

Inventory Management & Optimization in Practice

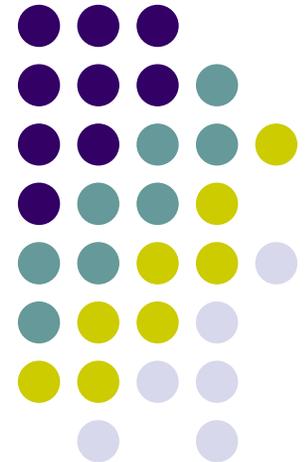
Lecture 16

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Session goals

- The challenges of inventory management in practice
- Approaches
- The supply chain dimension
- Role of technology

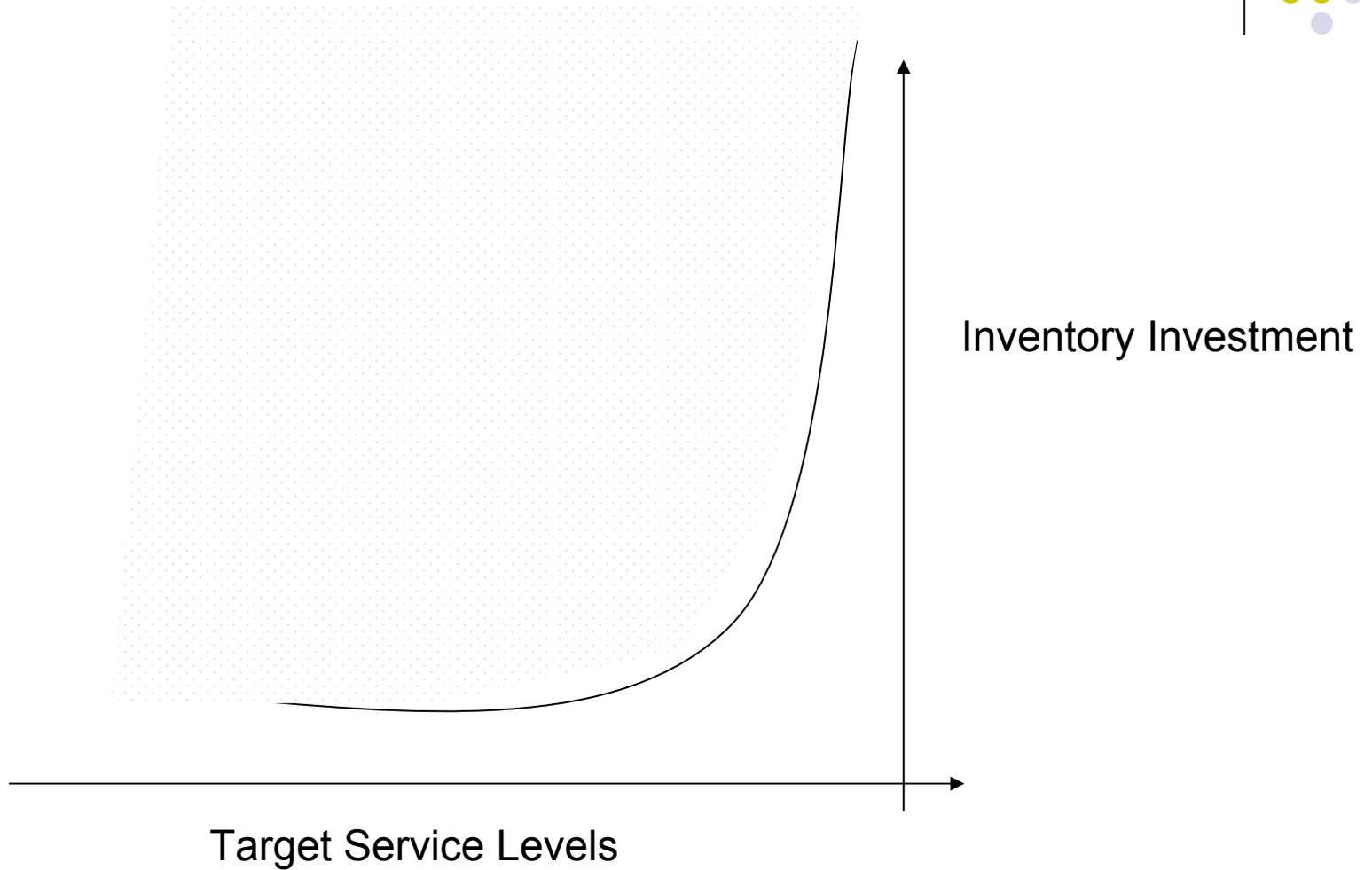
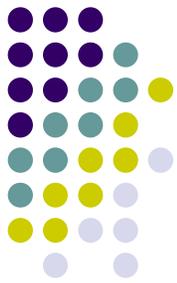


