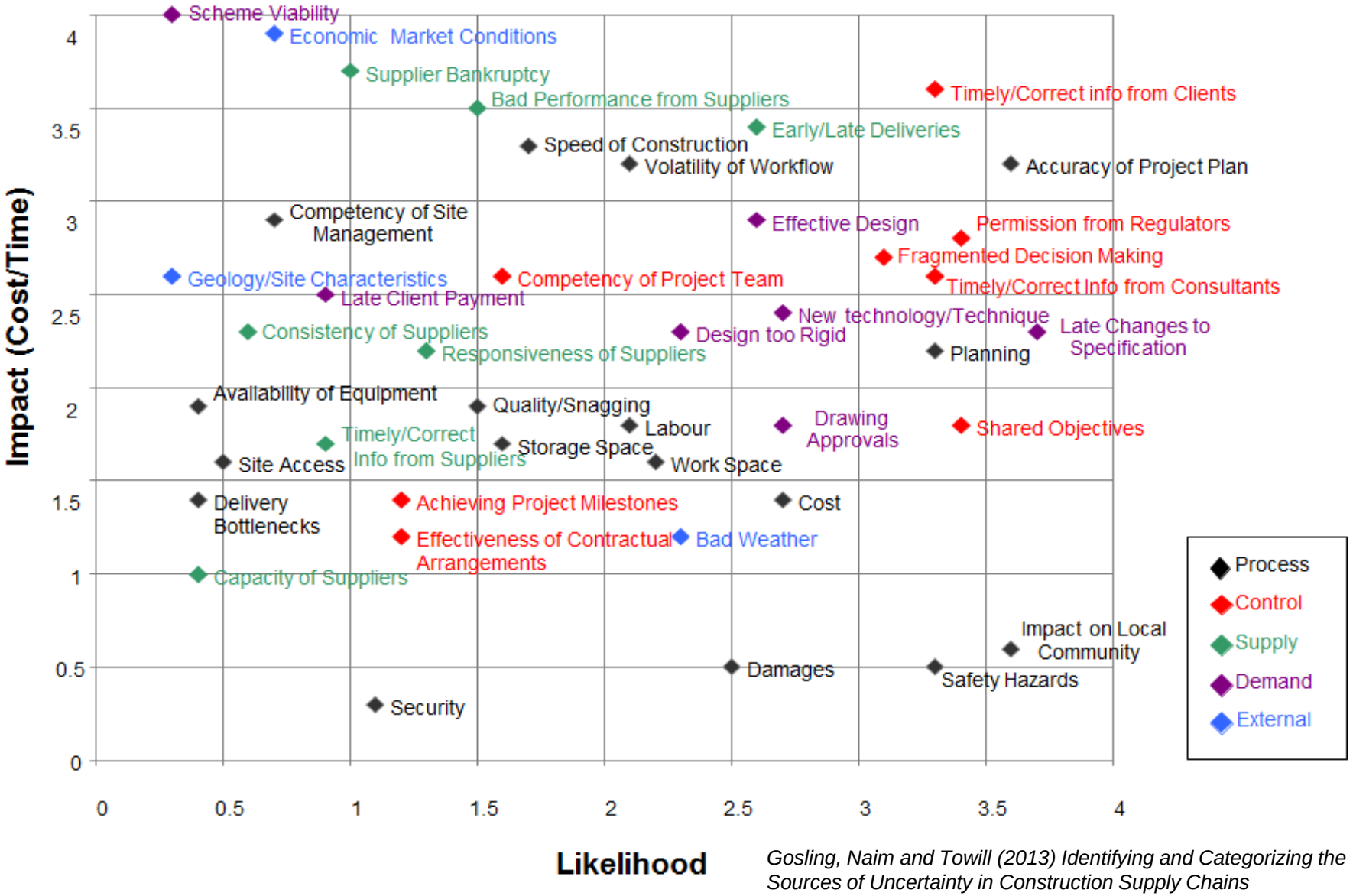


Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector


Task Name
Qtr 3, 2007
Qtr 4, 2007
Qtr 1, 2008
Qtr 2, 2008
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
37 Block B (Units 48-52)PP2
38 G Brick
39 Target G Brick
40 Scaffolding Erect
41 Sole Plates
42 Grout Sole Plates
43 Timber Frame
44 Fascias & Soffits
45 Gables/Parties
46 Roof coverings
47 Window installation
48 M/E Stacks and risers
49 Staircases
50 Ground floor screed
51 Masonary Gnd-1st
52 Masonry 1st-2nd
53 Windows Finals
54 External Render
55 RWPS
