

Supply chain modelling structures – Is physical logical?

**Workshop on Distributed Model Predictive
Control and Supply Chains (May 19–21 in Lund)**

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 - Professor in (production) logistics
- School of Engineering
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- Research areas
 - Supply chain dynamics
 - Simulation and control theory applications
 - Supply chain modelling structures
 - Planning and control
 - SMME focus



”Logistics and Operations Management”



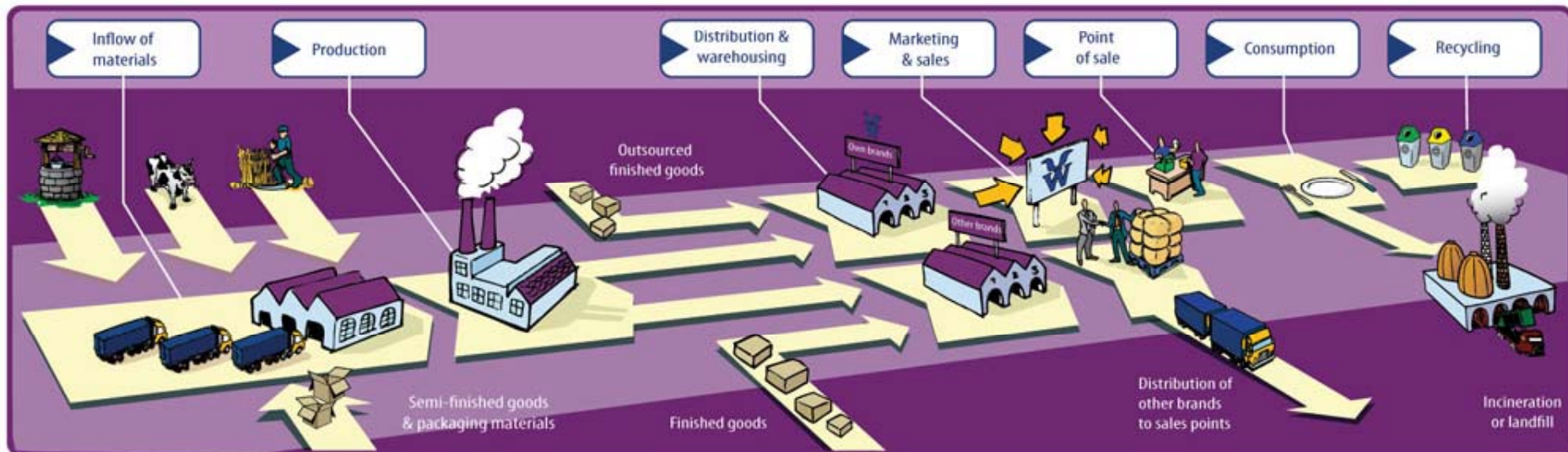
Contents

- Physical supply chain control model
- Demand perspective
- Supply perspective
- Logical supply chain control model
- Physical vs. logical supply chain control model
- Summary



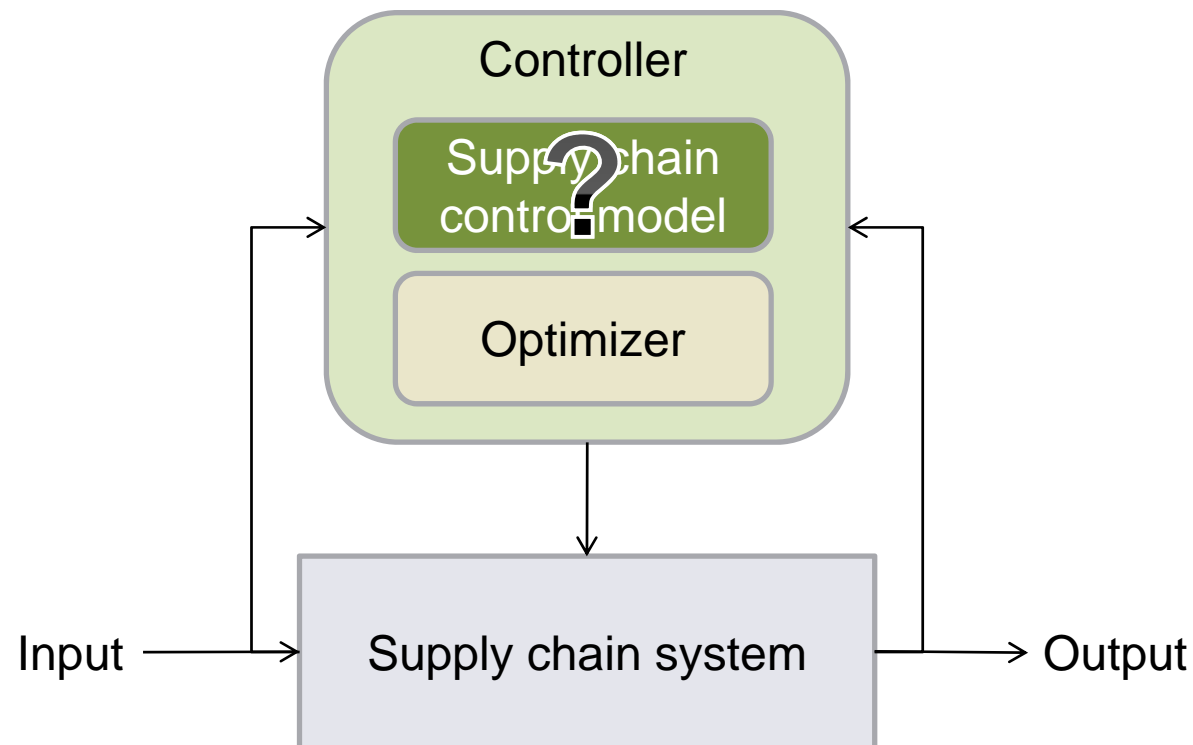
Supply chain system...

What is the business (supply chain) logic behind all this?

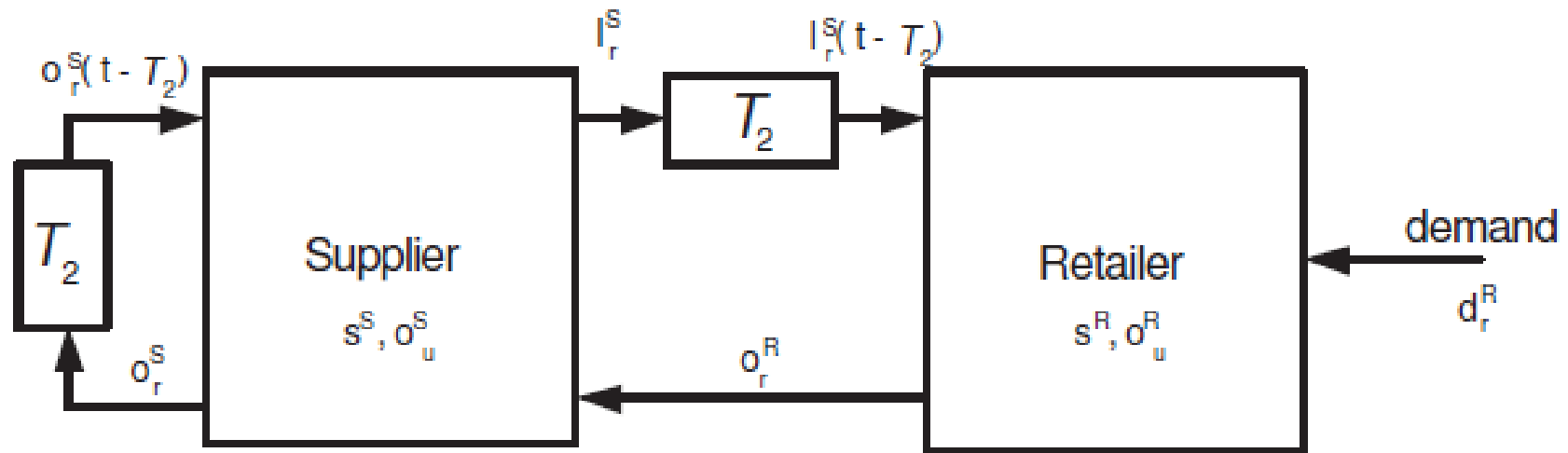


MPC and supply chains

Model Predictive Control (MPC)
(Integrated supply chain management)



"Physical" supply chain control model

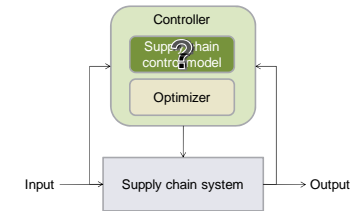


Source: Maestre, Muñoz de la Peña and Camacho (2009)
Distributed MPC: a supply chain case study

