Digital Supply Chain & Logistics Management

Reference books/articles/ podcast/ discussion cases

- Title: Supply chain management: strategy, planning, and operation Author(s): Chopra, Sunil; Meindl, Peter Publisher: Pearson ISBN: 9780133800203
- Title: Logistics 4.0: Digital Transformation of Supply Chain Management Author (s): Turan P; Sadia S; CG Kochan Publisher: CRC Press
- Title: Digital Supply Chains: Key Facilitator to Industry 4.0 and New Business Models; 3rd Edition, *Götz G. Wehberg*
- Digital Supply Chain: Literature review and a proposed framework for future research (https://www.sciencedirect.com/science/article/pii/S0166361517304487)
- The adoption of digital technologies in supply chains: Drivers, process and impact (https://www.sciencedirect.com/science/article/pii/S0040162521002274)
- Podcost: Continuous Improvement For A More Resilient Supply Chain - A Chat With Lytica CTO Ken Bradley
- www.supplychaindigital.com

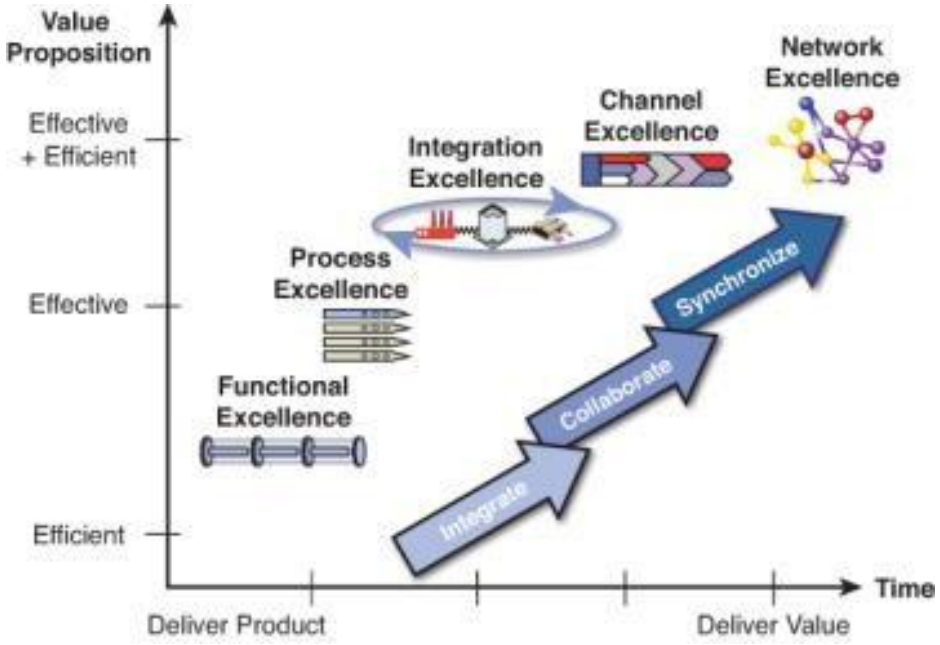
Motivation for studying DSCLM

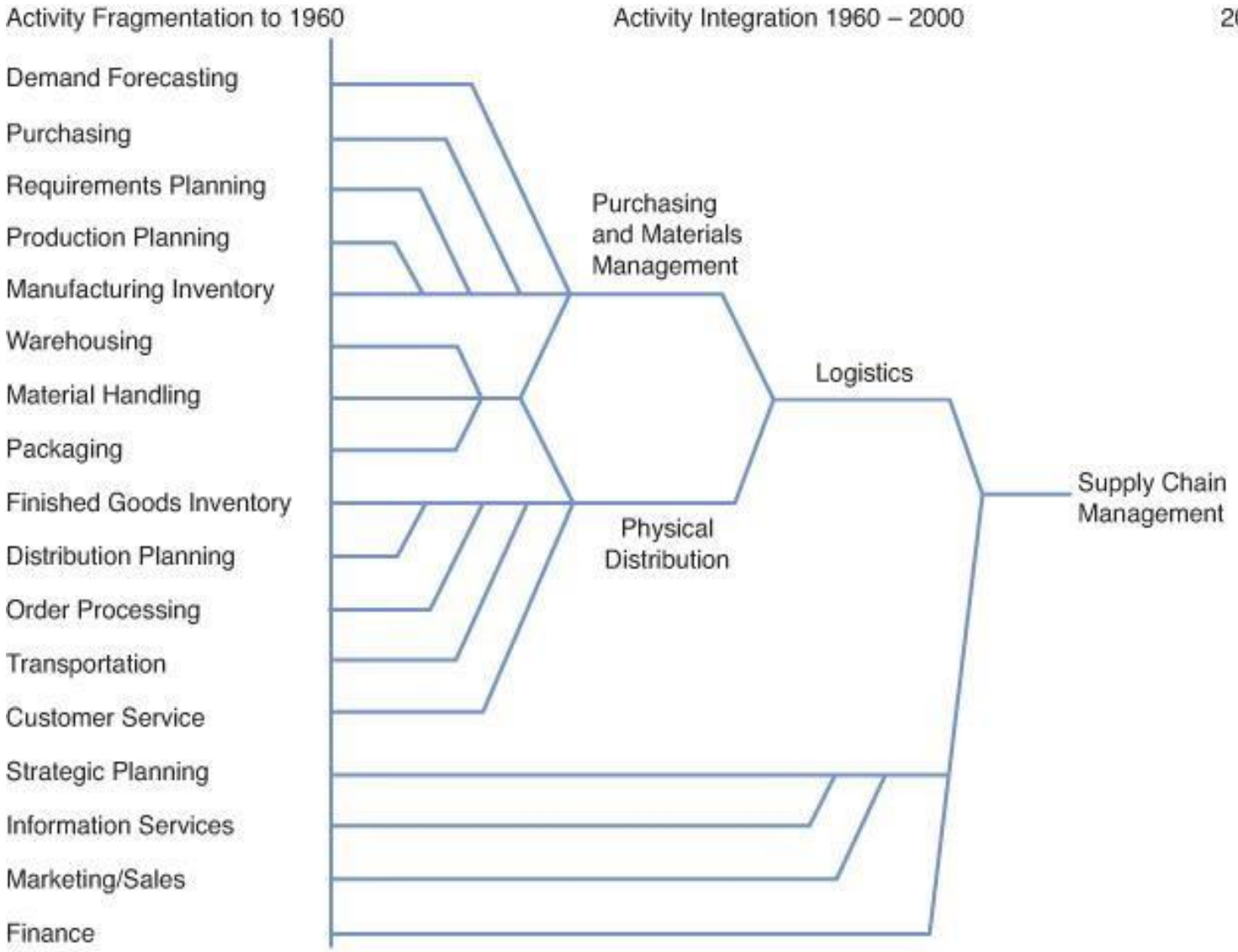
- The world (including global south and global north) megacities are the main facilitators and beneficiaries of a radical shift towards digital applications.
- Global resilience- local adaptation
- Shift from efficiency maximisation to vulnerability mitigation and resilience
- In 2050, the resilient world, with regionlised trade, heavily relies on digital logistics practices.
- Linking CIC (Complexity, information, and coordination)
- Support GPSCN (Global Production and SC Network)
- Supporting GVCR (Global value chain resilience)
- ….
- …..

1. Ready or Not: Managers' and Employees' Different Perceptions of Digital Readiness, https://journals.sagepub.com/doi/10.1177/0008125620977487