Why do companies hold inventory in the first place?



- It's a buffer in the Supply Chain
 - Time mismatch between supply-demand
 - Variability (supply, demand, forecast error)
 - Economic (costs, discounts)
- Main tradeoff
 - Service level
 - Inventory cost
- Keep it to a minimum

The fundamental tradeoff



Three simple questions ...



Three basic questions you want to answer through inventory management:

1. How often should I check my inventory?
2. How do I know if I should order more?
3. How much to order?

What you have learned so far...



- Not all items are created equal
 - Segmentation is needed
- Various models with different assumptions
 - EOQ
 - (s, Q)
 - (s, S)
 - (R, s, S)
 - (R, S)
 - Periodic vs. Continuous
- Definitions of service level matters

Reality check ...



“More than 60% of companies use overly simplistic inventory management methods. These companies frequently have 15-30% more inventory than they need and lower service levels. By contrast, companies that reported using new optimization methods..., commonly drove 20-30% reductions in on-hand inventory and 10-20% improvements in time to market.”

Aberdeen Group, March 2005

Good news & bad news



- Good news
 - Understanding theoretical models is important and matters
 - You can make money on this field!
- Bad news
 - Models are not used exactly as you have learned them
 - Technology matters
 - Business processes matter even more



Q1: How often?

- Home Depot Retail*
 - 1,800+ stores
 - 40,000 – 50,000 different items
 - Approx. 72-90 Million item/store combinations
- Processing power may be the bottle neck
 - Single server example:
 - Single database can process 500 transactions per second
 - 40-50 hours to “check” inventory
 - And you still need to do the math...
 - Distributed power
- Other examples
 - Department Store – 200,000+ items
 - Grocery Store – 100,000+ items
 - Book Store – 150,000 + items
 - Online Store – 5 million+ items

* Source – Home Depot 2004 Annual Report

Q1: How often?

(cont.)



- Segmentation
- Constrained by technology
 - Fashion Retailers – Daily/Weekly
 - Grocery Retailers – Hourly / 3-4 times a day
- Constrained by business processes
 - When are sales reflected in your inventory?
 - How often can you receive merchandise?
 - How often do you get orders from your clients?
 - Vary by time of the year?



Q2: Should I order?

- Function of two variables
 - Inventory Position
 - Order Point
- Inventory Position
 - On hand
 - On order
 - Committed
 - Backorders
- Order Point is a function of the inventory model

Inventory position: What can go wrong?



- Source: from ERP/legacy systems
 - Databases
- On hand
 - Incorrect product codes
 - “Fat Finger”
 - Scanner/Reader problems
 - Missing product codes
 - Shrinkage
 - Returns
- Physical Inventory / Reconciliation

Inventory position: What can go wrong?

(cont.)