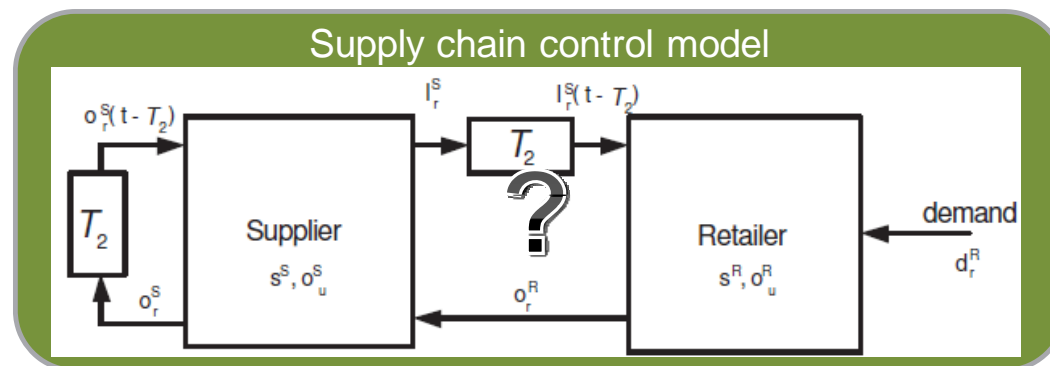
- d_r = Demand rate
- s = Stock level
- o_u = Order unfilled from upstream stage
- b = backlog level
- o_r = Order rate
- T_2 = Replenishment lead time (pure delay)
- I_r = Shipment rate



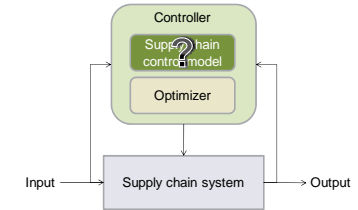
How general is this type of model?



- Impact of strategic initiatives such as:
 - Customization?
 - Postponement?
 - Outsourcing?
 - Transparency?



Resolution of control models



“Estimated” state variables

Core issue is tracking refer. values

Black box approach

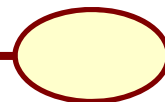
Low level of system structure knowledge

”Strategic” state variables

Core issue is balancing efficiency and responsiveness

(Strategic/aggregate level)

This presentation



E.g. Materials requirements planning (MRP)

”All” state variables

Core issue is balancing supply and demand

Detailed approach (see e.g. APS)

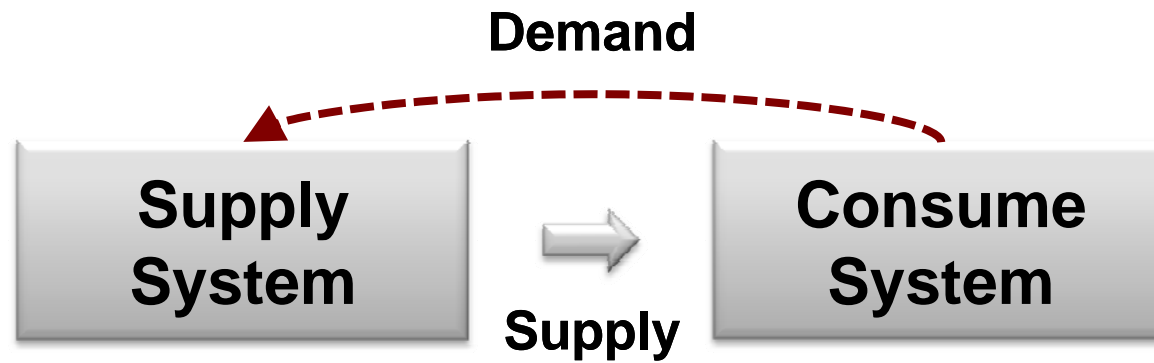
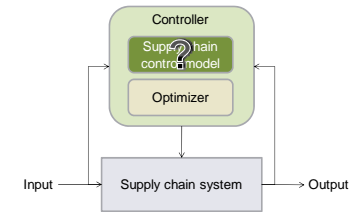
High level of system structure knowledge

APS = Advanced Planning and Scheduling



TEKNISKA HÖGSKOLAN
HÖGSKOLAN I JÖNKÖPING

Two key systems

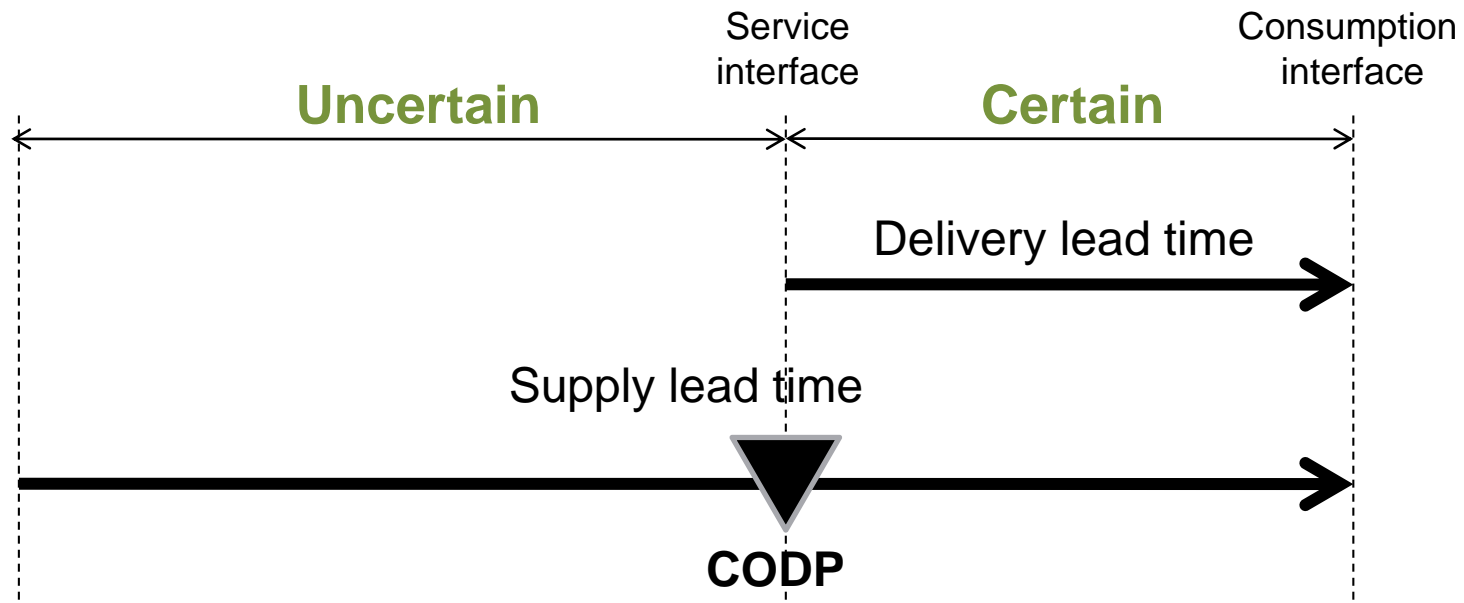
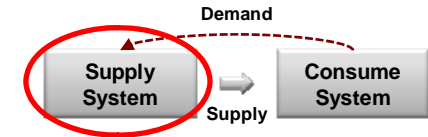


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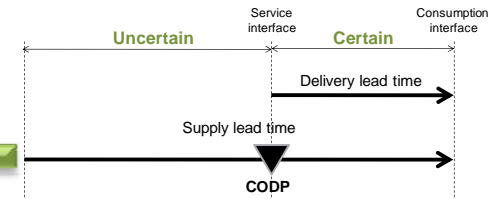
Strategic stock point 1



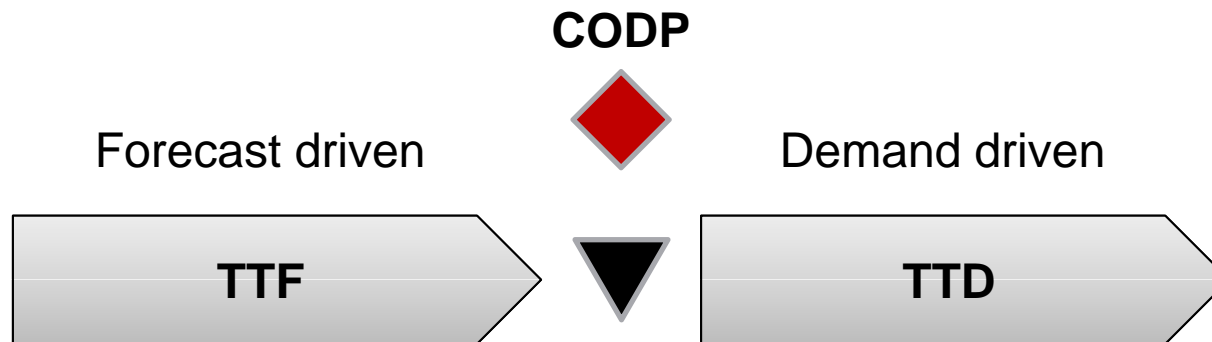
- Strategic intent – Reduction of demand risk:**
- **Be demand driven (move CODP to the left in relation to total supply lead time)**
 - **Enable late customization**

