Innovation in stock optimization

THE NEXT FRONTIER : MULTI-ECHELON PLANNING

Breda, November 2015

9026X113 RK-AB Innovation in stock optimization

GROENEWOUT

WHY INVENTORY?

5 REASONS FOR KEEPING INVENTORY

Supply chain: from raw materials till consumer

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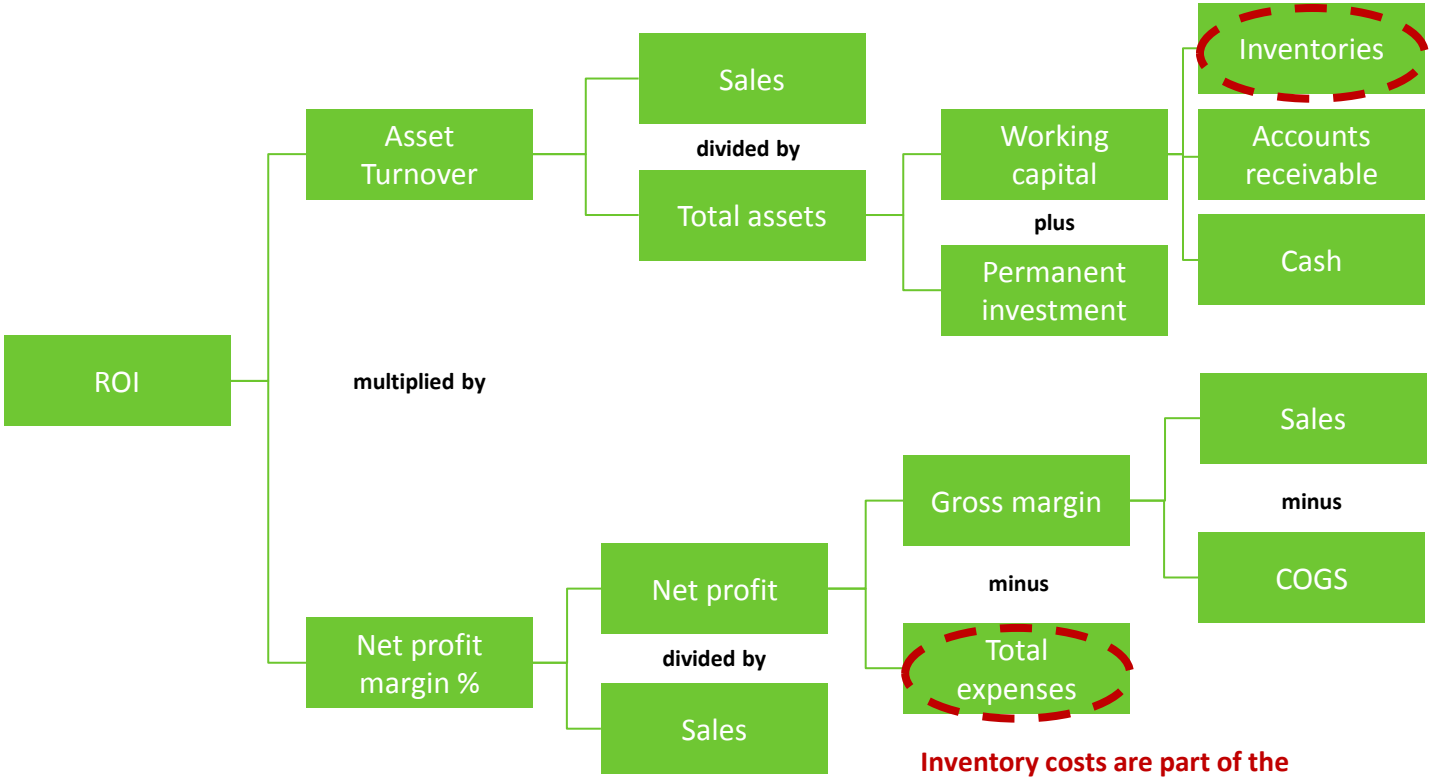
- **Strategic**: trading & speculation
- **Capacity**: limited capacity requires stockbuild (e.g. seasonality)
- **Order quantity**: economic to order more than 1 pcs.
- **Uncertainty**: demand -, supply quantity and lead times
- **Lead time**: Coverage of lead time demand