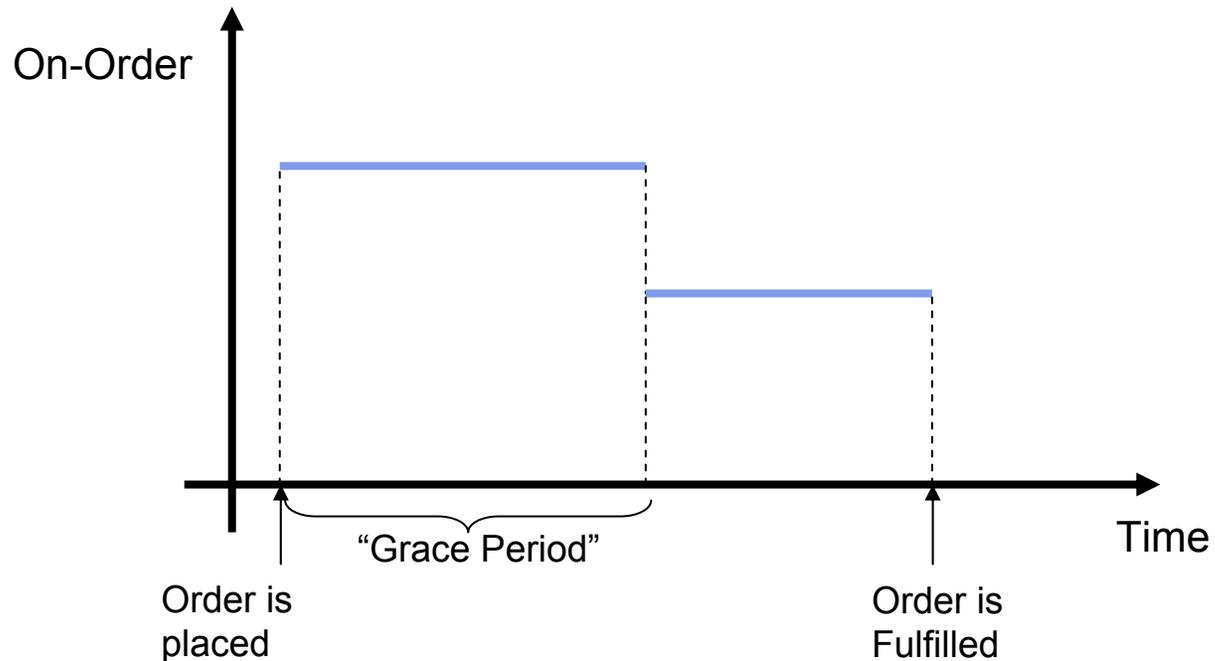
- When is something On-Order?
 - Order has been generated by the system
 - Order has been transmitted to the supplier
 - Order has been accepted by the supplier
 - Order has been shipped by the supplier
- Usually when an order has been generated by the system is added as an “on-order”
 - Includes an expected arrival date
- Expected arrival date is important
 - Will this expected arrival date get updated? By whom?
 - How about partial orders?
 - How about multiple vendors?

Inventory position: What can go wrong?

(cont.)



- Backorders & Committed
 - Cancellation policy
 - “Phantom Orders”



Q3: How much to order?



- Function of the inventory model
 - Order Point
 - Order Quantity
- Segmentation is widely used for selecting between inventory models or model parameters
 - ABC analysis on volume/sales dollars
 - Problems
 - Homogenous at the sub-class/item level
 - Little thought around variability
 - Not revised frequently enough
- Technology – Automated Replenishment
 - Exception based
 - Analysis tools (limited)



Which inventory models are used?