CODP = Customer Order Decoupling Point

Postponement – “Driver”



Two control domains of the Supply System



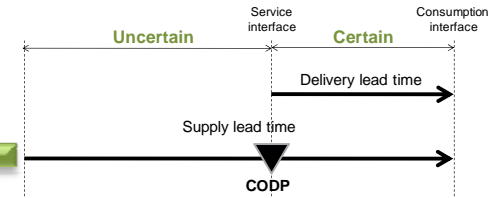
TTD = Transform to Demand (MTO = Make to Order)

TTF = Transform to Forecast (MTS = Make to Stock)

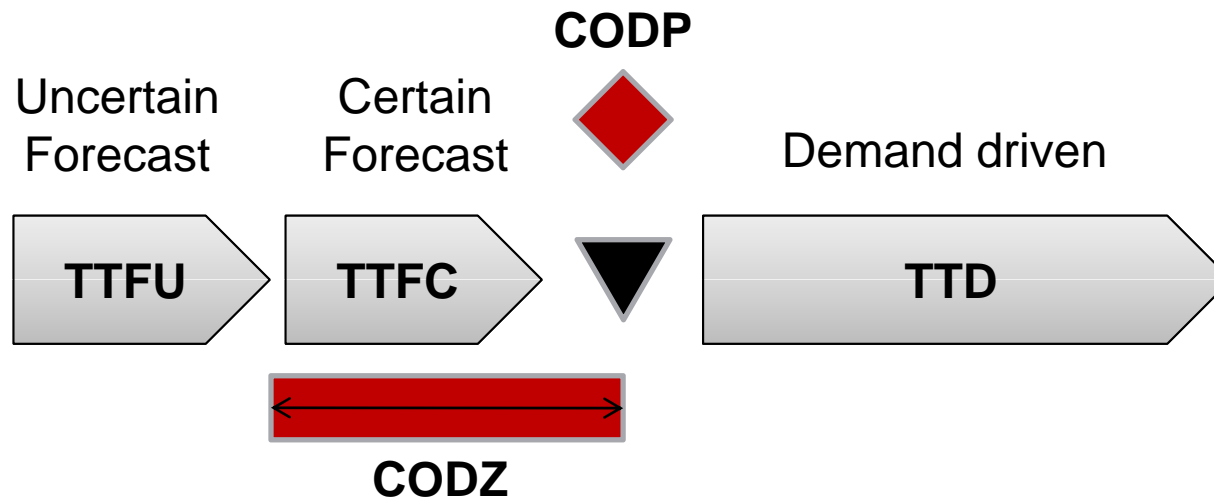
CODP = Customer Order Decoupling Point



Postponement – “Certainty”



Three control domains of the Supply System



CODZ = Customer Order Decoupling Zone

TTD = Transform to Demand (MTO = Make to Order)

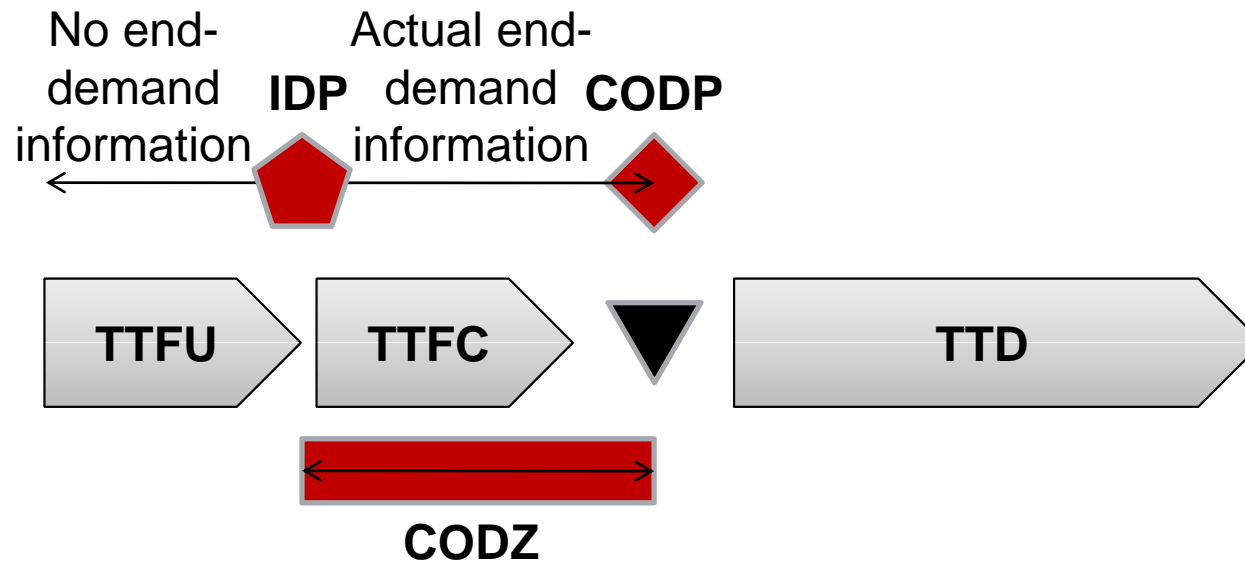
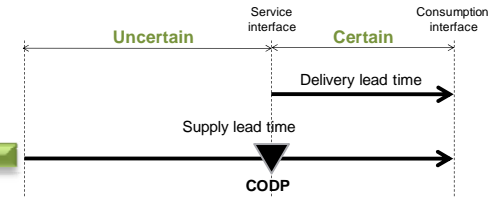
TTFU = Transform to Forecast Uncertain (MTS = Make to Stock)

TTFC = Transform to Forecast Certain (MTS = Make to Stock)

CODP = Customer Order Decoupling Point



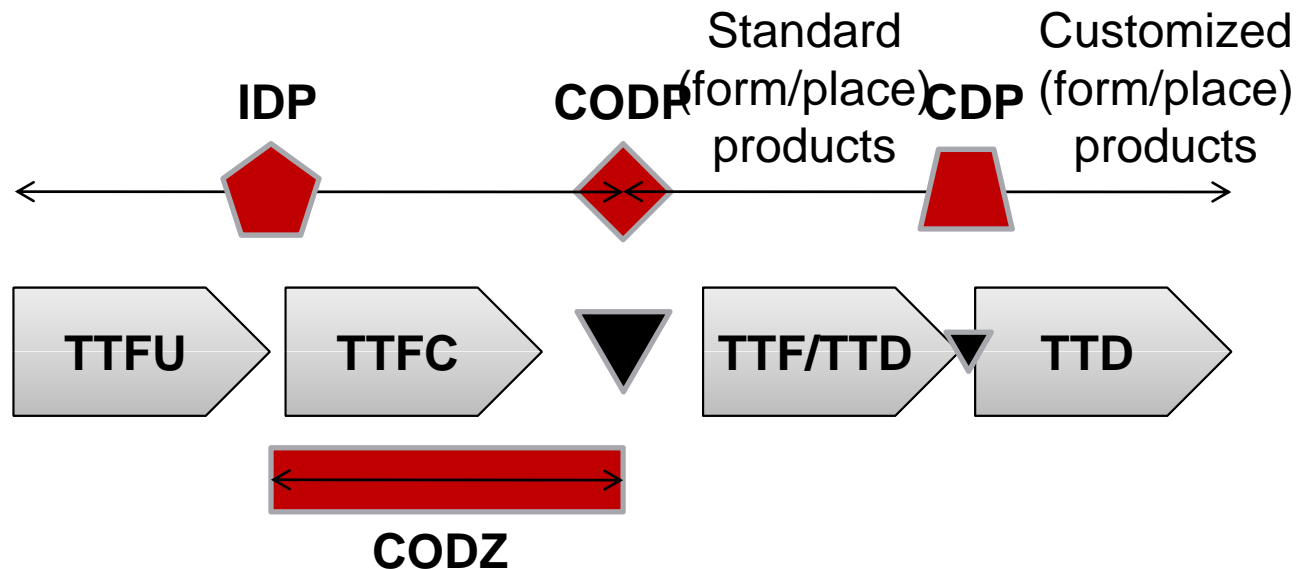
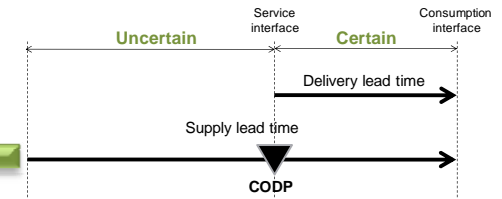
Transparency – “Integration”



- IDP = (Demand) Information Decoupling Point
- CODZ = Customer Order Decoupling Zone
- TTD = Transform to Demand (MTO = Make to Order)
- TTFU = Transform to Forecast Uncertain (MTS = Make to Stock)
- TTFC = Transform to Forecast Certain (MTS = Make to Stock)
- CODP = Customer Order Decoupling Point