The impact of inventory on Return On Investment

INVENTORY IMPACTS THE ASSET TURNOVER AND NET PROFIT MARGIN

DuPont chart: Inventory affects asset efficiency and net profit



On average companies* have 12,8% of their annual sales value on stock

Inventory costs are part of the expenses which are about 15-20% of the COGS

Inventory reduction results in an **increase** of **asset turnover** and **net profit margin**. Meaning that the **ROI** is leveraged from both sides. A lean inventory is a key issue to become an **industry leader**.

*source: working capital benchmark PwC July 2014

Inventory management scale

ASSES YOUR COMPANY INVENTORY MANAGEMENT MATURITY

Level of professionalism in inventory management

Symptoms	• Gut feeling inventory management • Many back orders • No idea about stock quantities and service level	• Days on inventory policies • Excel based computations • Inventory is monitored	• Basic statistic inventory calculations (P1) based on historic demand • ERP or Excel based computations • Inventory is monitored	• Demand and forecast planning • S&OP processes • Single echelon inventory optimization (P2) • Inventory is monitored	• Demand and forecast planning • S&OP processes • Multi-echelon inventory optimization • Inventory specialist
Service level:	**50-60%**	**60-80%**	**80-95%**	**Up to 99,9%**	**Up to 99,9%**
Potential:	**Base Case**	**Limited**	**20-30%**	**30-50%**	**> 50%**

Inventory strategy

THE MAIN 4 CONSIDERATIONS

- The value density of a product
- The criticality of a product for the continuity of your operation (internal as external)
- Predictability and variability of the demand
- Supplier lead-time and reliability

Straightforward extrapolations

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Straightforward extrapolations

PRAGMATIC, BUT NOT NECESSARILY WRONG

KANBAN

PULL KANBAN

GROENEWOUT

Singe echelon optimization

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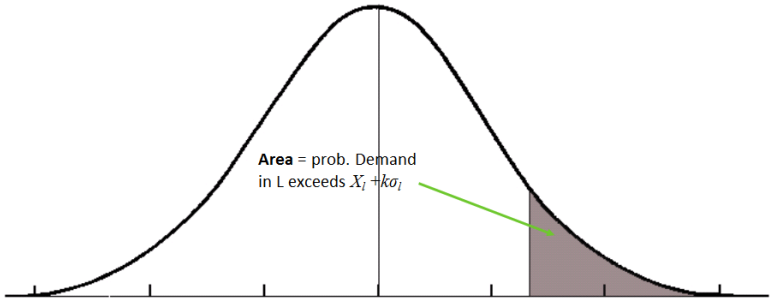
Single echelon optimization

STATISTICAL BASIC INVENTORY OPTIMIZATION

- **Four steps**
  1. Historic demand data
  2. Distribution fitting to lead time demand
  3. Implementation of basic safety stock calculations
  4. Calculate (and simulate)

- **Frequent mistakes**
  - Incorrect formulas
  - Excluding uncertainty in supply
  - Misunderstanding of inventory position

- **Best practices**
  - One year historic demand
  - Weekly time buckets
  - Frequency: twice per year