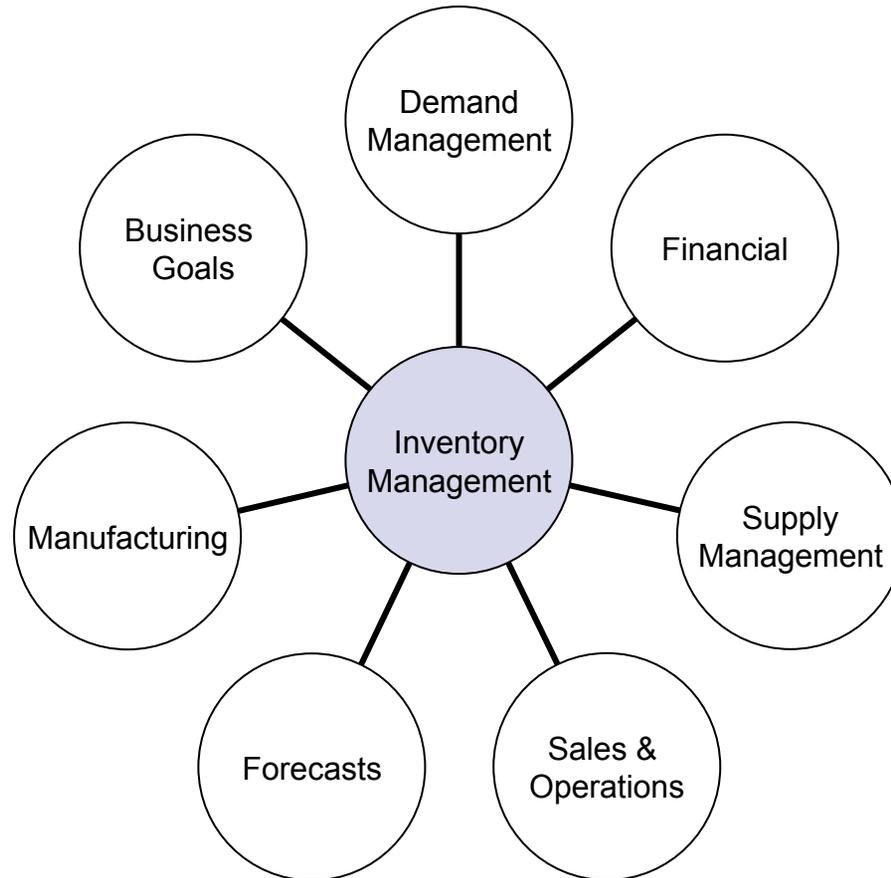
- Which ones are supported by my vendor or legacy system?
- Vendor selection becomes crucial
 - Cost/ROI
 - What is the problem I am trying to solve?
 - How does it fit with my business process?
 - Which inventory models are supported?
 - Do I have the data?
- Retail
 - Two broad types of products:
 - Basics – longer lifecycles, mostly seasonal
 - Fashion – short lifecycle, always seasonal
 - (R, s, S) – Also called min/max
 - Variations of (R, s, S) to accommodate seasonal demand
 - Variations of (R, s, Q)
 - To accommodate seasonal demand
 - Life cycle
- Manufacturing
 - All types of approaches
 - Forecasting based
 - “Supply Chain” based

Inventory models challenges - Assumptions



- Non - Stationary demand
 - Forecasting
 - Recalculate parameters on a regular basis
 - Manual
 - $(R, s[t], S[t])$
 - $(R, s[t], Q[t])$
 - May help with life-cycle
- Finite Capacity
 - Rough adjustments
- Independent items-locations
- No crossing/split of orders
- Demand size of one

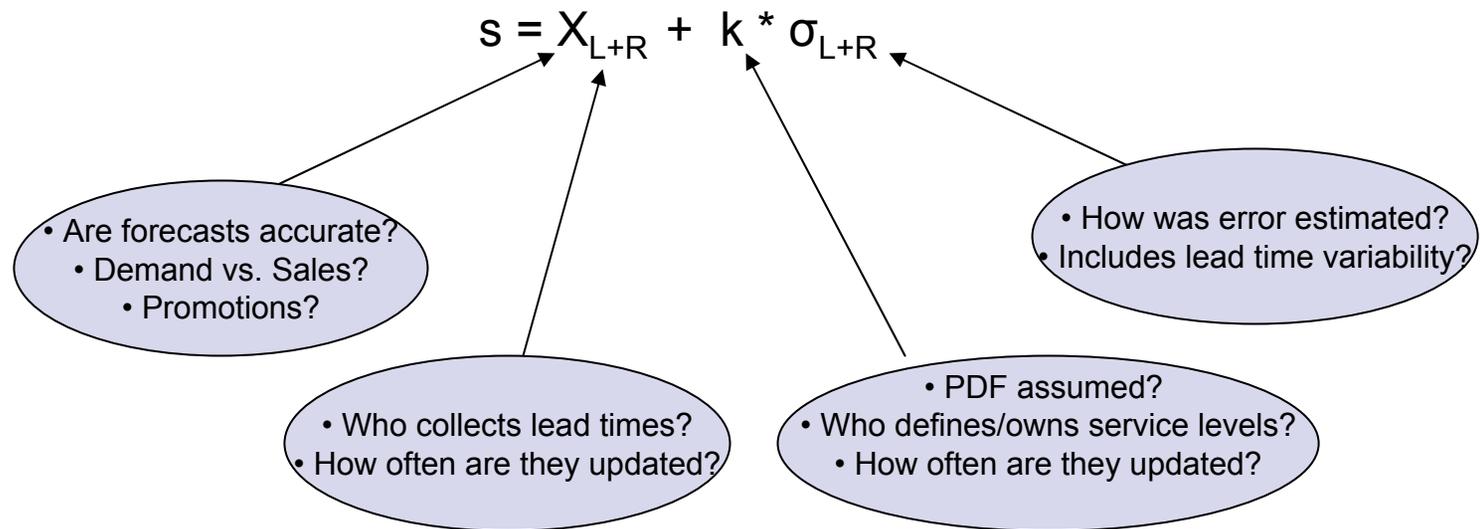
Inventory models challenges - Data: Garbage In, Garbage Out