56 First Fix all trades
57 Strike Scaffolds
58 Board/Skim/Plaster
59 Ceramic tiling
60 Second fix all trades
61 Decorations
62 Floor finishes
63 Finals

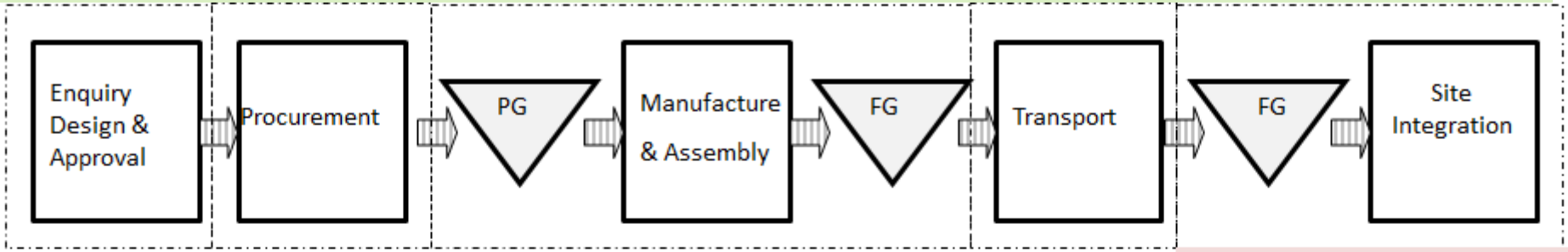

ETO Project
Windows (MTO)
Concrete (MTO)
Lifts (ATO)
Doors (BTO)
Bricks (MTS)
Timber Frame (MTO)
Roof System (MTO)
Metalwork (BTO)
Bathrooms (ATO)

Characterising Uncertainty and Risk from Project Team Perspective?



Gosling, Naim and Towill (2013) Identifying and Categorizing the Sources of Uncertainty in Construction Supply Chains

Typical Problems from a Manufacturer's Perspective?