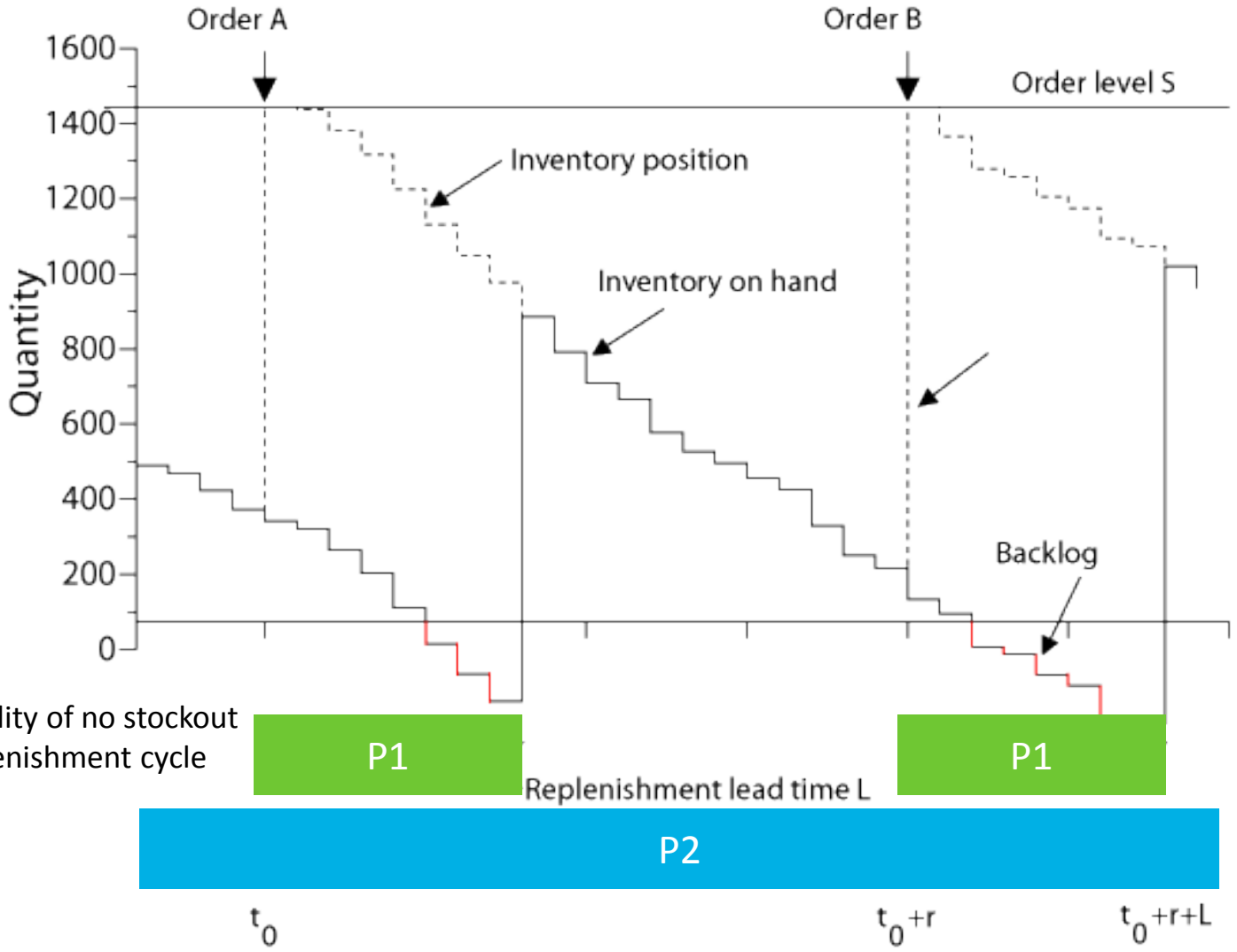
Safety stock based on service levels and charges

SAFETY STOCK DECISION RULES

- Specified Probability **(P1)** of No Stockout per Replenishment Cycle – Cycle Service Level.
- Specified Fraction **(P2)** of Demand to Be Satisfied Routinely from the Shelf – Fill Rate
- Specified Fraction of Time **(P3)** During Which Net Stock is Positive –Ready Rate
- Specified Average Time **(TBS)** Between Stockout Occasions