Inventory models challenges - Data: Garbage In, Garbage Out (cont.)



Consider generic reorder point calculation:



- Technology & business processes are the main drivers to minimize the impact

Inventory models challenges - Consistently inaccurate data



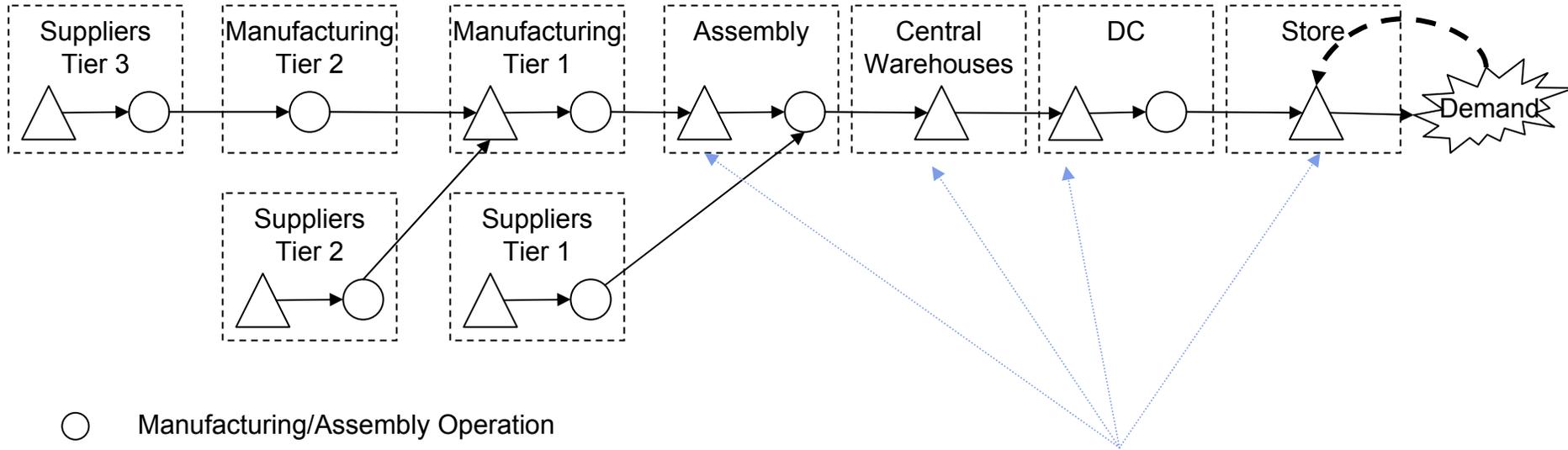
- Holding & ordering costs
- Service levels
 - Definition
 - Financial impact
- Service level targets at the item-location level
- Capacity
 - Push vs. Pull