2. Strategies for Digitalization in Manufacturing Firms https://journals.sagepub.com/doi/10.1177/0008125620920349

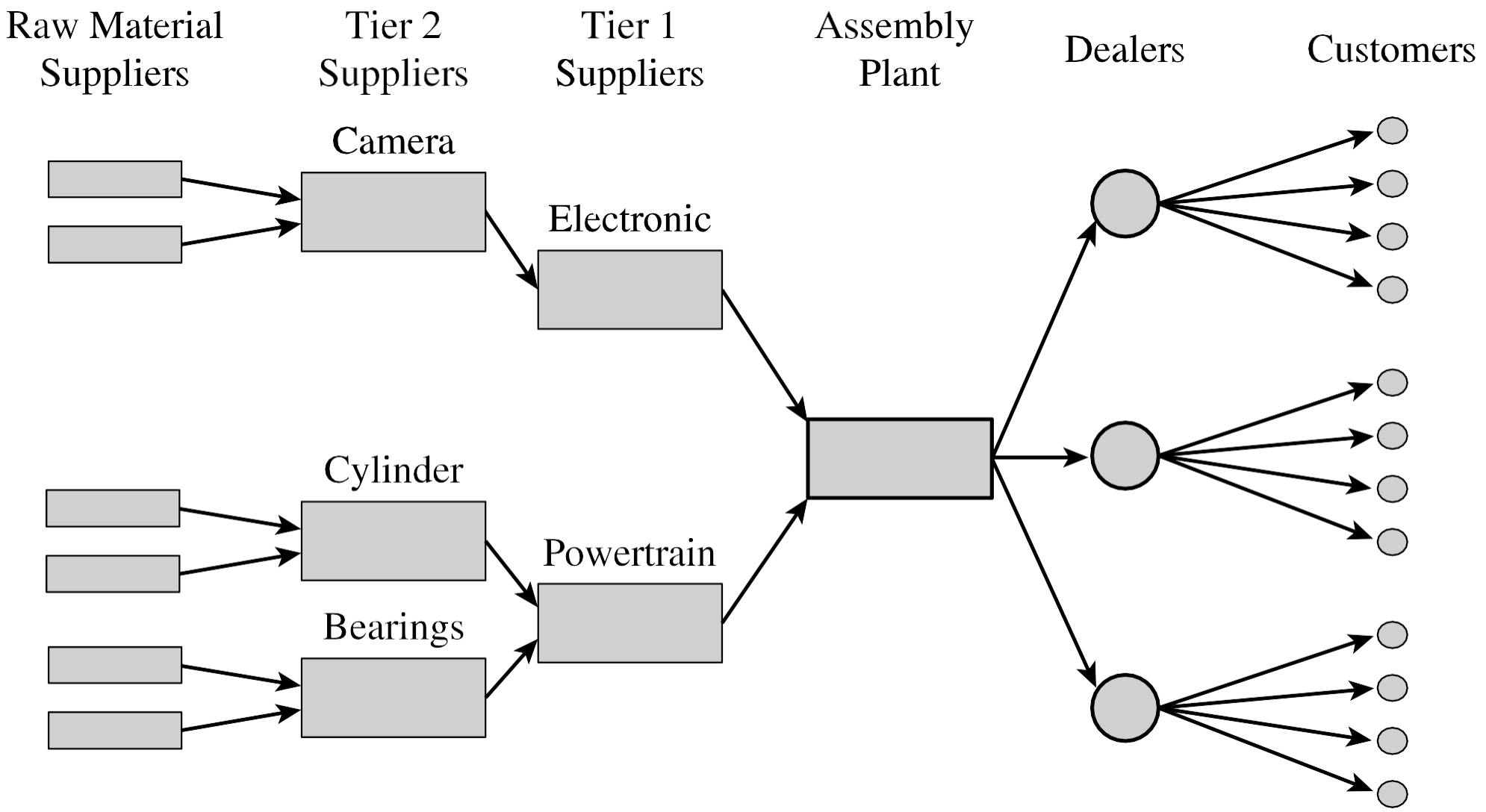
Evolution of SCM





Source: https://www.informit.com/articles/article.aspx?p=2166717&seqNum=5

Supply Chain

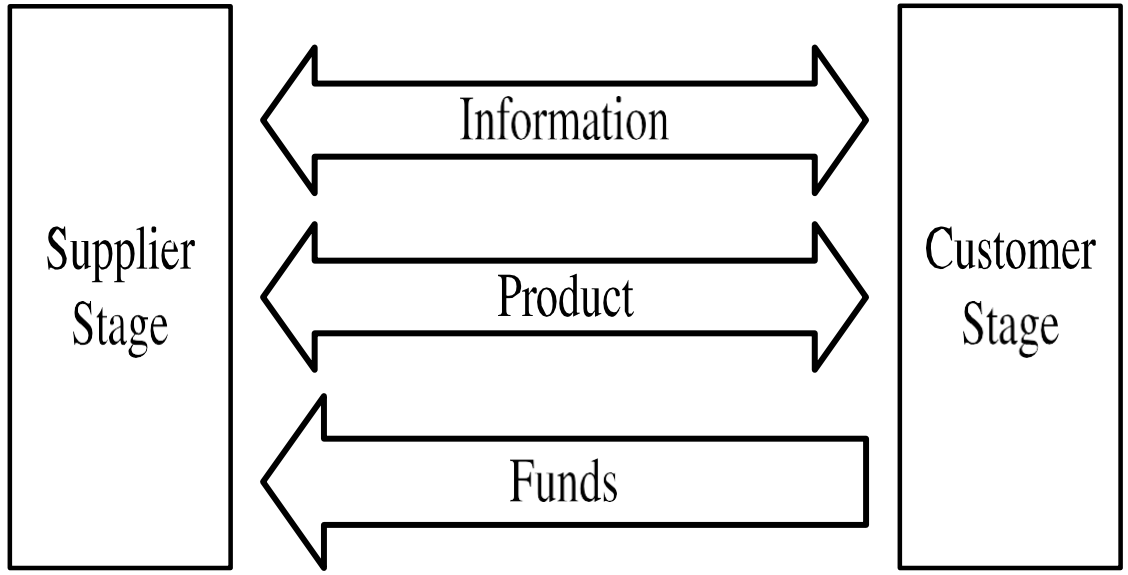


Source: Supply Chain Management by Sunil C. & Peter M.

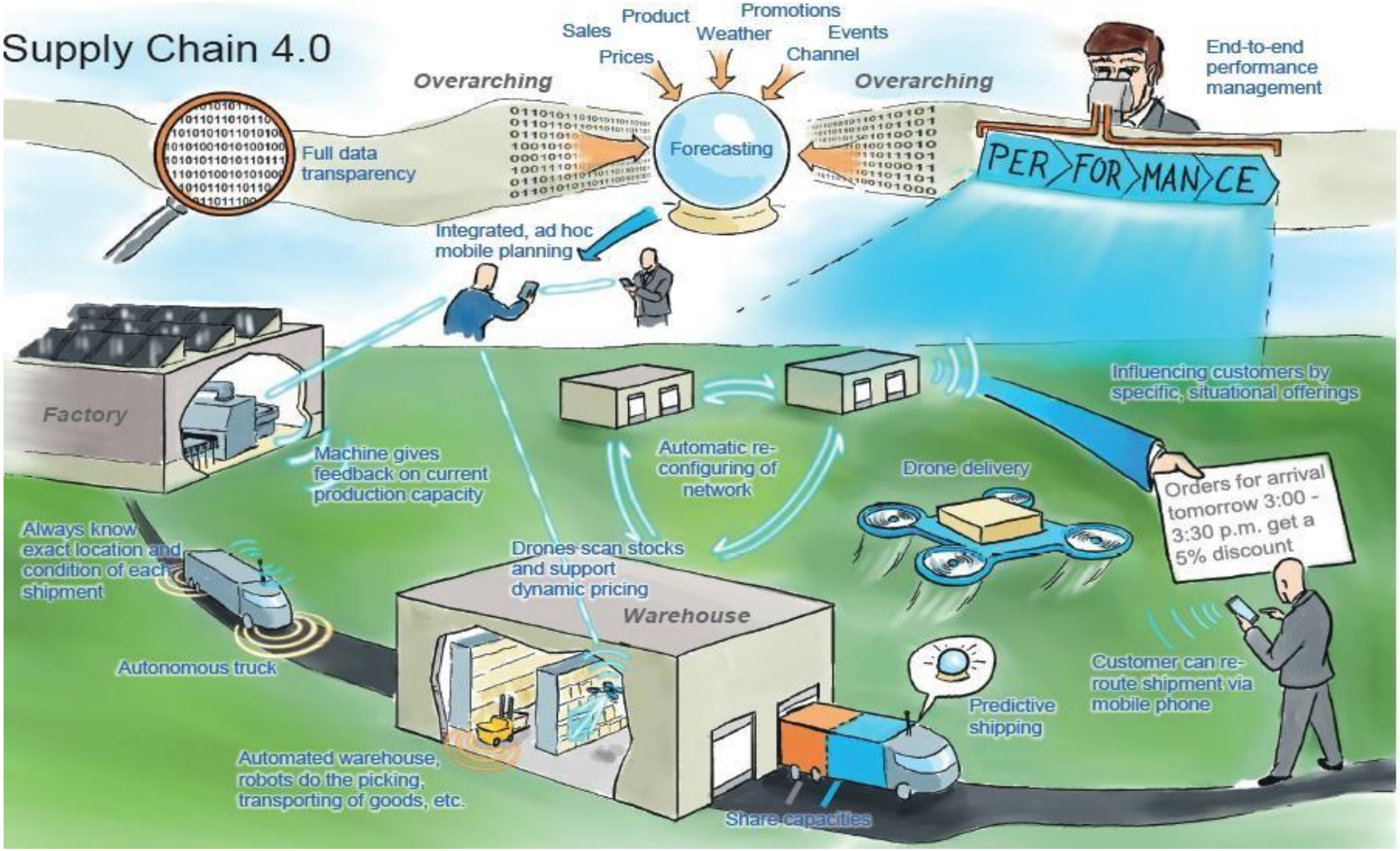
All parties involved, directly or indirectly, in fulfilling a customer request includes manufacturers, suppliers, transporters, warehouses, retailers, and customers.

Maximize net value generated

Supply Chain Surplus = Customer Value − Supply Chain Cost



Digital Supply Chain



Source: https://www.mckinsey.com/business-functions/operations/our-insights/supply-chain-40--the-next-generation-digital-supply-chain

Digital supply chain

- Digitalisation in supply chain has come to encompass digital products and services as well as handling the supply chain processes.
- DSC is a bundle of interconnected activities with novel technologies for flow of goods/services.
- Therefore, DSC is an intelligent, value added, novel process that utilizes new approaches for digital transformation which create competitive value and network effect.

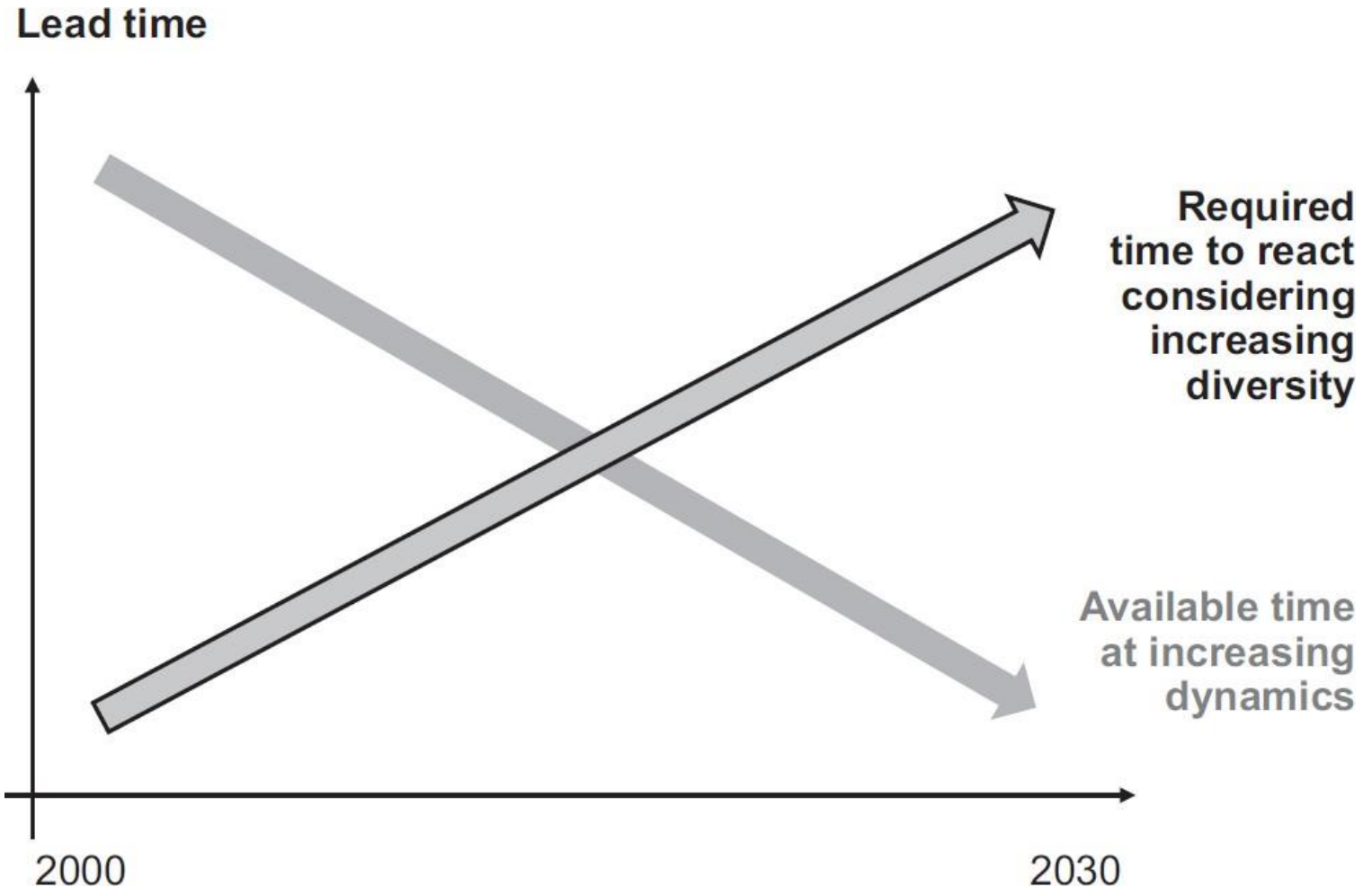
Possible way of digital transformation of SC

- Demand driven supply chain
- Customer expectations
- Value co-creation
- Connecting supply chain activities