Customer Service Level: P1 vs. P2

DIFFERENCE BETWEEN P1 AND P2 EXPLAINED



P1: Probability of no stockout during replenishment cycle

P2: Fill Rate

Potential of 30-50% by using P2

P2 CALCULATES WITH EXPECTED VALUE RATHER THAN PROBABILITY

- The expected value when rolling a dice
  - The expected value is 3,5
  - (1/6 * 1) + (1/6 * 2) + (1/6 * 3) + (1/6 * 4) + (1/6 * 5) + (1/6 * 6) = 3,5

- Expected value of a stock-out when rolling a dice
  - Demand during lead-time is determined by the dice
  - Re-order point is 4 units
  - Expected value of stock-out is:
    (1/6 * (5-4)) + (1/6 * (6-4)) = 1/6+2/6 = ½

- P2 versus P1 service level definitions

P2
- P2 implies 4 cycles without stock out, 1 cycle with 1 unit stock-out, 1 cylcle with 2 units stock-out
- With purchase order qty. of 10 units, P2 service level is 1 -(½ / 10) = 95%

P1
- P1 would indicate a service level of 1 – (2/6) = 67%

Potential of 30-50% by using P2

BESIDES DEMAND AND FORECASTING PLANNING CAN REDUCE VARIANCE IN LEAD TIME

- **Approach**
  - The approach of P2 is similar to P1
  - Calculated based upon expected value rather than probability
  - P2 can be implemented in Excel, but it is more difficult

- **Frequent mistakes**
  - Using P1 in case of high order quantities leads to dead stock
  - Forecast error which is higher than the variance in demand

- **Best practices**
  - In case of high order quantities use P2
  - Demand and forecast planning is key in lowering safety stocks

Multi-echelon optimization

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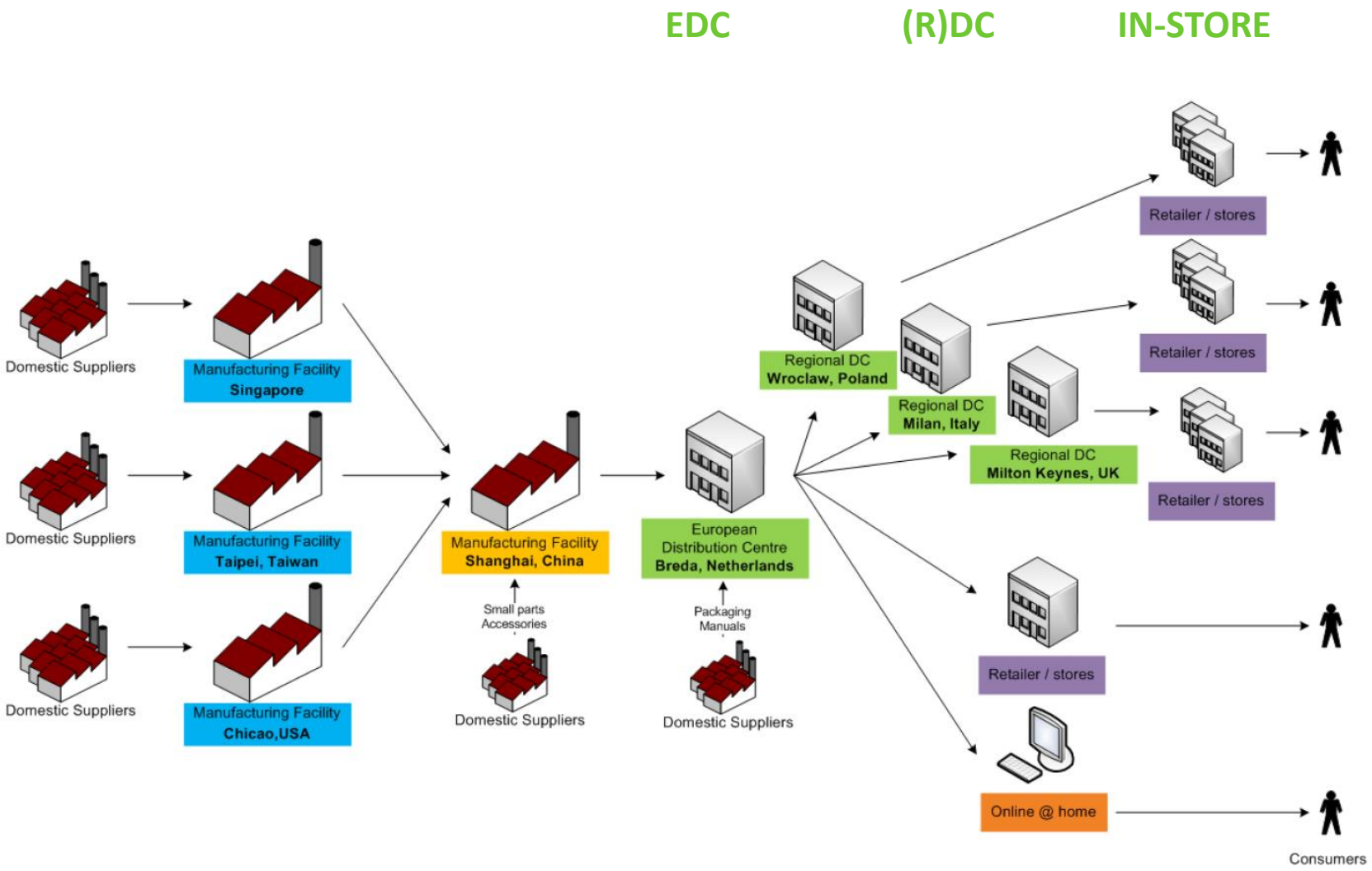
Multi-Echelon Inventory optimization