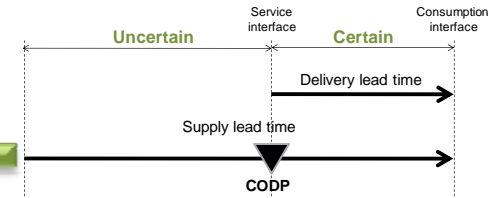
Customization – “Options”



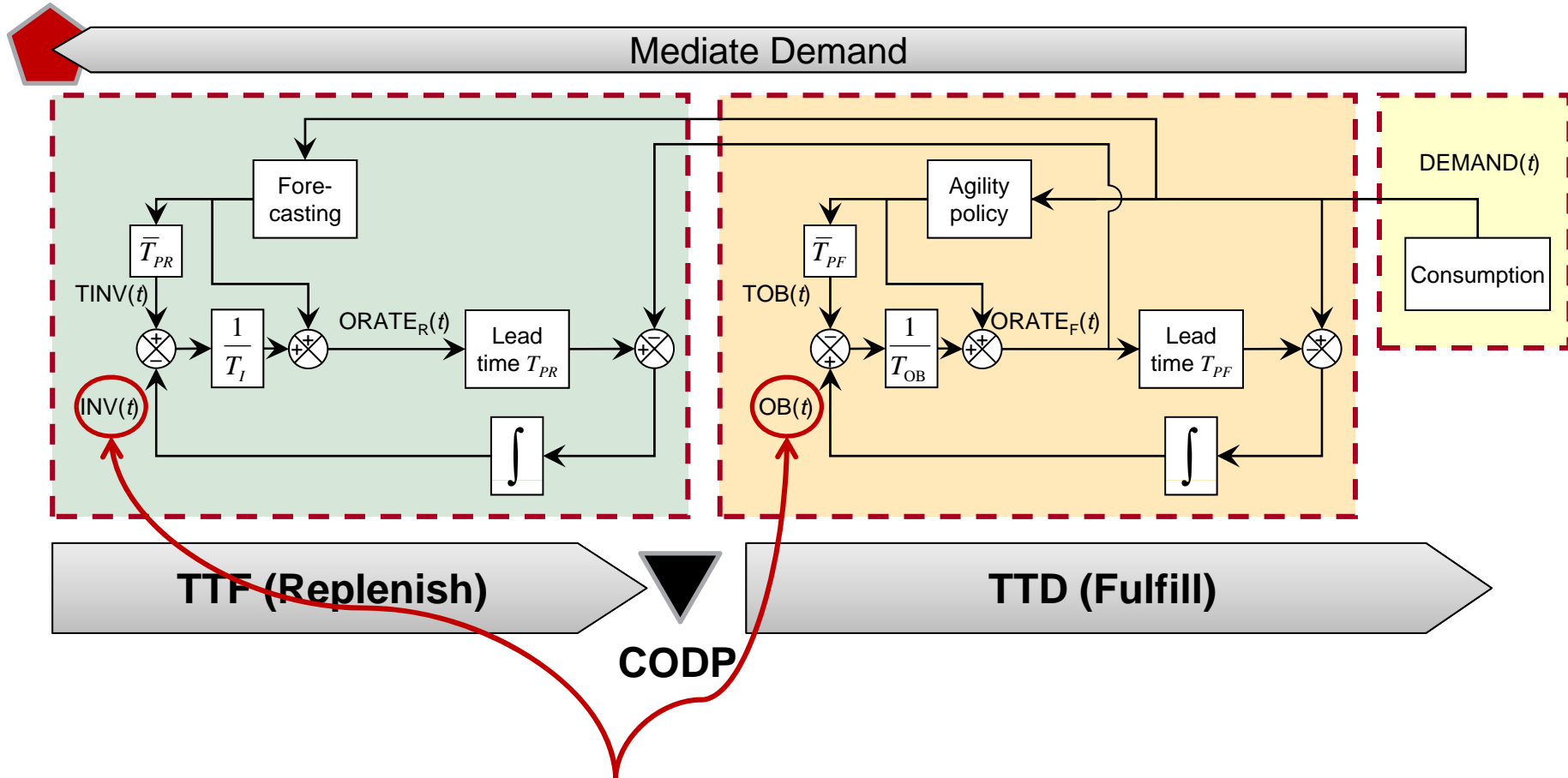
- CDP = Customization Decoupling Point
- IDP = (Demand) Information Decoupling Point
- CODZ = Customer Order Decoupling Zone
- TTF = Transform to Forecast (MTS = Make to Stock)
- TTD = Transform to Demand (MTO = Make to Order)
- TTFU = Transform to Forecast Uncertain (MTS = Make to Stock)
- TTFC = Transform to Forecast Certain (MTS = Make to Stock)
- CODP = Customer Order Decoupling Point



Ex: CODP/IDP “application”



IDP



Key state variables

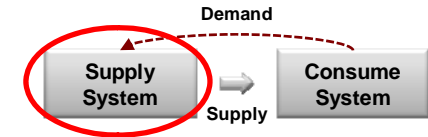


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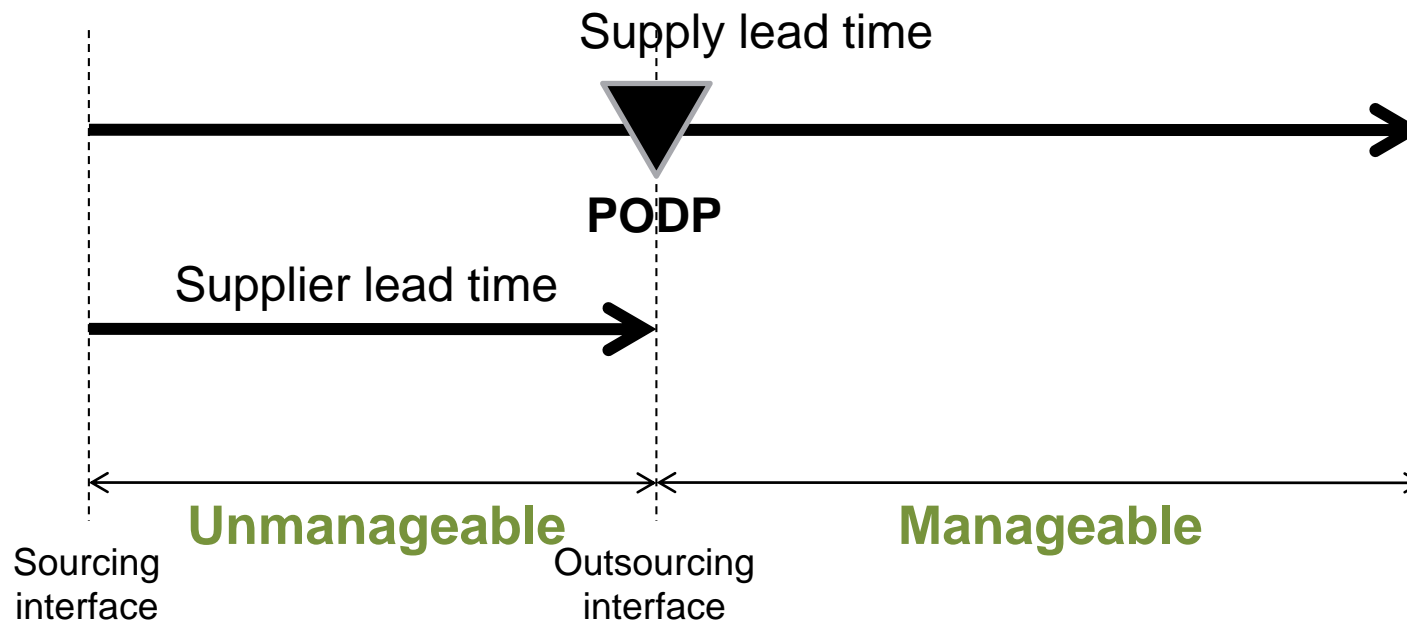


Strategic stock point 2



Strategic intent – Reduction of supply risk:

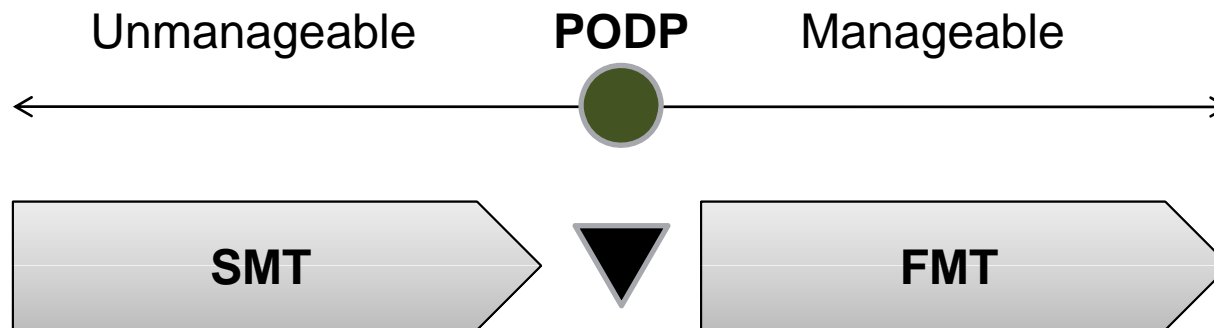
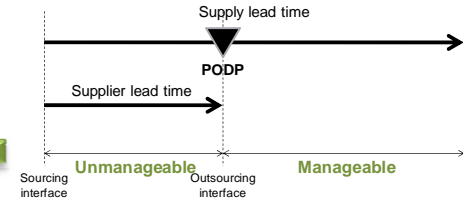
- **Outsource non-core activities (move PODP to the right)**
- **Focus on core competence**



PODP = Purchase Order Decoupling Point



Outsourcing – “Influence”



FMT = Focal actor Managed Transformation
 SMT = Supplier Managed Transformation
 PODP = Purchase Order Decoupling Point

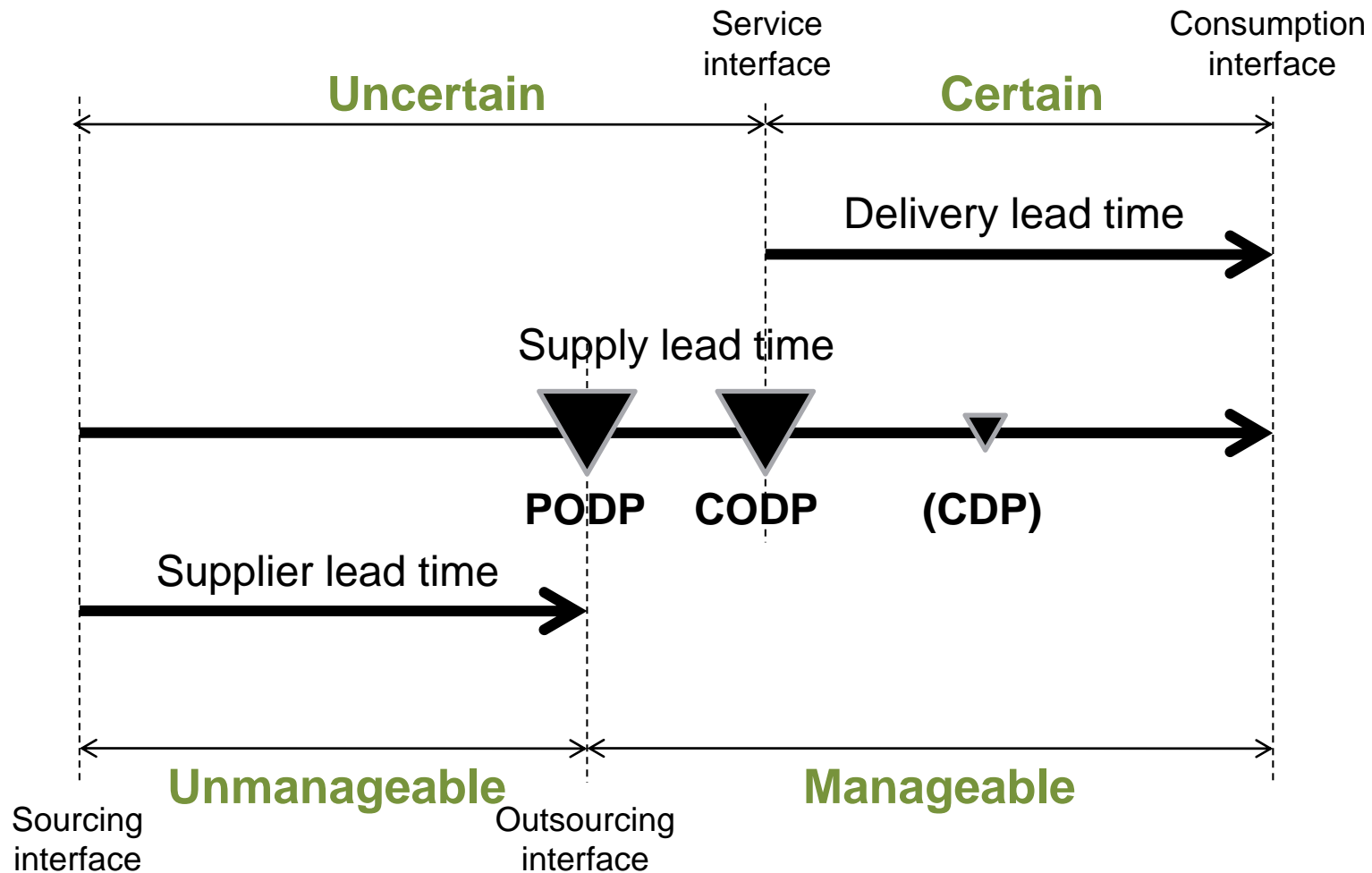
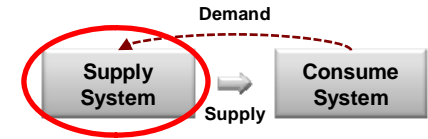


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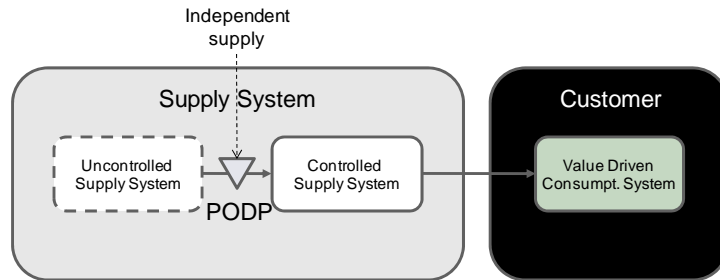