DSCLM key points

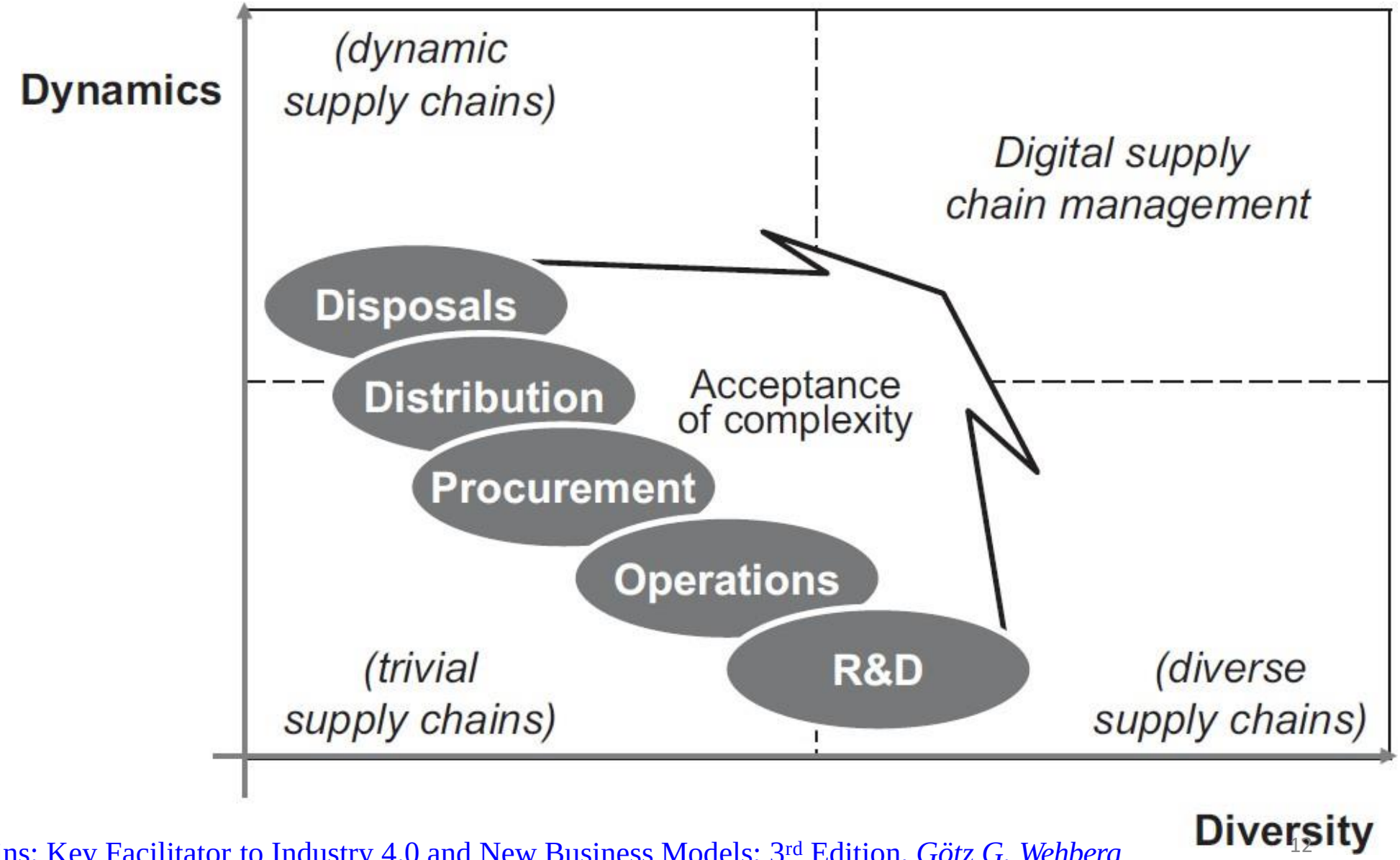
- DSC means innovation
- DSC cope with complexity of the SC
- DSC is more than Cyberphysical system
- DSC need a clear concept
- DSC is not limited to delivery
- DSC must be specific
- DSC are at the beginning

The role of DSC in future SC



Source: Digital Supply Chains: Key Facilitator to Industry 4.0 and New Business Models; 3rd Edition, *Götz G. Wehberg*

Supply chain integration for DSC

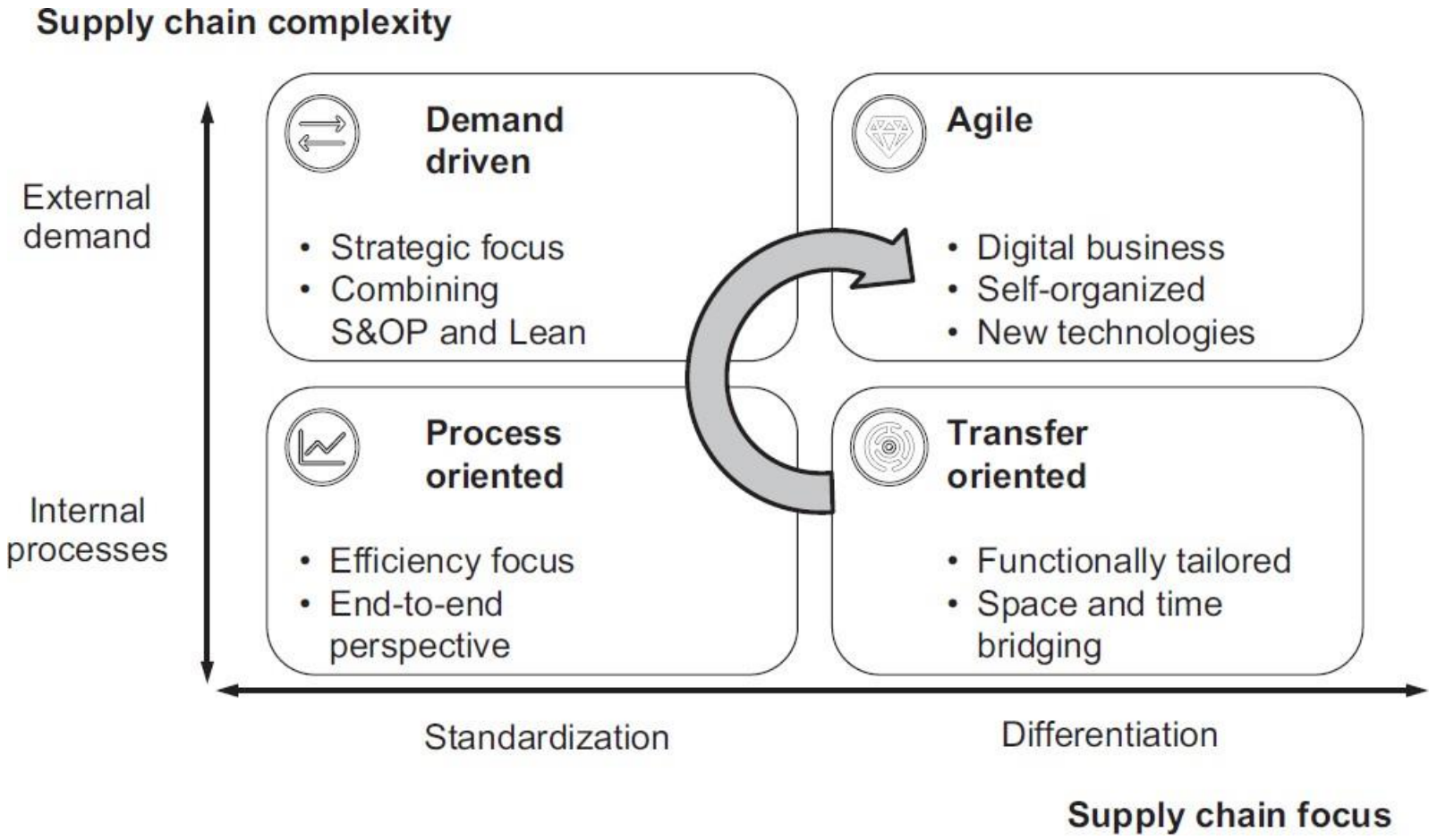


Source: Digital Supply Chains: Key Facilitator to Industry 4.0 and New Business Models; 3rd Edition, *Götz G. Wehberg*

Complexity, Information, and Coordination matrix

DSC would support

- Individualization of customer wishes.
- Flexibility of supply.
- Improved resource efficiency.



Source: Digital Supply Chains: Key Facilitator to Industry 4.0 and New Business Models; 3rd Edition, *Götz G. Wehberg*

Digital supply Chain benefits

- The digitalization of supply chain enables organizations to address the new requirements of the customers, supply challenges, and improvising the responsiveness/efficiency of the supply chain.
- Faster: (Amazon's predictive shipping)-Anticipatory shipping
- More flexible (adhoc and real-time planning allows a flexible reaction to changing demand/supply situation).
- Support to new business models like Supply Chain as a Service (SCaaS)—Uberization of transport
- More granular: The demand of customers for more and more individualised products is increasing day-by-day. (Drone delivery)
- More accurate
- More efficient
- Data capturing and management
- Integrated process optimisation

DSC application area

- Planning
- Physical flow
- Supply chain performance
- Customer order management
- Collaboration
- SC strategy