COMPLEX SUPPLY CHAINS WITH BILL OF MATERIALS



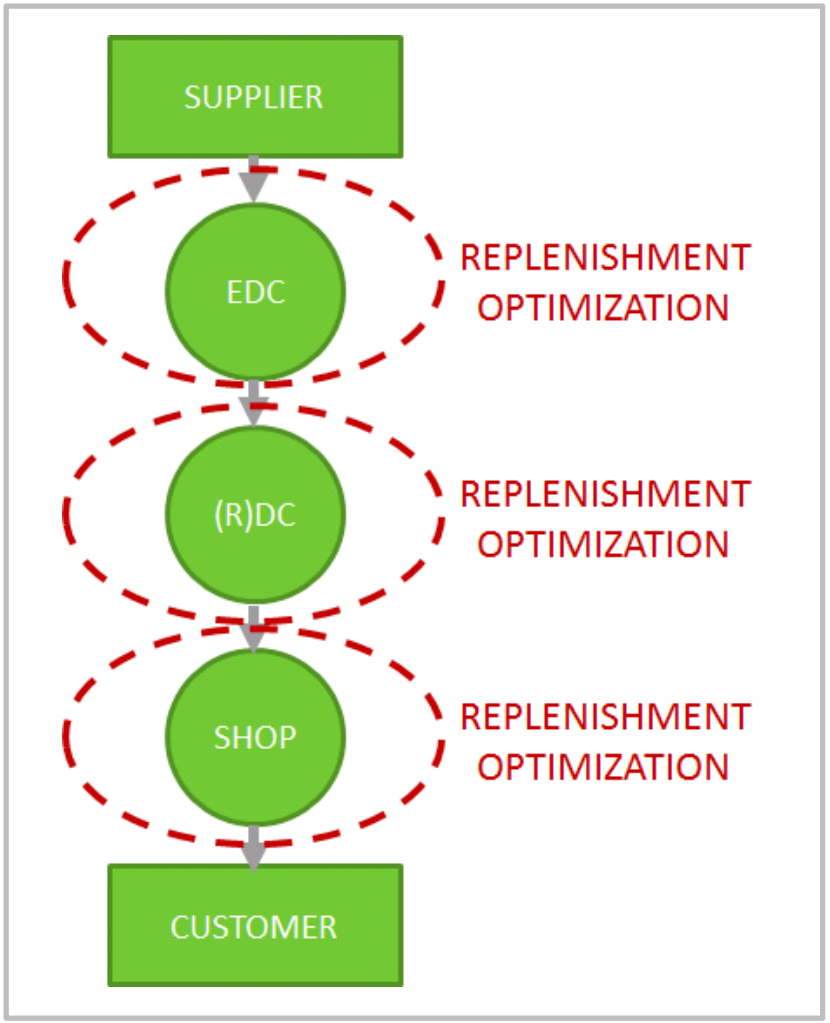
Multi-Echelon Inventory optimization

SIGNIFICANT EXTENDED PLANNING ISSUES

- What is the proper measure of demand to the EDC and (R)DC and how should this demand be forecasted?
- How does the trend towards larger orders from the EDC to the supplier affect the order supply strategy for the (R)DC & shop SKUs?
- What is the optimal service level goal between the EDC and its "customers," which are the (R)DCs?
- How do you factor the individual DCs' inventory positions into the RDC and shop replenishment decisions?