Incorrect Specification Received

Demand Uncertainty from Project Environment

Labour Shortages

Supply Problems

Unable to Establish Site Readiness

Access Issues

Integration of trades

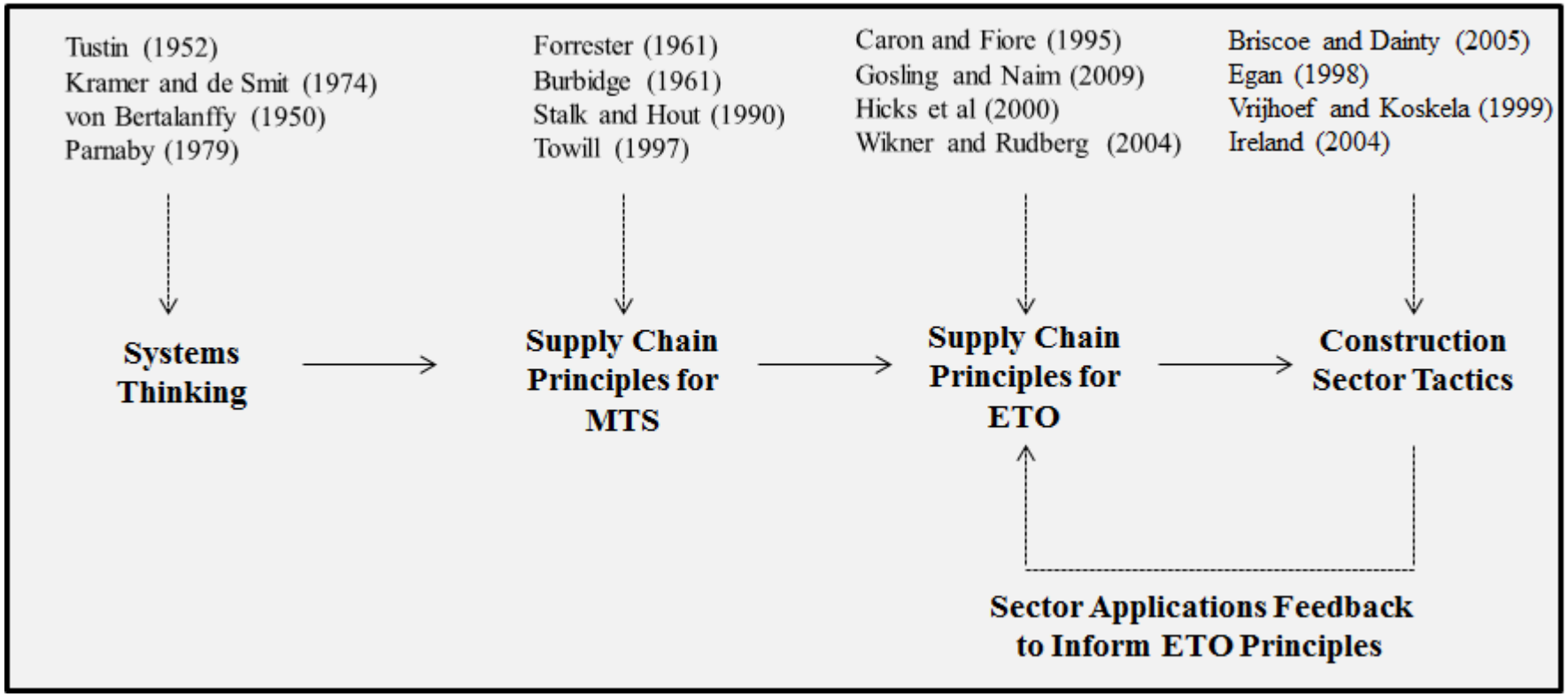
Lack of up to date information

Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector

Are there sufficient similarities across ETO sectors?

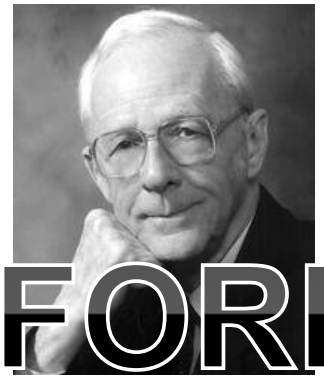
Do you recognize these challenges and problems?

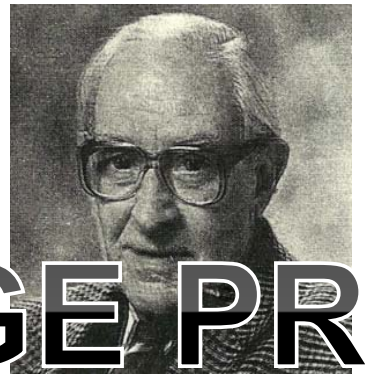
Transfer of Best Practice

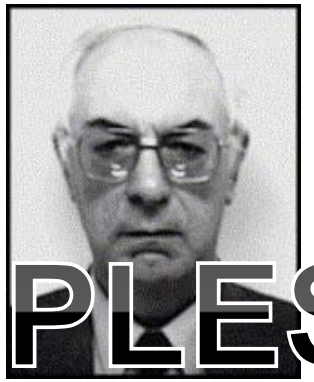


Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector

Adopting, adapting, and implementing improvement initiatives from MTS







FORRIDGE PRINCIPLES

Jay Forrester

Jack Burbidge

Denis Towill

Production Planning & Control, 2014
http://dx.doi.org/10.1080/09537287.2014.880816

Taylor & Francis
Taylor & Francis Group

Principles for the design and operation of engineer-to-order supply chains in the construction sector