Beyond the item-location



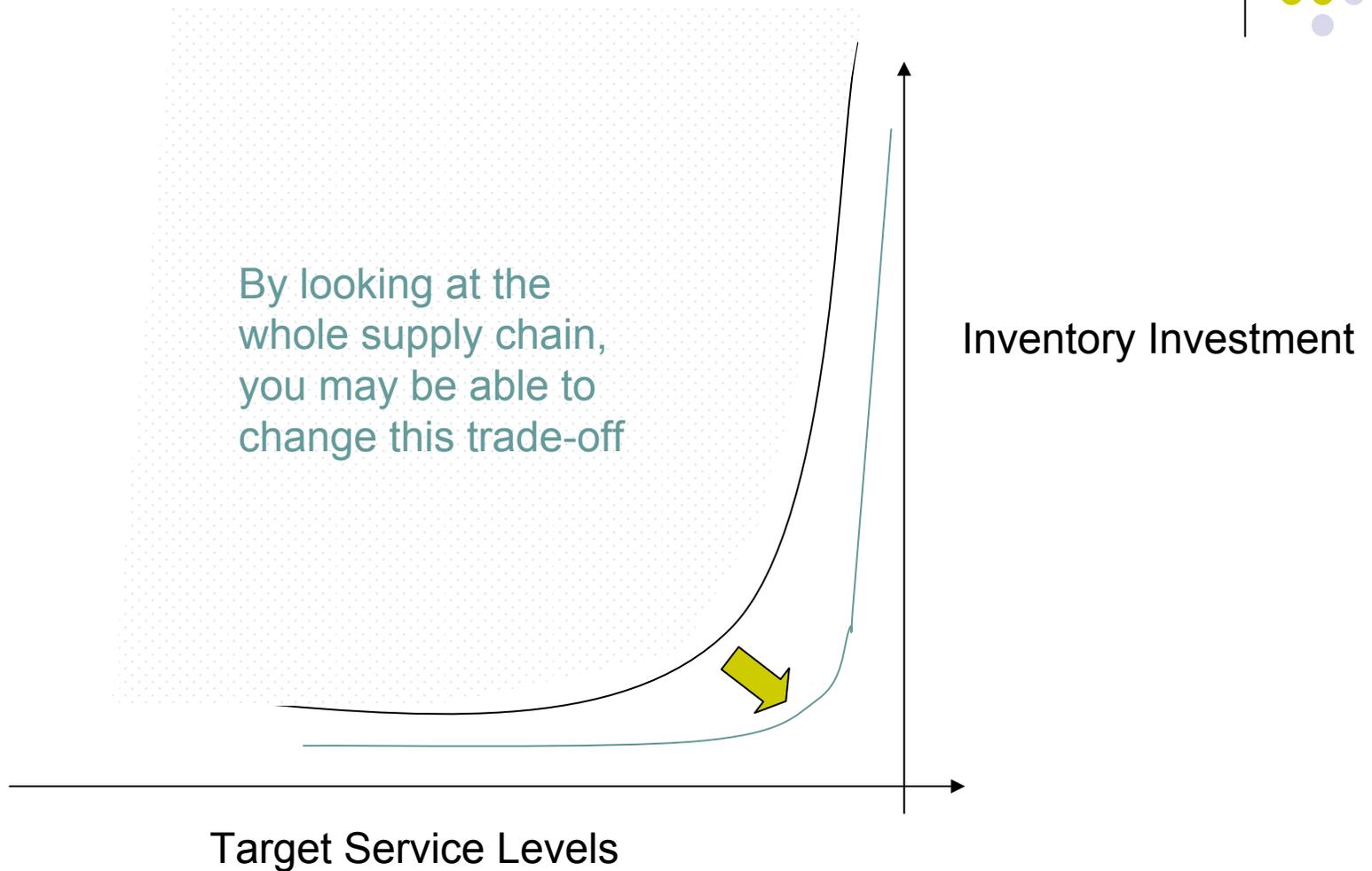
- Inventory decisions are made at the item-location level
- “Optimal” decisions at item-location may not be the best decisions for the system
 - Ex: Service level
 - Ex: Presentation stock
 - Ex: Substitute items
 - Ex: Vendor level management
 - Ex: Multi-echelon

Multi-echelon inventory management



Where should I keep the inventory?

The fundamental tradeoff



Multi-echelon inventory management



- Ignore it
 - Bullwhip effect - upstream levels of the supply chain observe higher variability which translates into higher safety stock levels
- Tackle it
 - Increase complexity
 - Visibility & data sharing
 - Advanced inventory models
 - Business processes!!!!