- How do the inventory drivers at the EDC, such as the replenishment review frequency and the service level goal, affect inventory and service levels at the (R)DC & shop level?
- When faced with a limited supply situation at the RDC, how should you allocate product down to the DCs?

Multi-Echelon Inventory optimization

THE TWO TRADITIONAL APPROACHES



TRADITIONAL SOLUTIONS

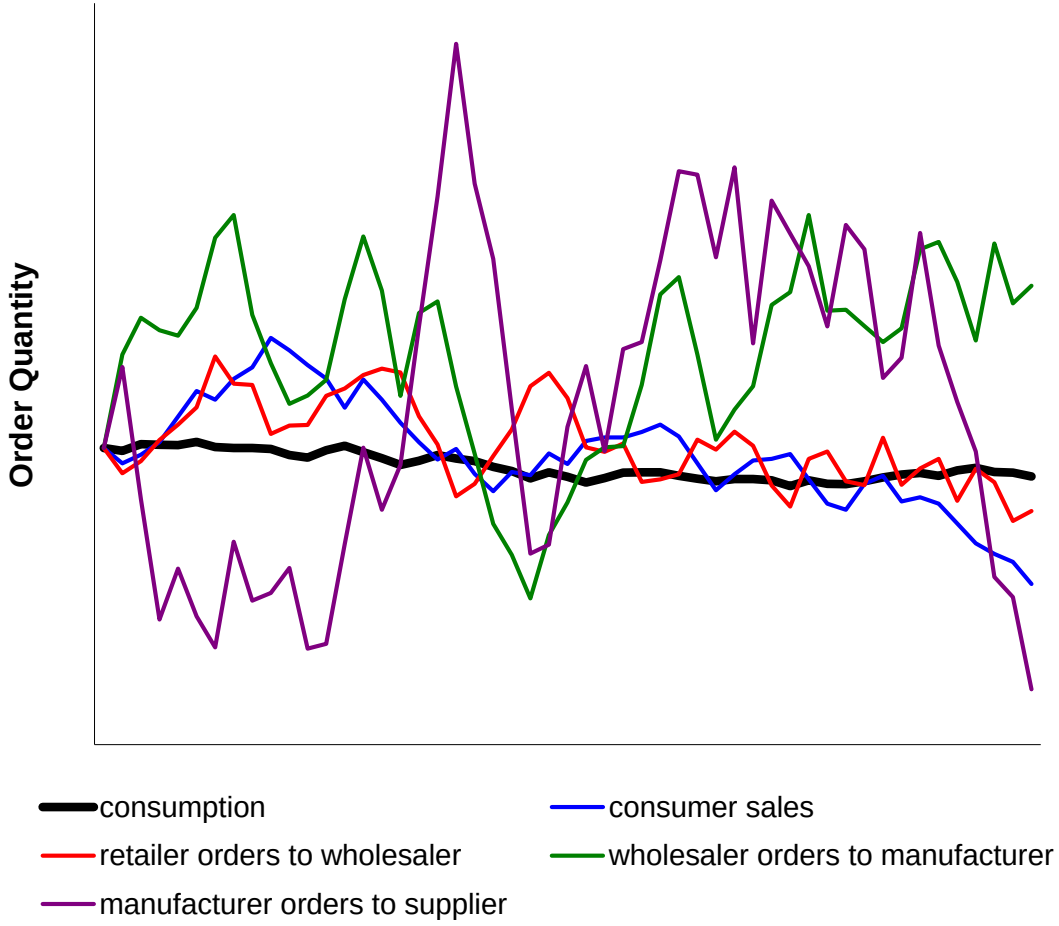
- Apply the single-echelon approach to each echelon in the network
- Use a distribution requirements planning (DRP) approach or a variation