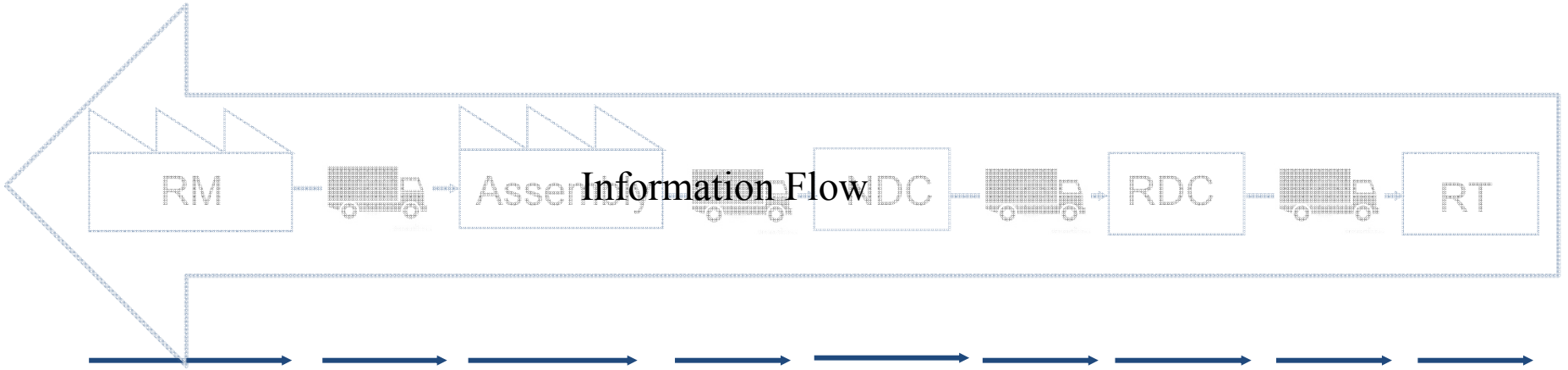
Jonathan Gosling[a]*, Denis R. Towill[a], Mohamed M. Naim[a] and Andrew R. J. Dainty[b]

[a]*Logistics Systems Dynamics Group, Logistics and Operations Management Section, Cardiff University, Aberconway Building, Cardiff, CF10 3EU, UK;* [b]*School of Civil and Building Engineering, Loughborough University, Leicestershire, LE11 3TU, UK*

(*Received 19 March 2012; accepted 14 December 2013*)

How do these Principles apply to ETO?