Finally supporting to *4V* of the production/supply system

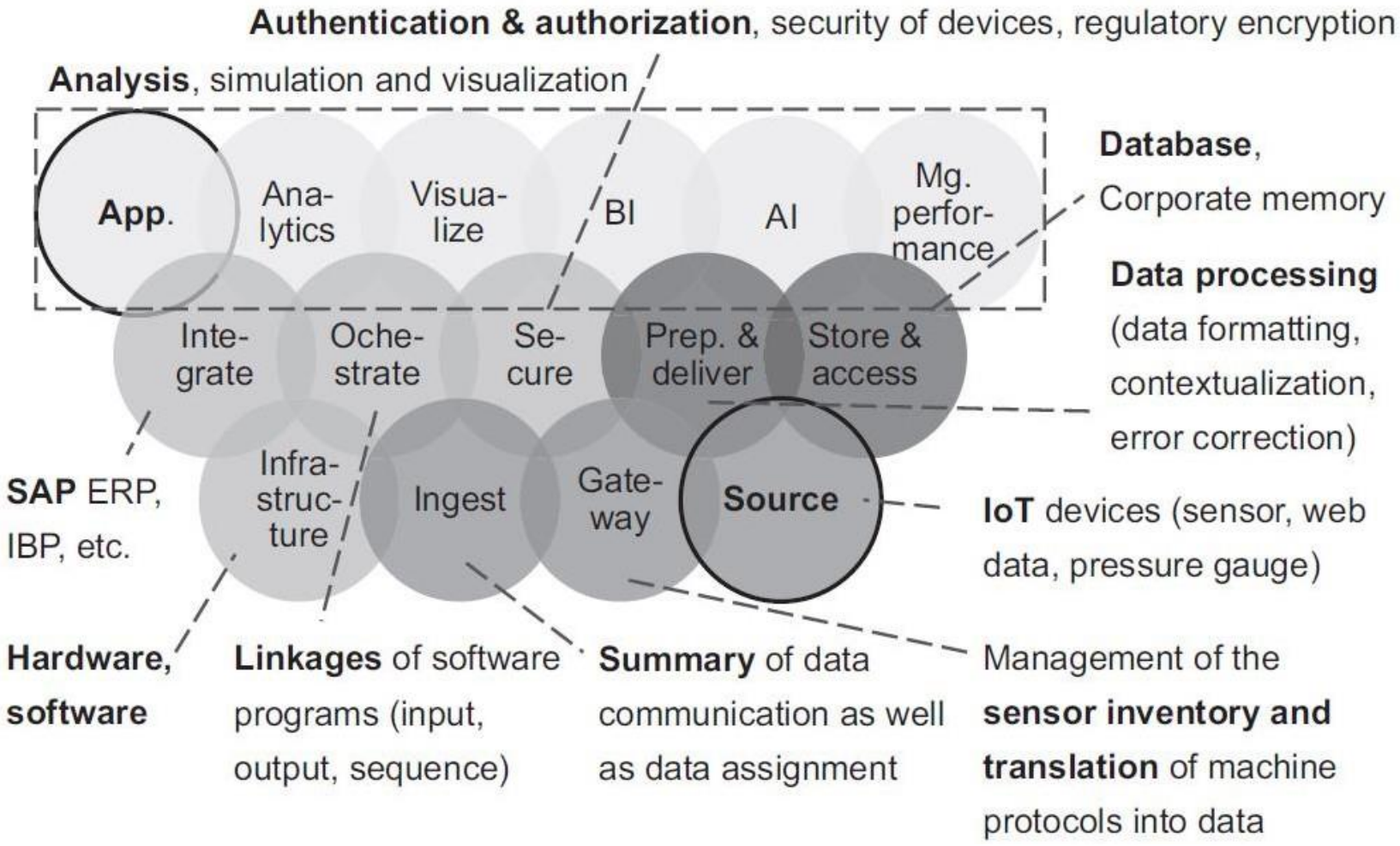
V1: Value

V2: Variety

V3: Volume

V4: Variability

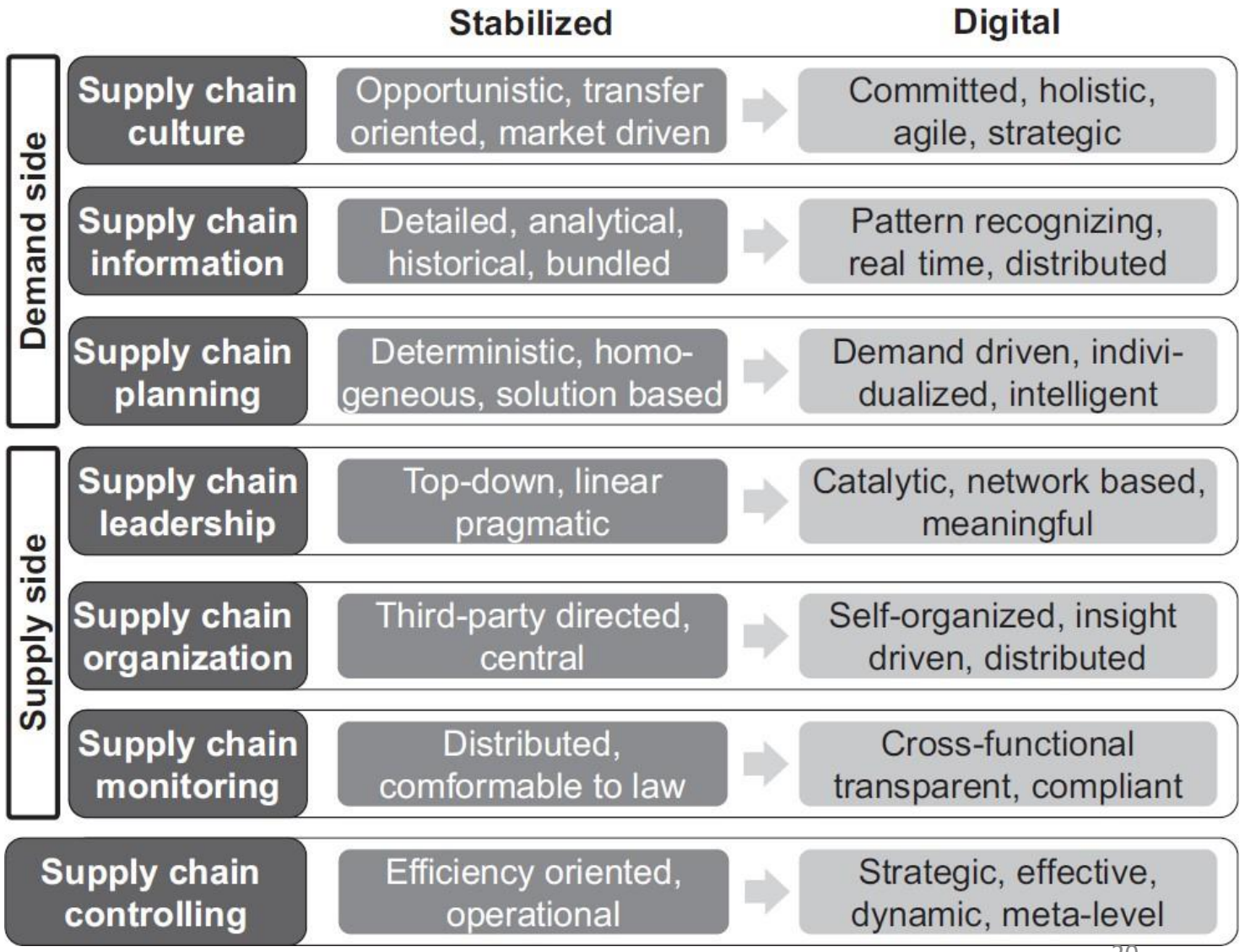
Reference architecture for digital supply chains



Source: Digital Supply Chains: Key Facilitator to Industry 4.0 and New Business Models; 3rd Edition, *Götz G. Wehberg*

Characteristics of DSCM

What about *supply chain design* in terms of complexity versus stability?



Source: Digital Supply Chains: Key Facilitator to Industry 4.0 and New Business Models; 3rd Edition, *Götz G. Wehberg*

WHAT MAKES A SUPPLY CHAIN "DIGITAL"?

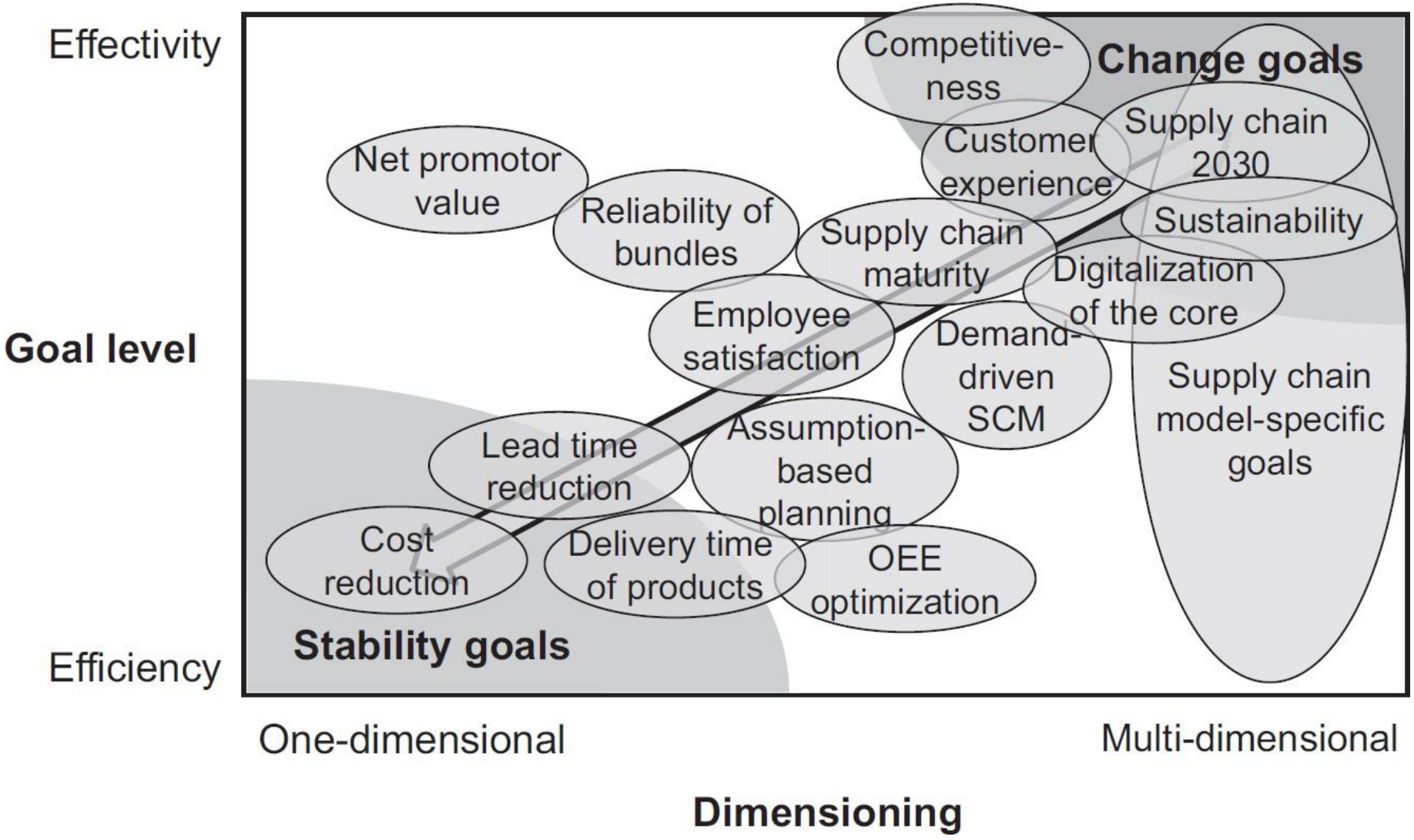
Three trends are fueling digital supply chain transformations:

- First is an abundance of data, generated by traditional transaction-based systems (e.g. POS, RFID, ERP).

- Second, enormous advances in data storage, computing power, and intelligent algorithms are enabling faster and more comprehensive processing of data.

- Third, improvements in sensors and servomechanisms, and in the programming of these devices, are enabling greater levels of process automation.

Change profile of supply chain target



Decision Phases in a Supply Chain

1. Supply chain strategy or design
   - How to structure the supply chain over the next several years?
2. Supply chain planning
   - Decisions over the next quarter or year
3. Supply chain operation
   - Daily or weekly operational decisions

Process Views of a Supply Chain

1. **Cycle View:** The processes in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of the supply chain.
2. **Push/Pull View:** The processes in a supply chain are divided into two categories, depending on whether they are executed in response to a customer order or in anticipation of customer orders.

Pull processes are initiated by a customer order, whereas

Push processes are initiated and performed in anticipation of customer orders.