Strategic stock points

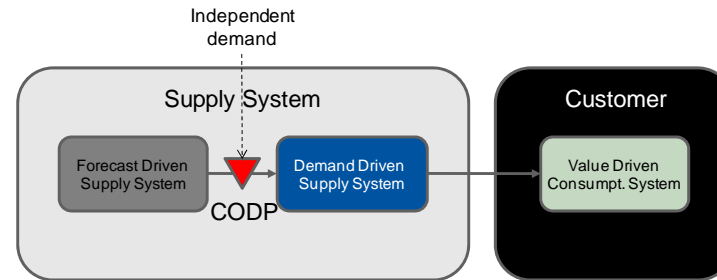


Four types of sub-system

PODP perspective of supply system



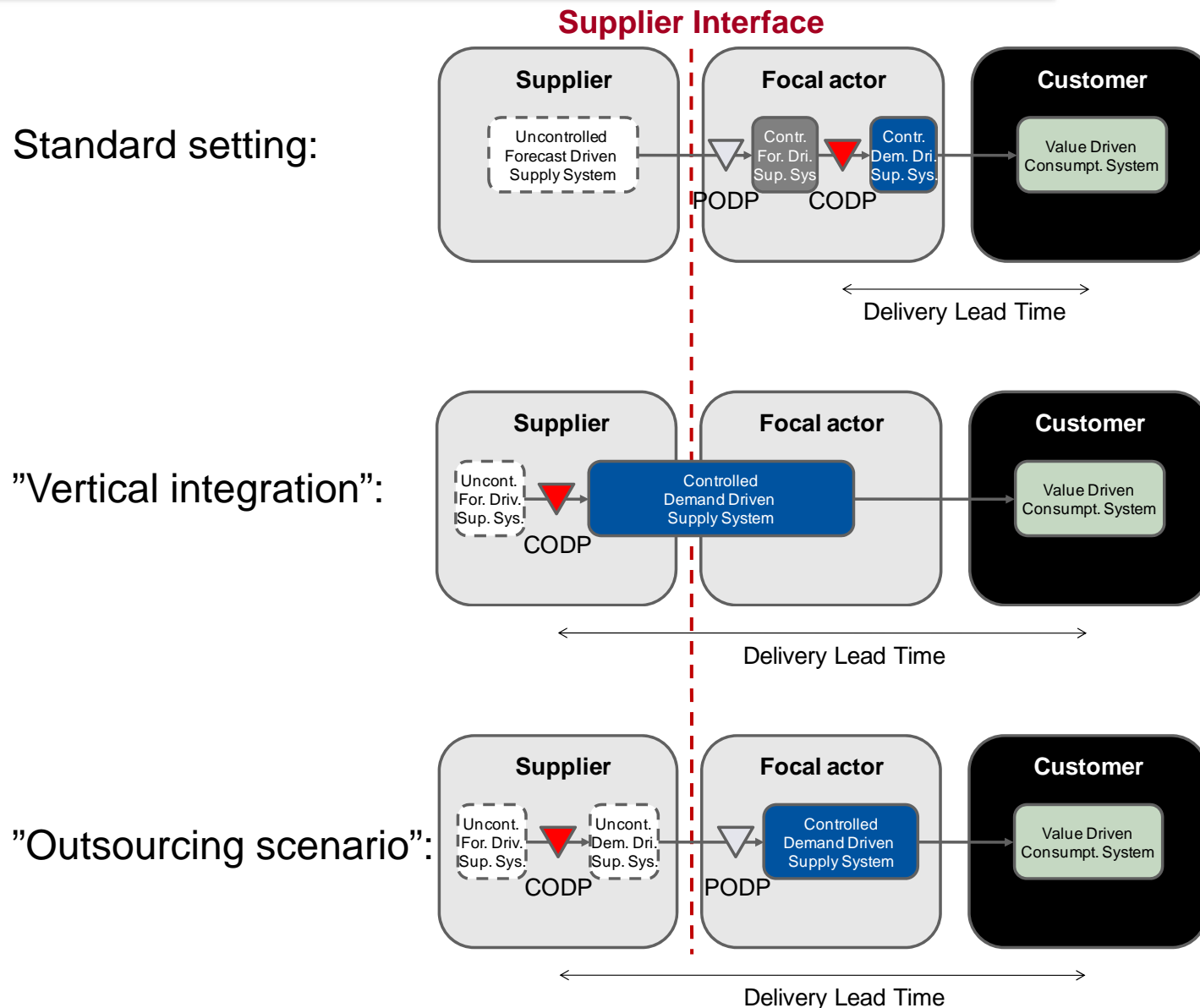
CODP perspective of supply system



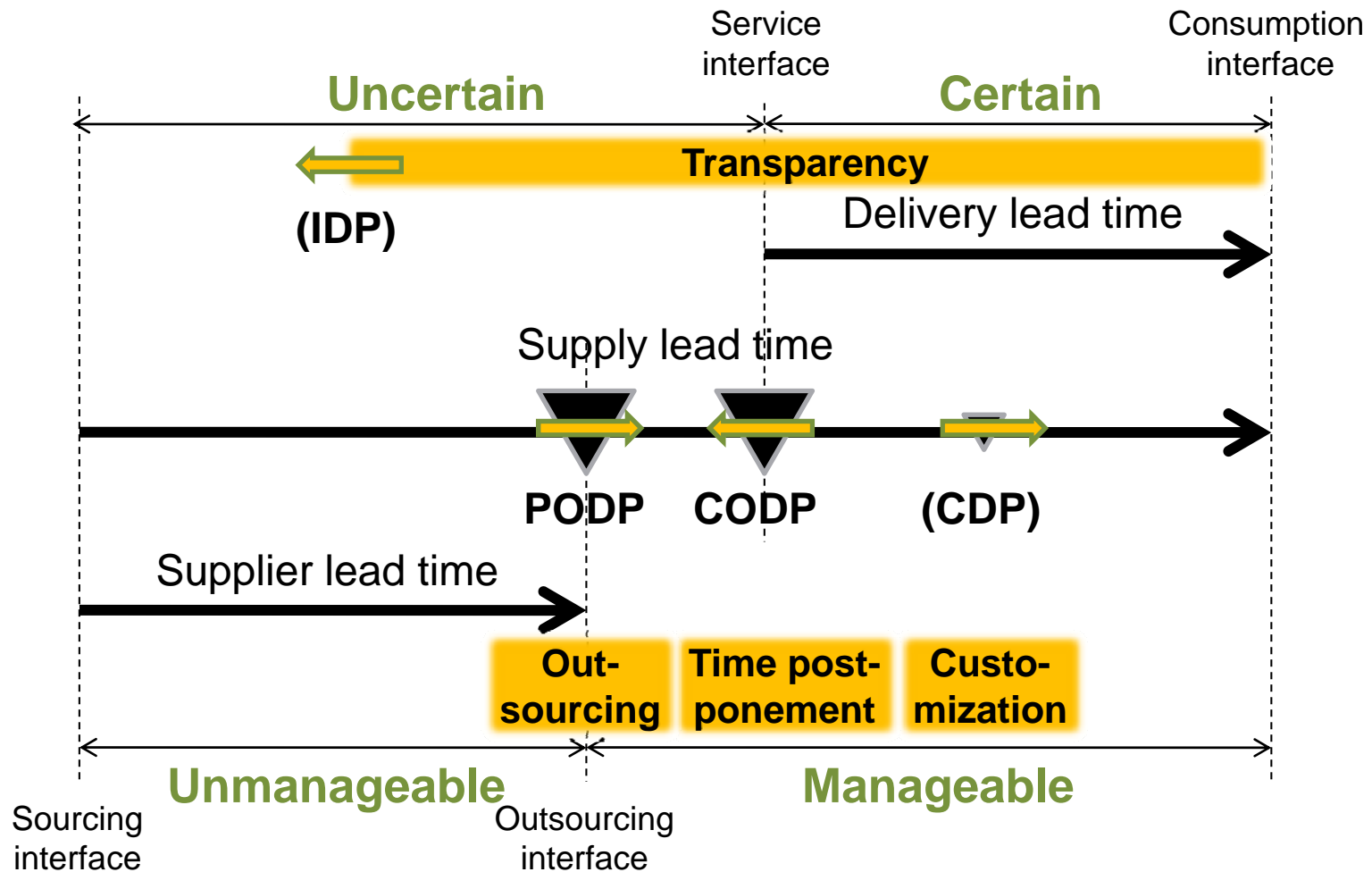
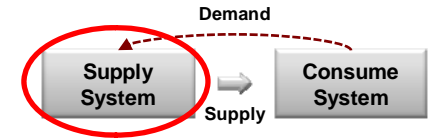
| | Forecast Driven | Demand Driven |
|-----------------------------|--|--|
| Uncontrolled (Unmanageable) | Uncontrolled Forecast Driven Supply System | Uncontrolled Demand Driven Supply System |
| Controlled (Manageable) | Controlled Forecast Driven Supply System | Controlled Demand Driven Supply System |



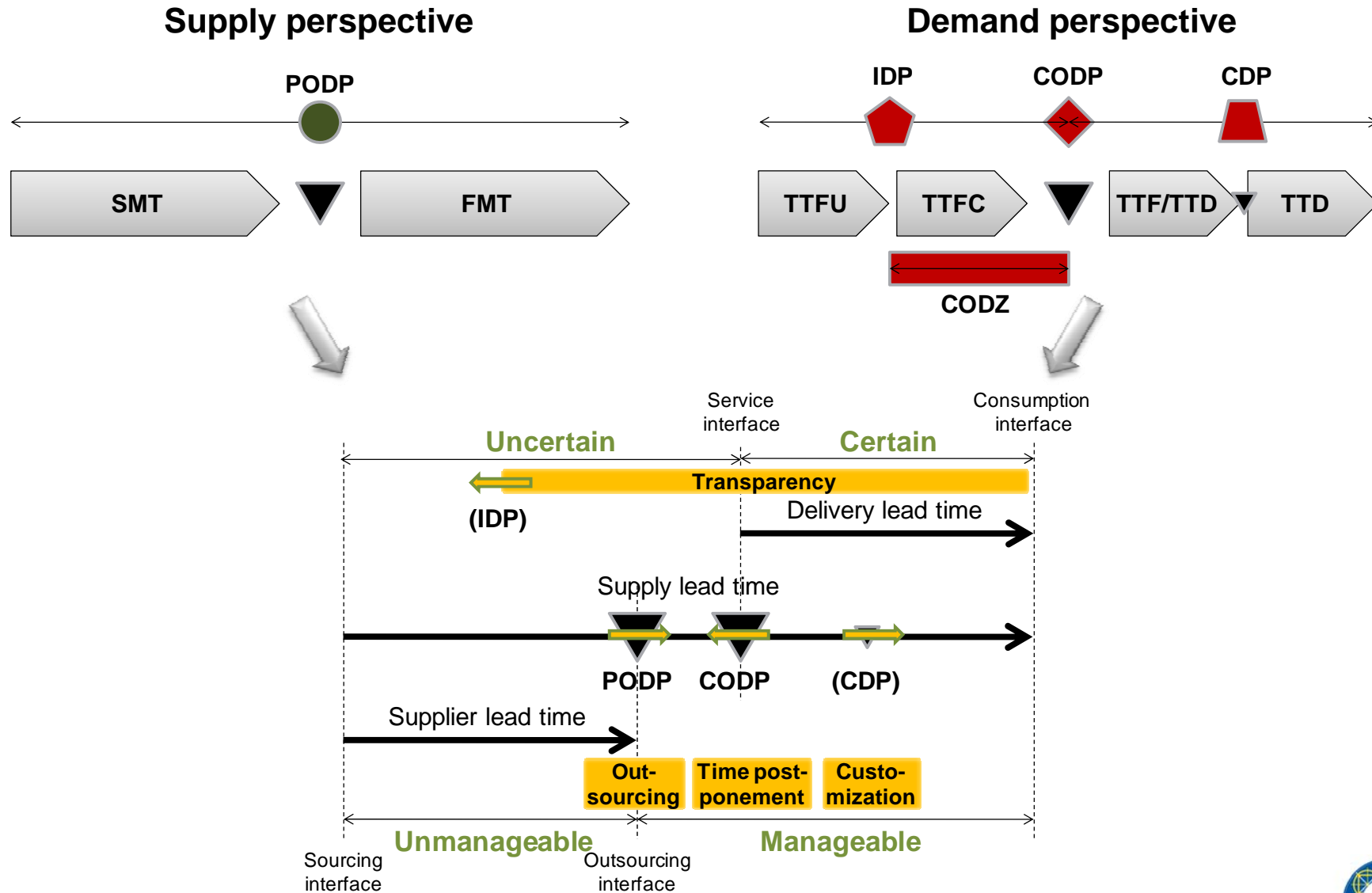
Supply chain configurations – exampl.