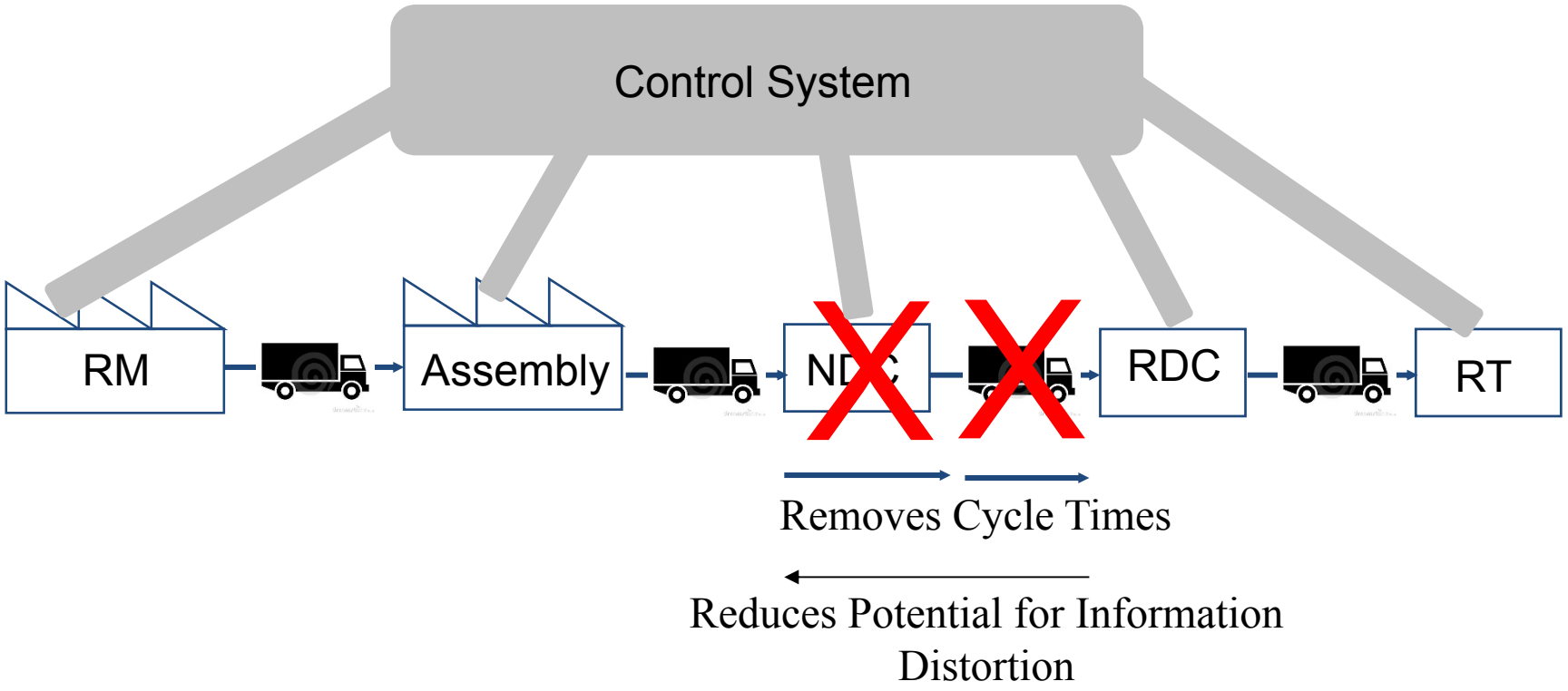
Adapted from Gosling et al 2014



Time Compression Principle

Information Transparency

Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector

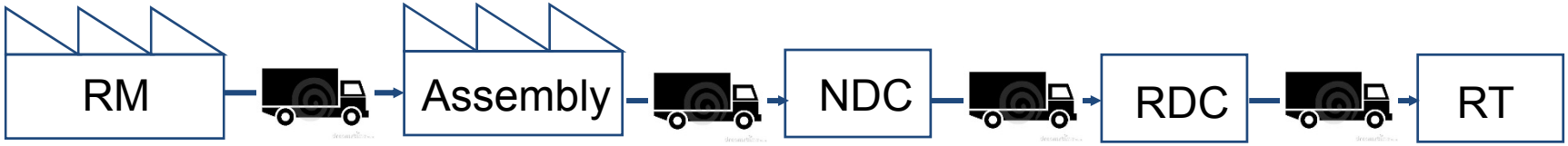


Echelon Elimination Principle