Cycle View of Supply Chain Processes

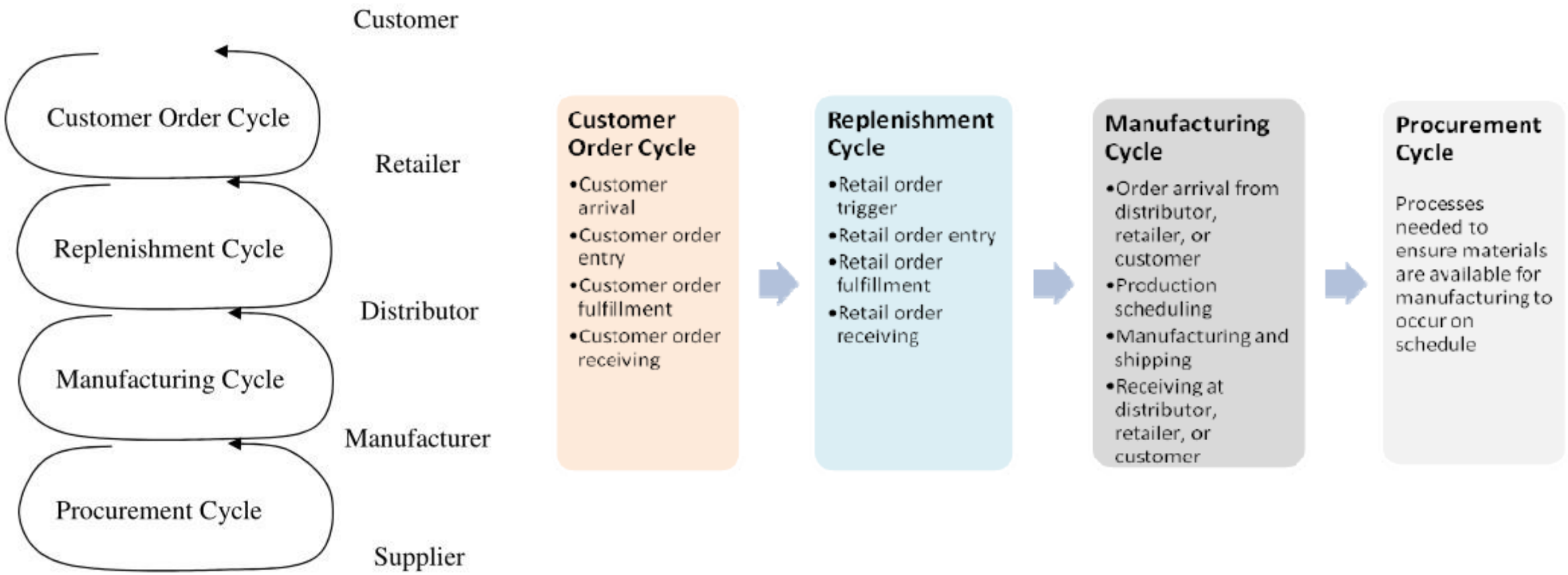


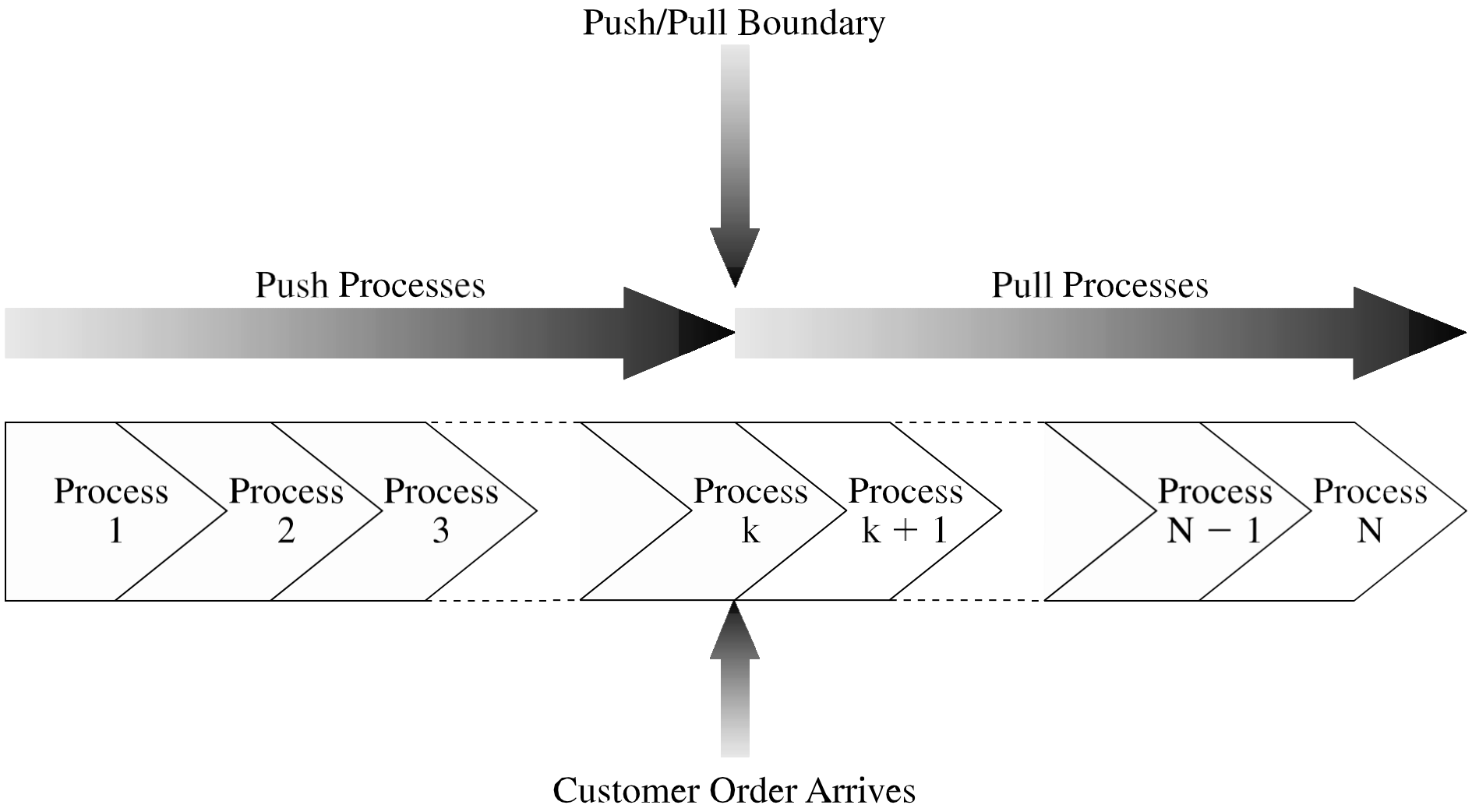
Figure Supply Chain Process Cycles

Source: Supply Chain Management by Sunil C. & Peter M.

Push/Pull View of Supply Chain Processes

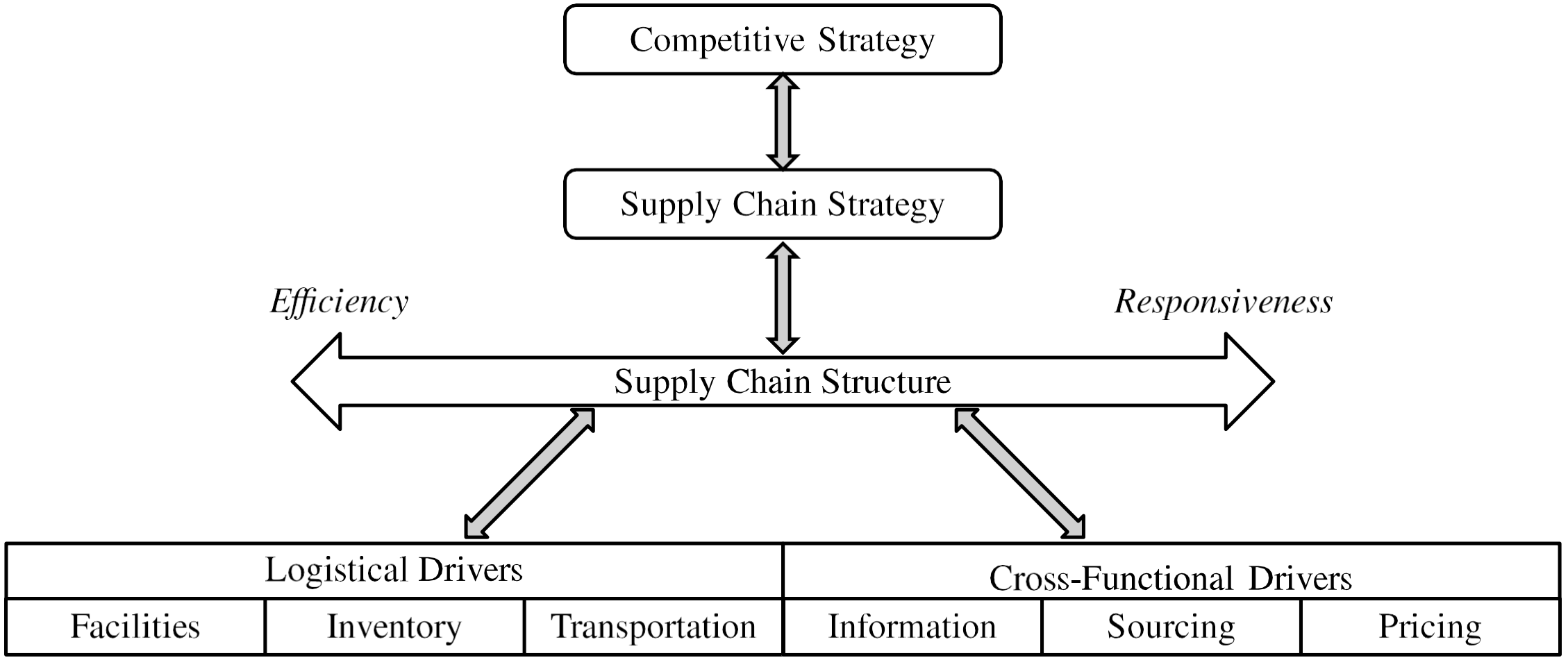
- Supply chain processes fall into one of two categories depending on the timing of their execution relative to customer demand
- Pull: execution is initiated in response to a customer order (**reactive**)
- Push: execution is initiated in anticipation of customer orders (**speculative**)
- **Push/pull boundary** separates push processes from pull processes

Push/Pull View of Supply Chains



Source: Supply Chain Management by Sunil C. & Peter M.

Framework for Supply Chain Decisions



Source: Supply Chain Management by Sunil C. & Peter M.

Framework for Supply Chain Decisions

- Logistical Drivers
  - Facilities
  - Inventory
  - Transportation
- Cross-Functional Drivers
  - Information
  - Sourcing
  - Pricing
- Interactions determine overall supply chain performance

Competitive and Supply Chain Strategies

- **Competitive strategy** defines the set of customer needs a company seeks to satisfy through its products and services.
- **Product development** strategy specifies the portfolio of new products that the company will try to develop.
- **Marketing and sales** strategy specifies how the market will be segmented and product positioned, priced, and promoted.
- **Supply chain** strategy determines the nature of material procurement, transportation of materials, manufacture of product or creation of service, distribution of product, follow-up service, whether processes will be in-house or outsourced.
- All functional strategies must support one another and the competitive strategy.

Achieving Strategic Fit

- **Strategic fit** – competitive and supply chain strategies have aligned goals

- A company may fail because of a lack of strategic fit or because its overall supply chain design, processes, and resources do not provide the capabilities to support the desired strategy.

https://www.livemint.com/news/india/modi-positions-india-as-alternative-to-china-in-global-supply-chain-11599150792839.html

Achieving Strategic Fit

1. The competitive strategy and all functional strategies must fit together to form a coordinated overall strategy. Each functional strategy must support other functional strategies and help a firm reach its competitive strategy goal.
2. The different functions in a company must appropriately structure their processes and resources to be able to execute these strategies successfully.
3. The design of the overall supply chain and the role of each stage must be aligned to support the supply chain strategy.

How Is Strategic Fit Achieved?