Industry trends



“Logical” supply chain control model

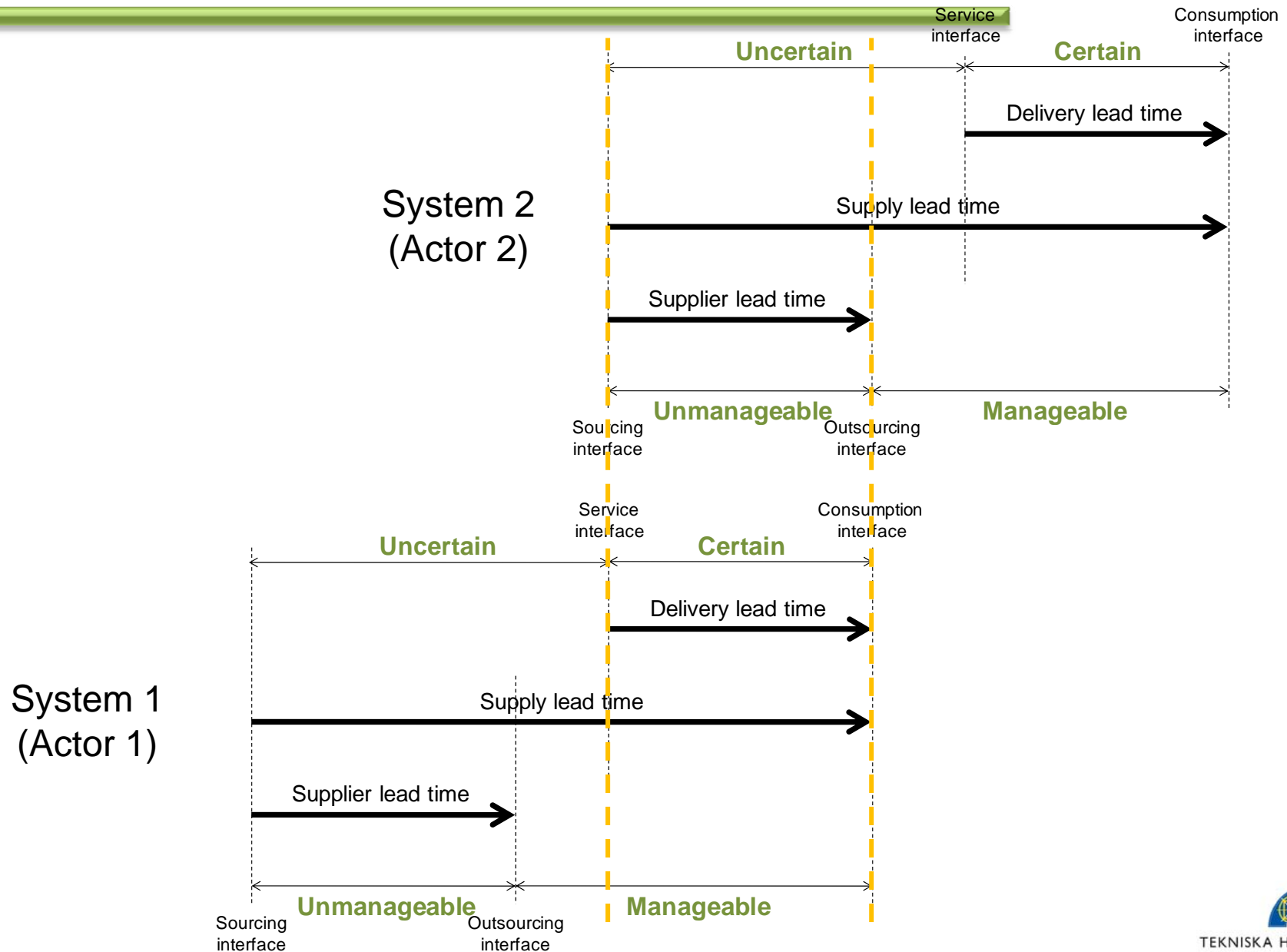


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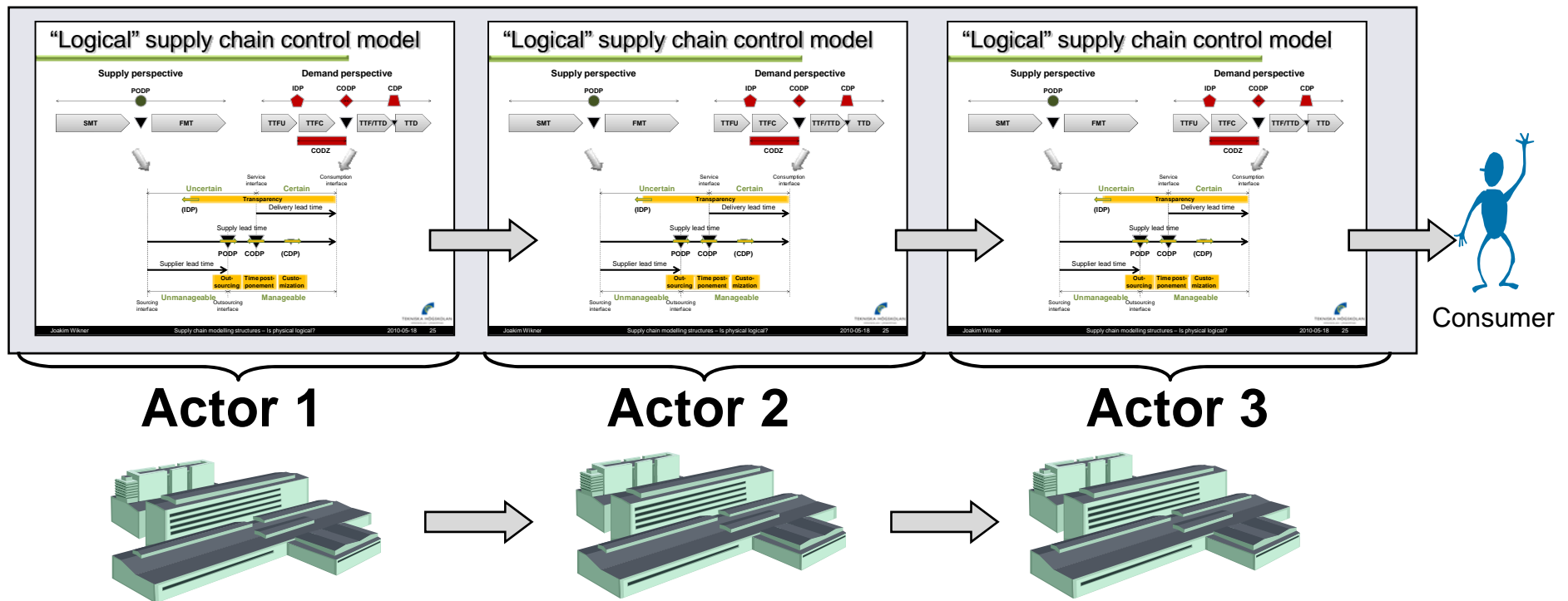