Control System Principle

Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector

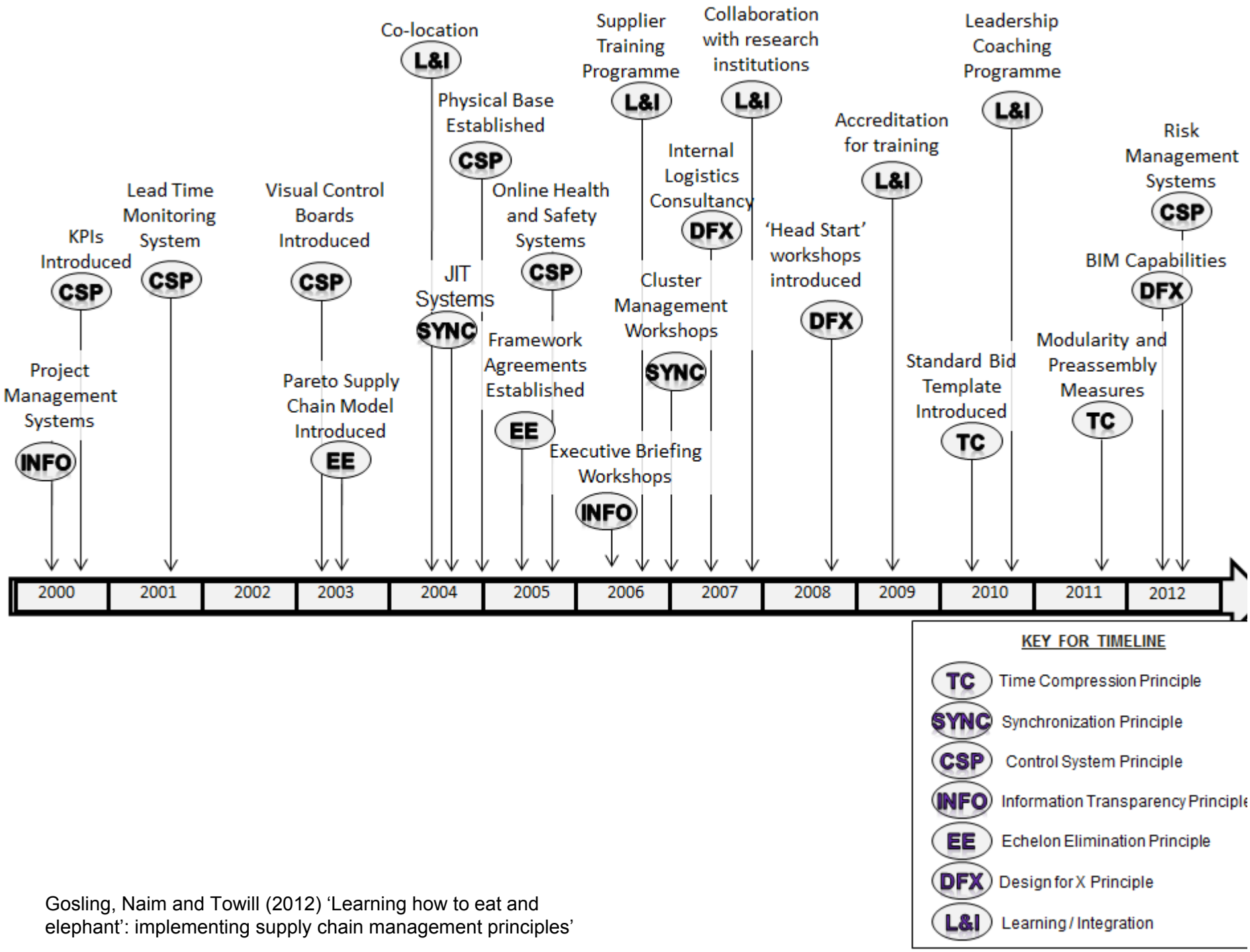
Adapted from Gosling et al 2014



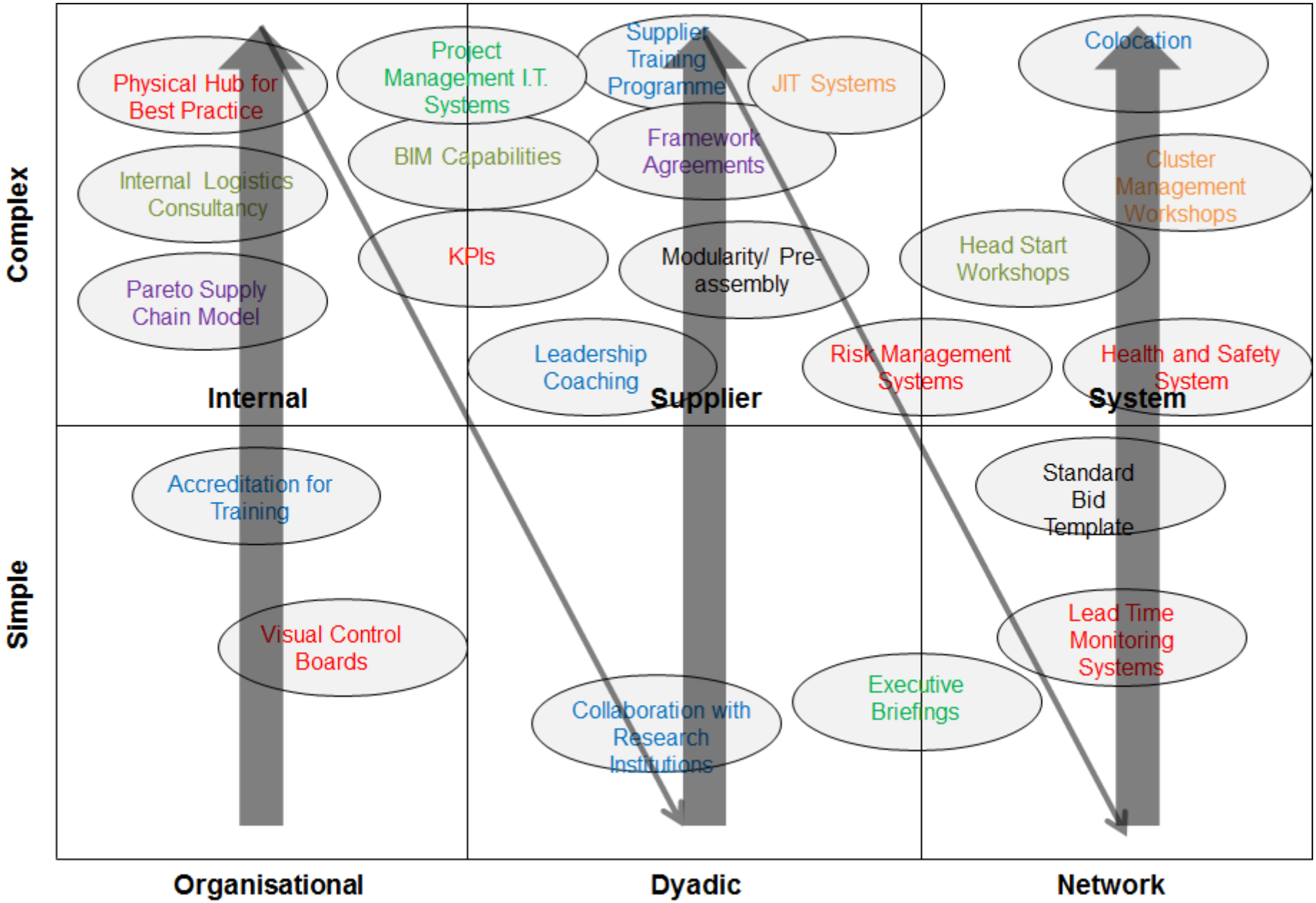
Synchronization Principle

Decisions, information and orders are co-ordinated and related to discrete points in time

Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector



Gosling, Naim and Towill (2012) 'Learning how to eat and elephant': implementing supply chain management principles'