1. Understanding the customer and supply chain uncertainty
2. Understanding the supply chain capabilities
3. Achieving strategic fit

Step 1: Understanding the Customer and Supply Chain Uncertainty

- Quantity of product needed in each lot
- Response time customers are willing to tolerate
- Variety of products needed
- Service level required
- Price of the product
- Desired rate of innovation in the product

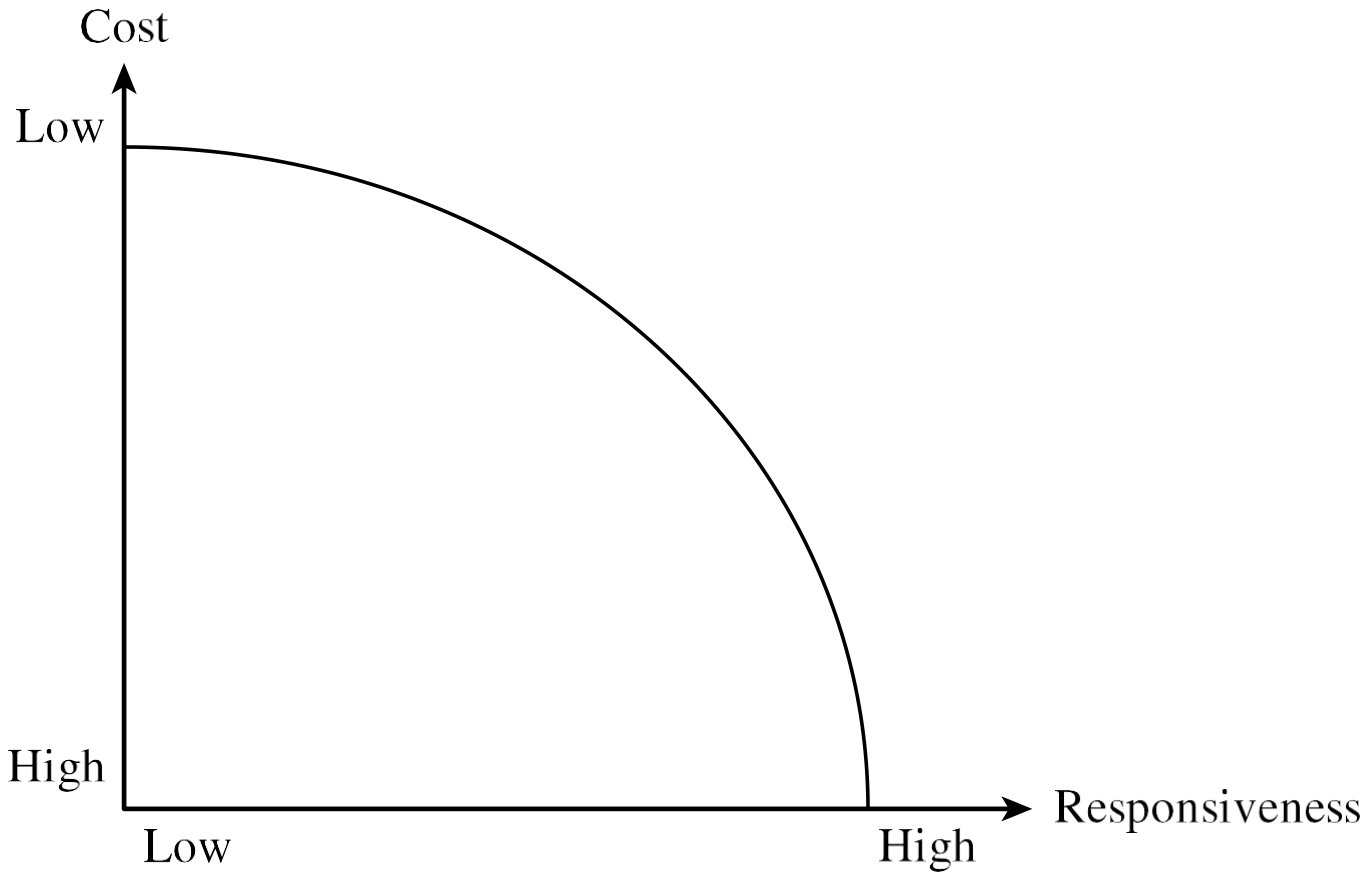
Step 2: Understanding Supply Chain Capabilities

- How does the firm best meet demand?
- Supply chain responsiveness is the ability to
  - Respond to wide ranges of quantities demanded
  - Meet short lead times
  - Handle a large variety of products
  - Build highly innovative products
  - Meet a high service level
  - Handle supply uncertainty

Step 2: Understanding Supply Chain Capabilities

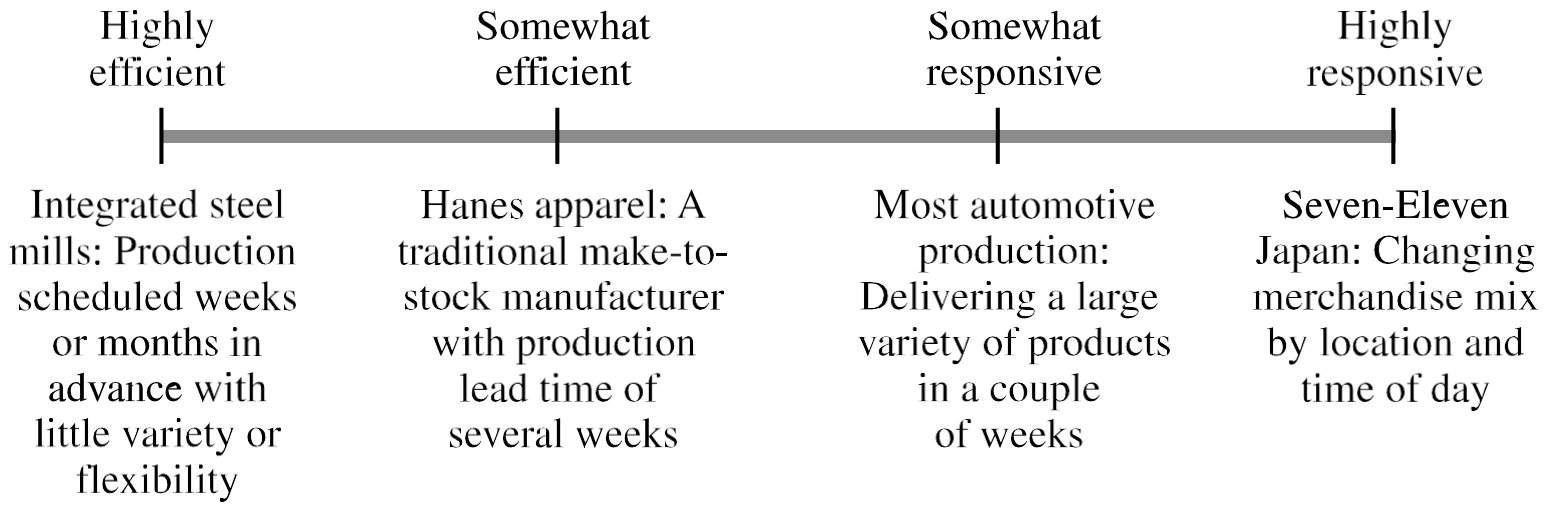
- Responsiveness comes at a cost
- **Supply chain efficiency** is the inverse to the cost of making and delivering the product to the customer
- The **cost-responsiveness efficient frontier** curve shows the lowest possible cost for a given level of responsiveness