Technology landscape



- Legacy systems
 - Various degrees of sophistication
- ERP/SCP vendors provide inventory models in their base replenishment packages
 - Users have to configure parameters
 - Daunting task
 - Support tools sold separately
 - Integration with forecasting (data level)
 - Check the assumptions!
- Niche vendors connect to ERP systems to provide tailored inventory management models

Niche vendors

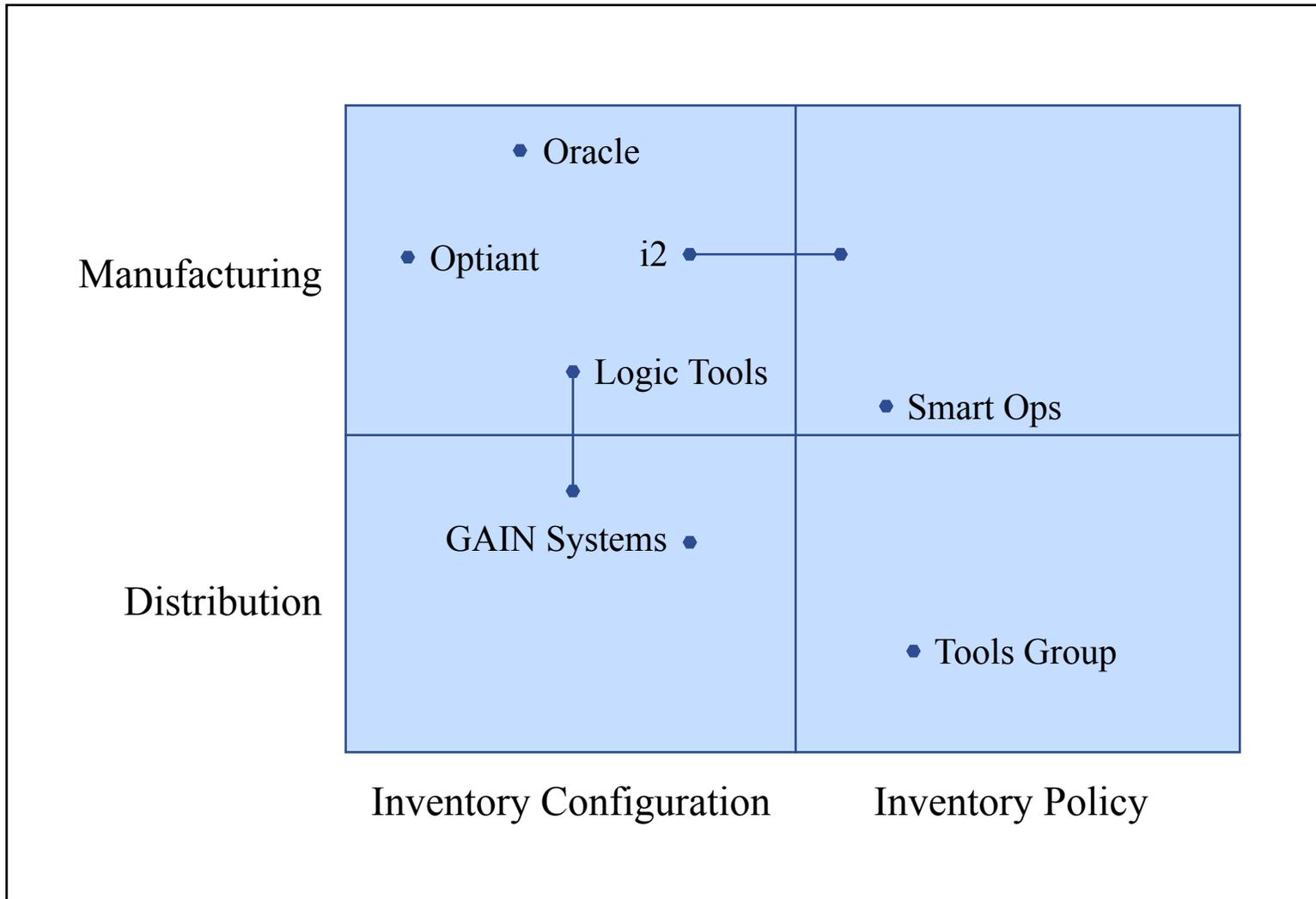


Figure by MIT OCW.



Questions?

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