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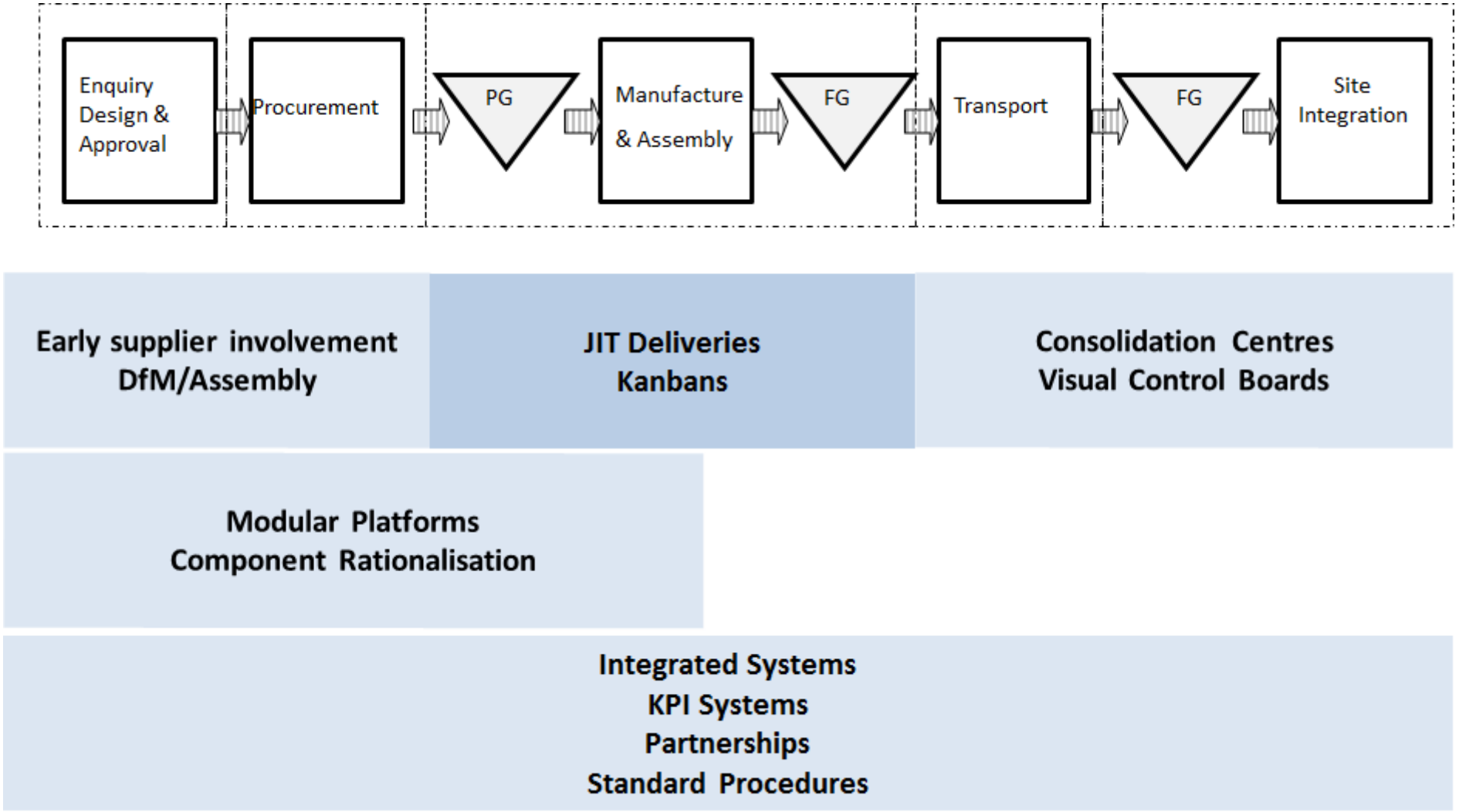

Adapted from Gosling, Towill Naim and Dainty (2014) 'Principles for the design and operation of engineer-to-order supply chains in the construction sector

We concluded that initiatives need appropriate ‘interpretation’ & additional extras.

Closing thoughts

- ETO is an important model – maintain ETO identify while translating best practice initiatives
- Manufacturing as a construction process (?)
  - Shipbuilding, aerospace
- Sustainability and Resilience
- Complex adaptive systems
- Risk and Reward

ETO References Used

- Gosling, Jonathan, and Mohamed M. Naim. "Engineer-to-order supply chain management: A literature review and research agenda." *International Journal of Production Economics* 122.2 (2009): 741-754.
- Gosling, J., L. Purvis, and M. M. Naim. "Supply chain flexibility as a determinant of supplier selection." *International Journal of Production Economics* 128.1 (2010): 11-21.
- Gosling, J., Naim, M. M., Fowler, N., & Fearne, A. (2007, July). MANUFACTURERS'PREPAREDNESS FOR AGILE CONSTRUCTION. In *Agile Manufacturing, 2007. ICAM 2007. IET International Conference on* (pp. 103-110). IET.
- Gosling, J., Naim, M., & Towill, D. (2013). A supply chain flexibility framework for engineer-to-order systems. *Production Planning & Control*, *24*(7), 552-566.
- Gosling, Jonathan, et al. "Principles for the design and operation of engineer-to-order supply chains in the construction sector." *Production Planning & Control* ahead-of-print (2014): 1-16.
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Many thanks for listening