Cost-Responsiveness Efficient Frontier



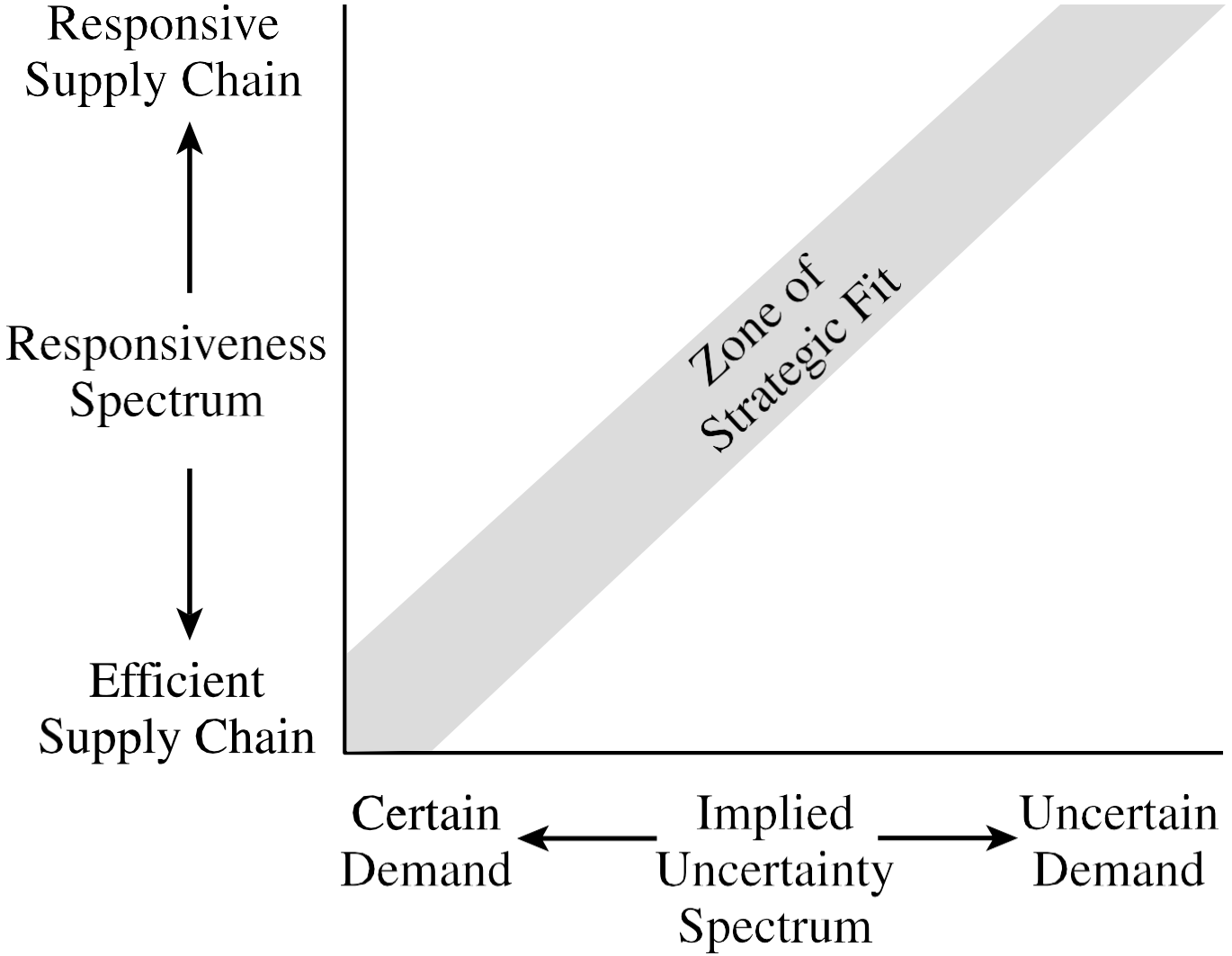
Cost-Responsiveness Efficient Frontier

Responsiveness Spectrum



The Responsiveness Spectrum

Zone of Strategic Fit



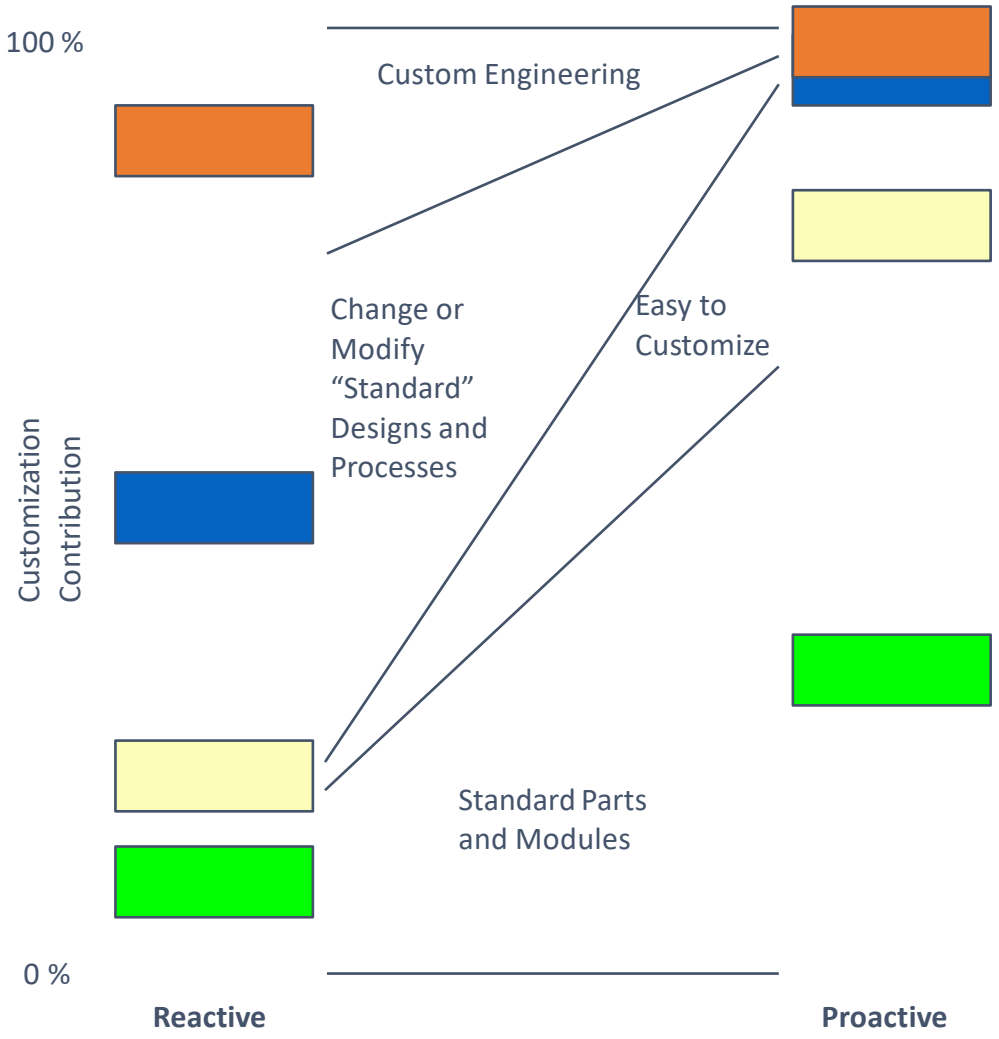
Efficient and Responsive Supply Chains

Comparison of Efficient and Responsive Supply Chains

	Efficient Supply Chains	Responsive Supply Chains
Primary goal	Supply demand at the lowest cost	Respond quickly to demand
Product design strategy	Maximize performance at a minimum product cost	Create **modularity** to allow postponement of product differentiation
Pricing strategy	Lower margins because price is a prime customer driver	Higher margins because price is not a prime customer driver
Manufacturing strategy	Lower costs through high utilization	Maintain capacity flexibility to buffer against demand/supply uncertainty
Inventory strategy	Minimize inventory to lower cost	Maintain **buffer inventory** to deal with demand/supply uncertainty
Lead-time strategy	Reduce, but not at the expense of costs	Reduce aggressively, even if the costs are significant
Supplier strategy	Select based on cost and quality	Select based on speed, flexibility, reliability, and quality

Affordable Customization and Variety

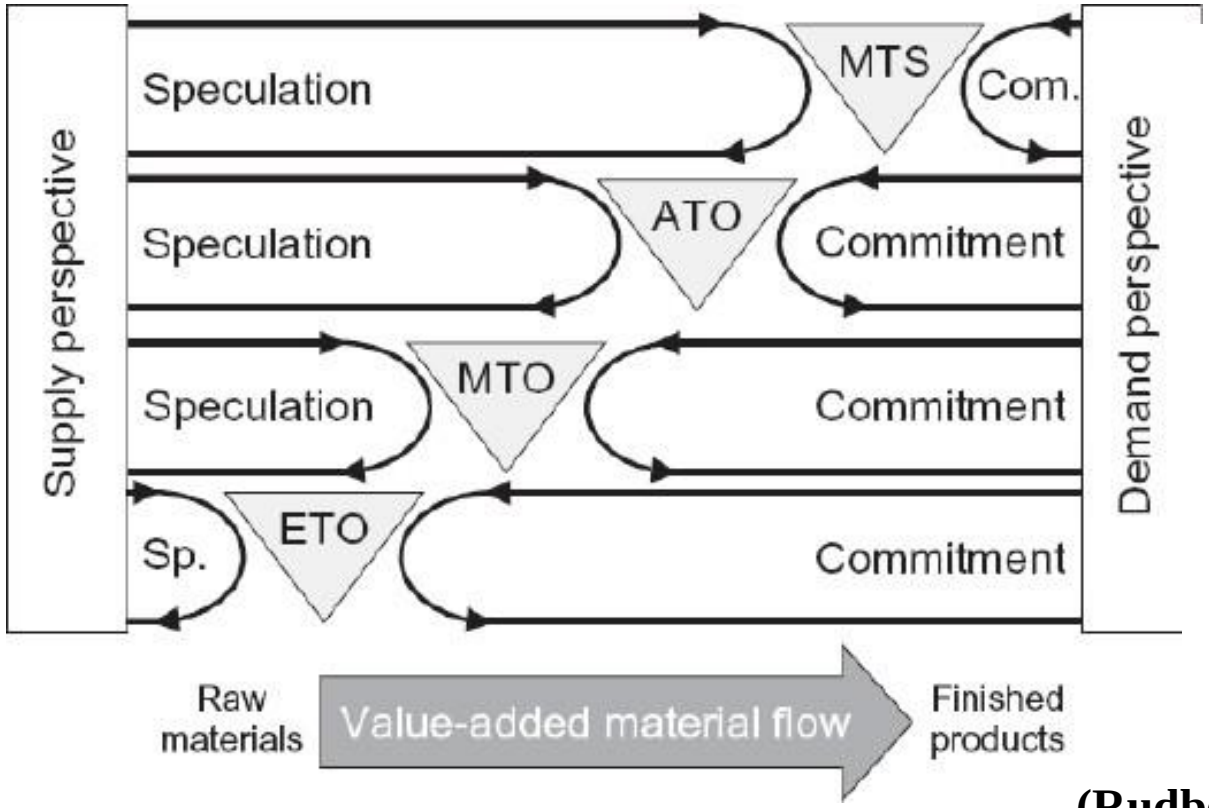
- Reactive vs. proactive modes of customization
- Must consider cost, control, time constraints
- Best to strive for platforms – product and process – that allow you to be proactive

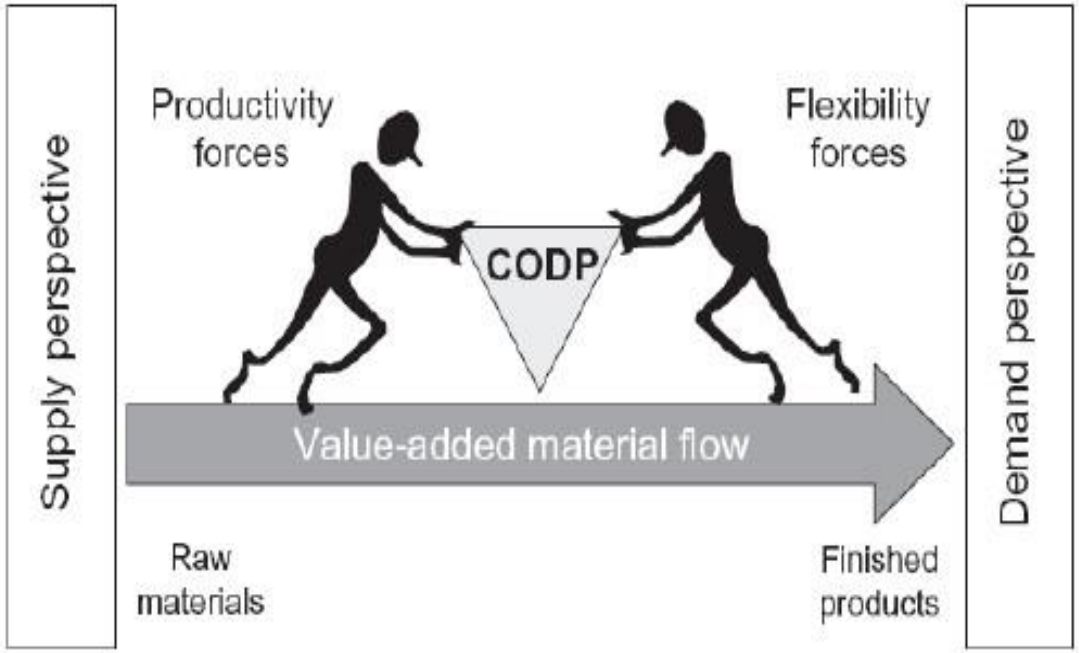


Adapted from: Anderson, D.M., 1997, Agile Product Development for Mass Customization, Irwin, Chicago, IL.

COPD

- Customer order decoupling point (CODP), also known as order penetration point,
- The COPD as the point where the product is linked to a specific customer order in the manufacturing value chain.