Control models in tandem



A disintegrated supply chain

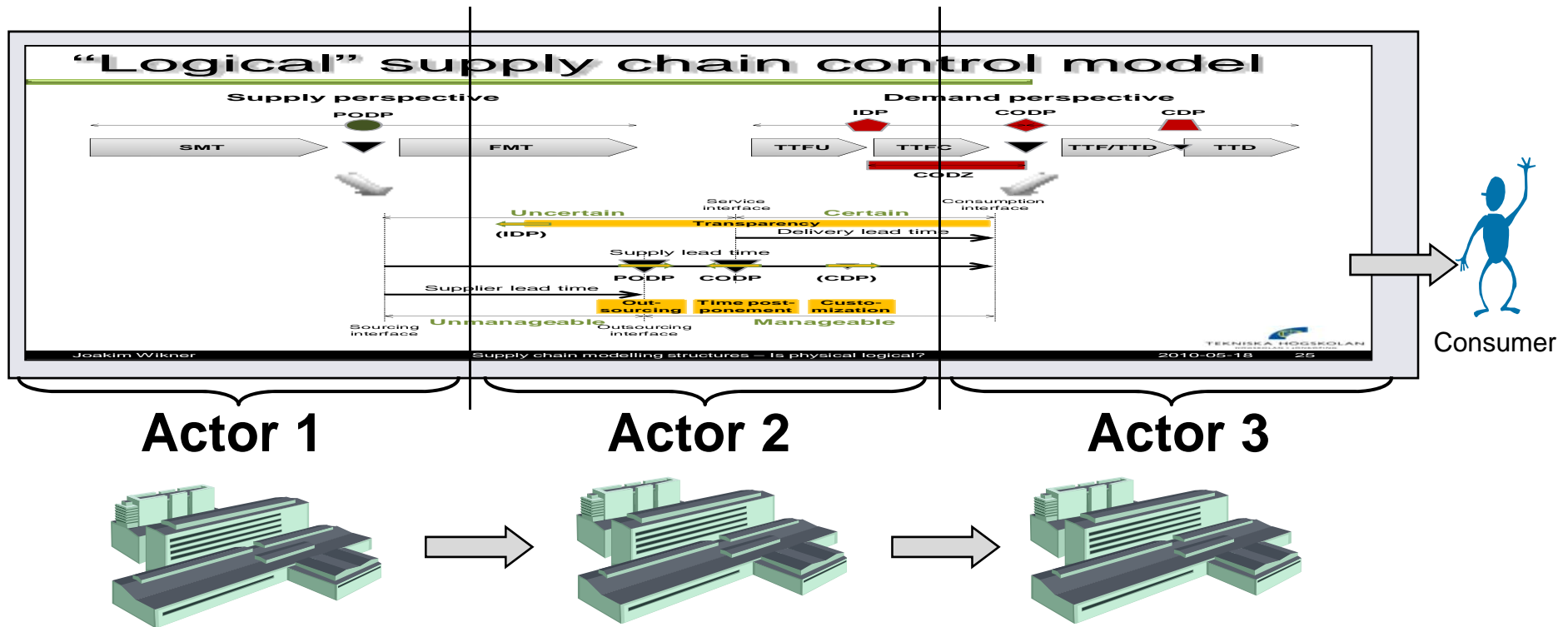
Decentralized supply chain control



One logical control model per actor!

An integrated supply chain

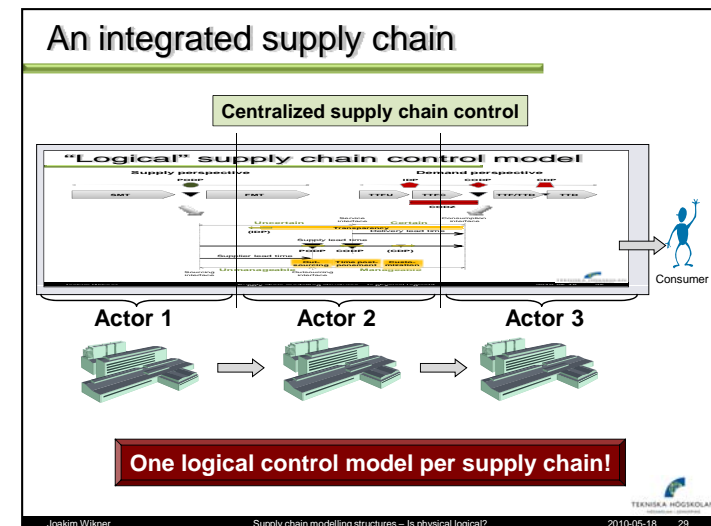
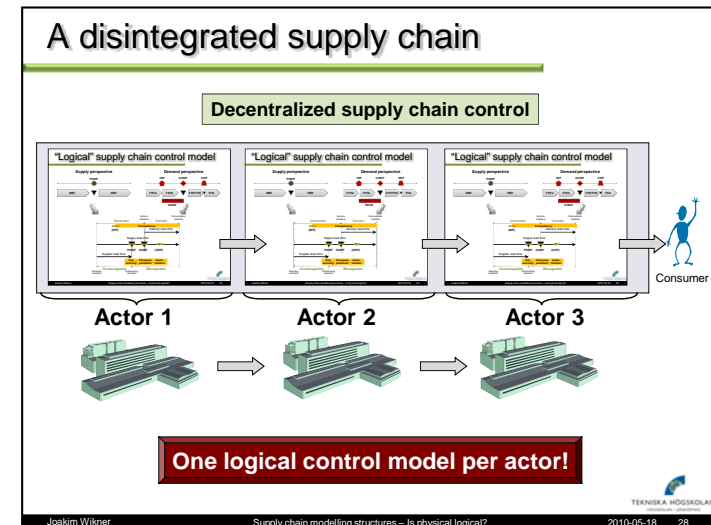
Centralized supply chain control



One logical control model per supply chain!

The next step...

- A model reflecting the strategic initiatives
 - Customization
 - Postponement
 - Outsourcing
 - Transparency
- How should this be applied to distributed supply chain control?



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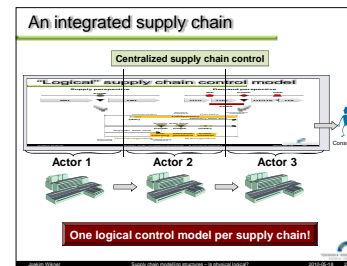
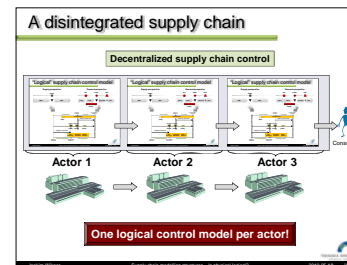
Summary

“Supply chain modelling structures – Is physical logical?”

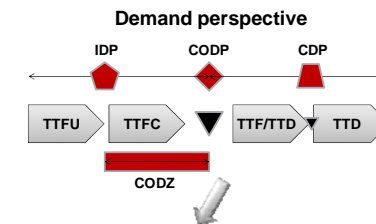
The next step...

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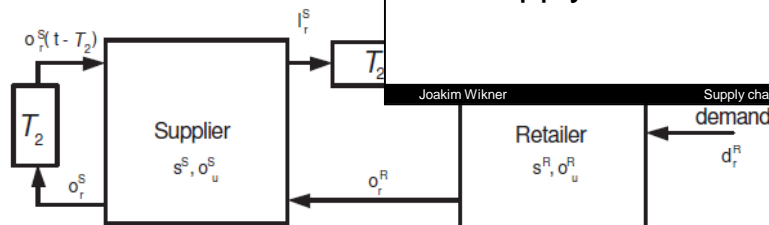
USUALLY NOT...



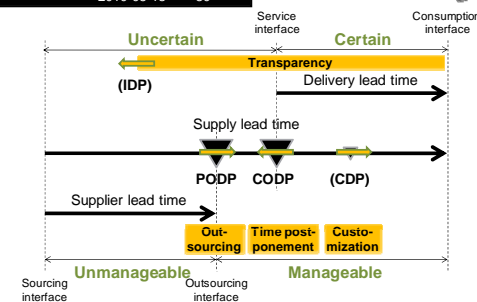
Supply chain control model



Physical supply chain



Source: Maestre, Muñoz de la Peña and Camacho (2009) Distributed MPC: a supply chain case study



Some references

Please contact joakim.wikner@jth.hj.se for more information

- **CODP:** Hoekstra, S. and Romme, J. (Eds.) (1992) *Integral Logistic Structures: Developing Customer-Oriented Goods Flow*, New York: Industrial Press.
- **CODZ:** Wikner J. and Rudberg M. (2005) *Introducing a Customer Order Decoupling Zone in Logistics Decision Making*, International Journal of Logistics: Research and Applications, Vol. 8, No. 3, pp. 211-224
- **IDP:** Mason-Jones, R. and Towill, D.R. (1999) *Using the information decoupling point to improve supply chain performance*, International Journal of Logistics Management, Vol. 10, No. 2, pp.13–26.
- **CDP:** Wikner J. and Wong H. (2007) *Postponement Based on the Positioning of the Differentiation and Decoupling Points*, in Olhager J. and Persson F., IFIP International Federation for Information Processing, Volume 246, Advances in Production Management Systems, pp. 143-150
- **PODP:** Wikner, J., Johansson, E., and Persson, T. (2009) *Process based inventory classification*, Proceedings of the 21 NOFOMA conference.
- **Control models:** Wikner J. and Naim M. M. and Rudberg M. (2007) *Exploiting the order book for mass customized manufacturing control systems with capacity limitations*, IEEE Transactions on Engineering Management, Vol. 54, No. 1, pp. 145-155 (see also list of references in this paper for control model examples).