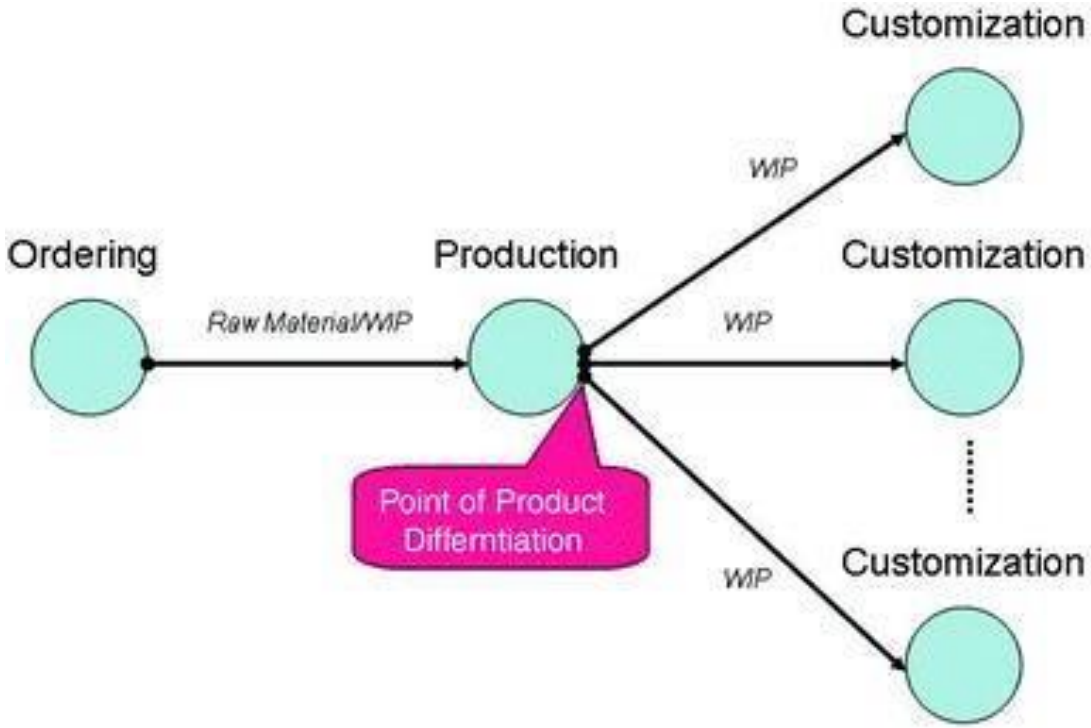


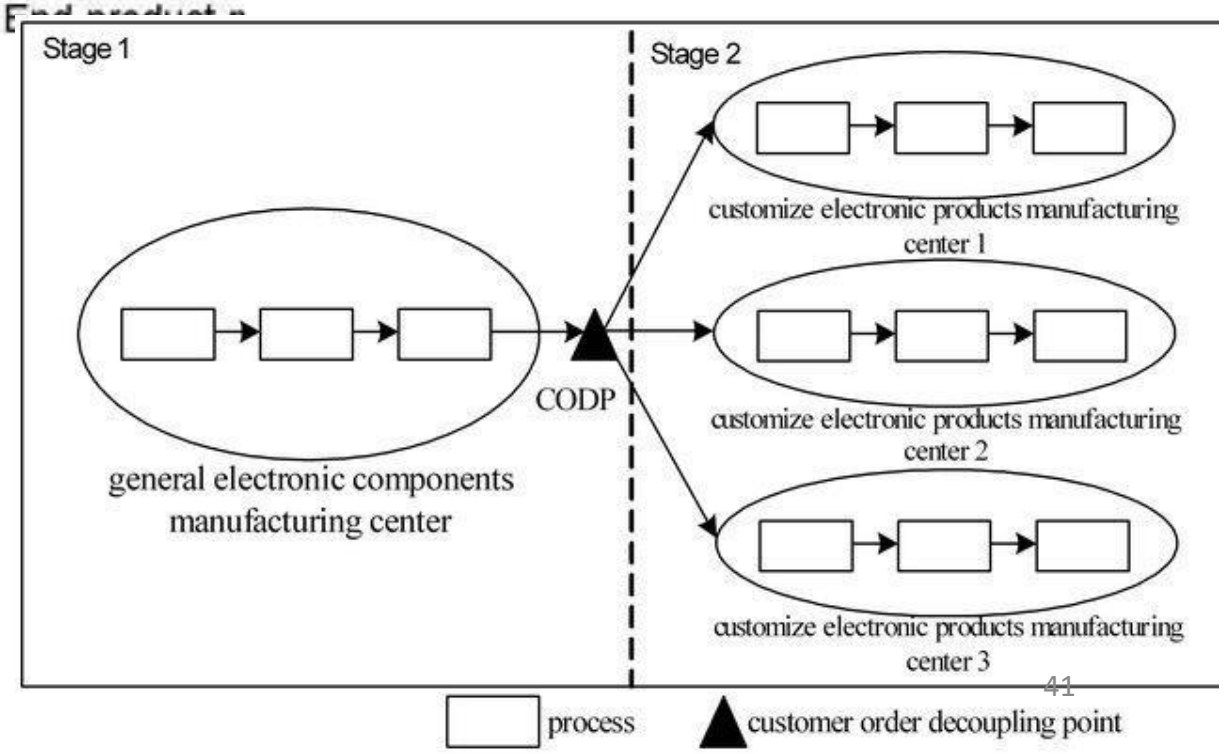


(Rudberg and Wikner 2004)

Postponement strategy

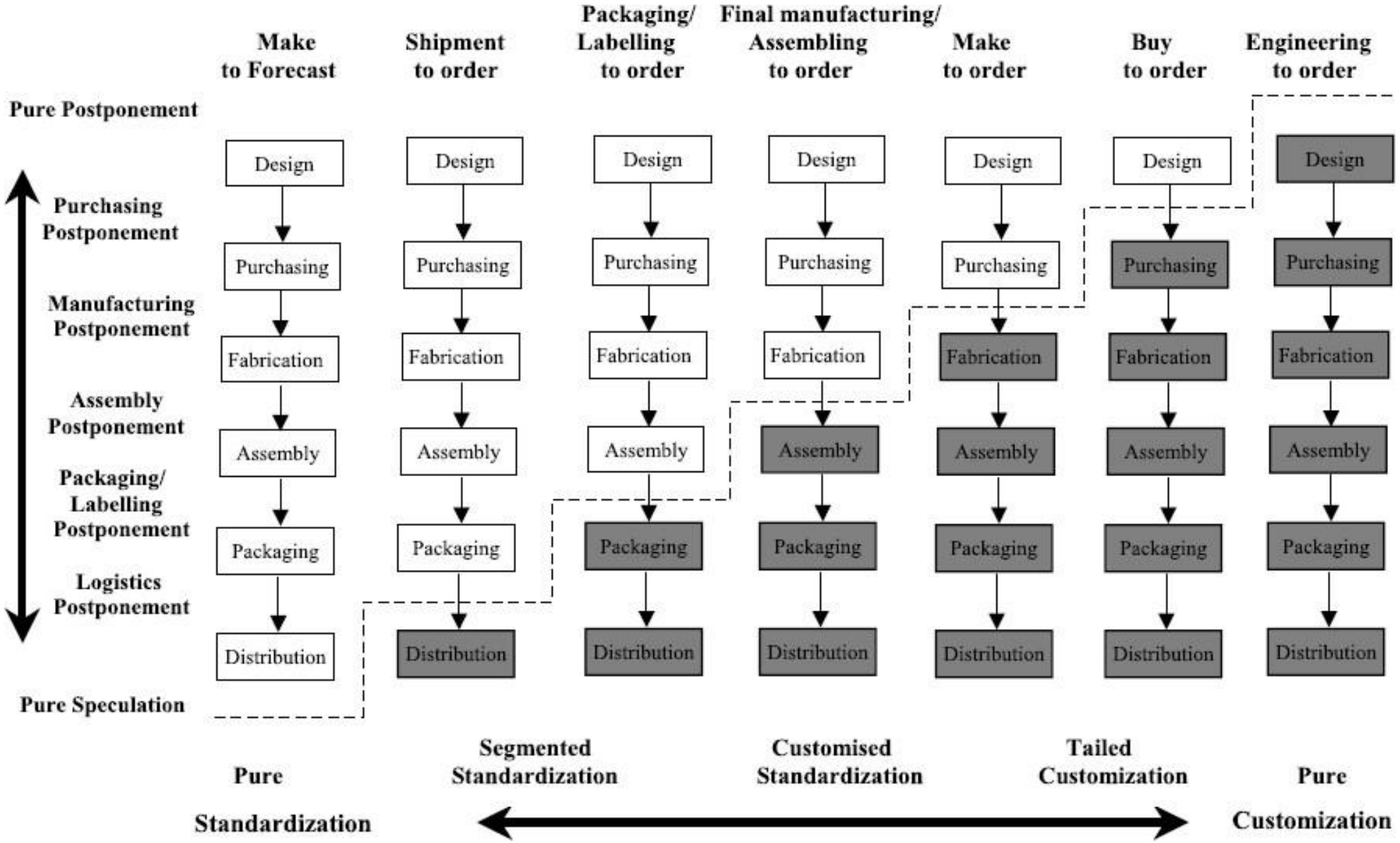
- Postponement is a concept which brings the efficiency of the lean concept and the responsiveness of the agile concept together.
- “Postponement means delaying activities in the supply chain until customer orders are received with the intention of customizing products, as opposed to performing those activities in anticipation of future orders.”
- According to this definition, companies can delay distribution, packaging, assembling, production or even purchasing until they receive exact customer orders


Customization
End-product 1
WIP
Ordering
Production
Customization
Raw Material/WIP
WIP
End-product 2
Point of Product
Differntiation
Customization
WIP


Stage 1
Stage 2
customize electronic products manufacturing center 1
CODP
customize electronic products manufacturing center 2
general electronic components manufacturing center
customize electronic products manufacturing center 3
process
customer order decoupling point

Mainly three types of postponement strategies are mentioned in supply chains:

- Time postponement: delaying the forward movement of goods until customer orders are received (delaying the determination of the time utility);
- Place postponement: storage of goods at central locations in the channel until customer orders are received (delaying the determination of the place utility);
- Form postponement: delaying product finalization until customer orders are received (delaying the determination of the form / function utility)”



Source: Yang & Burns 2003

Assessing Direct Costs of Product Variety

- Assessing the direct costs of variety are easy (DFM)
  - DFM is good for assessing direct costs associated with the design and production of a single product.
  - The resulting product is not "optimum" but has reduced manufacturing costs as a result of applying DFM.

- What are examples of direct costs involved with product variety?
  - Capital equipment
  - Manufacturing costs
  - Material costs
  - Component costs
  - Labor costs
  - Assembly costs
  - Supplier/vendor costs
  - Training
  - Drawing fabrication

Assessing Indirect Costs of Product Variety

- Indirect costs are not always understood or easy to capture, e.g.,
  - logistics of managing variety
  - quality
  - capacity change due to set-ups
  - raw material inventory
  - part documentation
  - work-in-process inventory
  - finished goods inventory
  - post-sales service
- Furthermore, assessing indirect costs is not easy
- Design for Variety (DFV) defines three indices to assess indirect costs of offering product variety:
  - Commonality
  - Differentiation Point
  - Set-Up Cost

Source: (Martin & Ishii, 1998)

Commonality Index (CI)

- Commonality Index (CI) measures how well the design utilizes standardized parts

$$CI = 1 - \frac{u - \max p_j}{\sum_{j=1}^{v_n} p_j - \max p_j}$$

- u = # of unique parts
- p = # of parts in model j
- v_n = total amount of variety offered

Differentiation Index (DI)

- Differentiation Index (DI) measures where the point of differentiation occurs within the process flow

Reflects to what extent the product structure has moved away from the worst case scenario

$$DI = \frac{\sum_{i=1}^{n} d_i v_i a_i}{n d_1 v_n \sum_{i=1}^{n} a_i}$$

Indicates worst possible case wherein all variety is determined in the first process and all the costs are incorporated at that point

- v_i = # of different products exiting process i
- n = # of processes
- v_n = final # of varieties offered
- d_i = average throughput time for process i to sale
- d_1 = average throughput time from beginning of production to sale
- a_i = value added at process i

Manufacturing Postponement

- The concept of “postponement” is a form of DFM that is applicable when producing families of products

- Postponement is defined as “redesigning the product or production process so that the point of differentiation is delayed as much as possible”
  - Delayed product differentiation (DPD), product differentiation postponement (PDP), design for localization

- General postponement strategies:
  - Component and Process Standardization
  - Modular Product Design
  - Process Restructuring
  - Design for Logistics

General Postponement Strategies

- Component and Process Standardization
  - allow facilities to perform identical operations
  - reduces complexity of operations
  - increases flexibility of WIP inventory usage
- Modular Product Design
  - allows for easier assembly
  - integration can be performed at later points
- Process Restructuring
  - Postponement of operations (postpone operations downstream)
  - Reversal of operations (re-order adjacent operations)
- Design for Logistics
  - designing products for cheaper transportation, with smaller packaging to reduce freight costs