SHORTCOMINGS

- Lack of visibility in the demand chain
- Demand distortion from the bull-whip effect.
- Total network costs remain unevaluated.

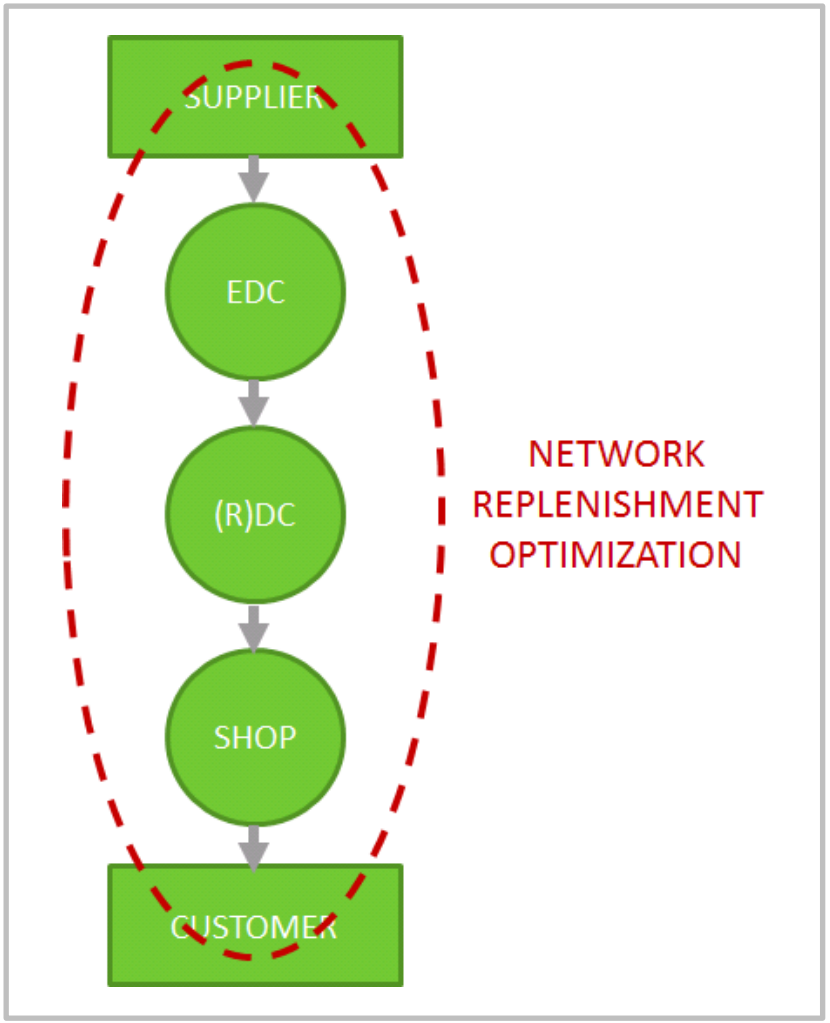
No suitable traditional multi-echelon approach

BULL-WHIP EFFECT



Multi-Echelon Inventory optimization

TRUE MULTI-ECHELON APPROACH

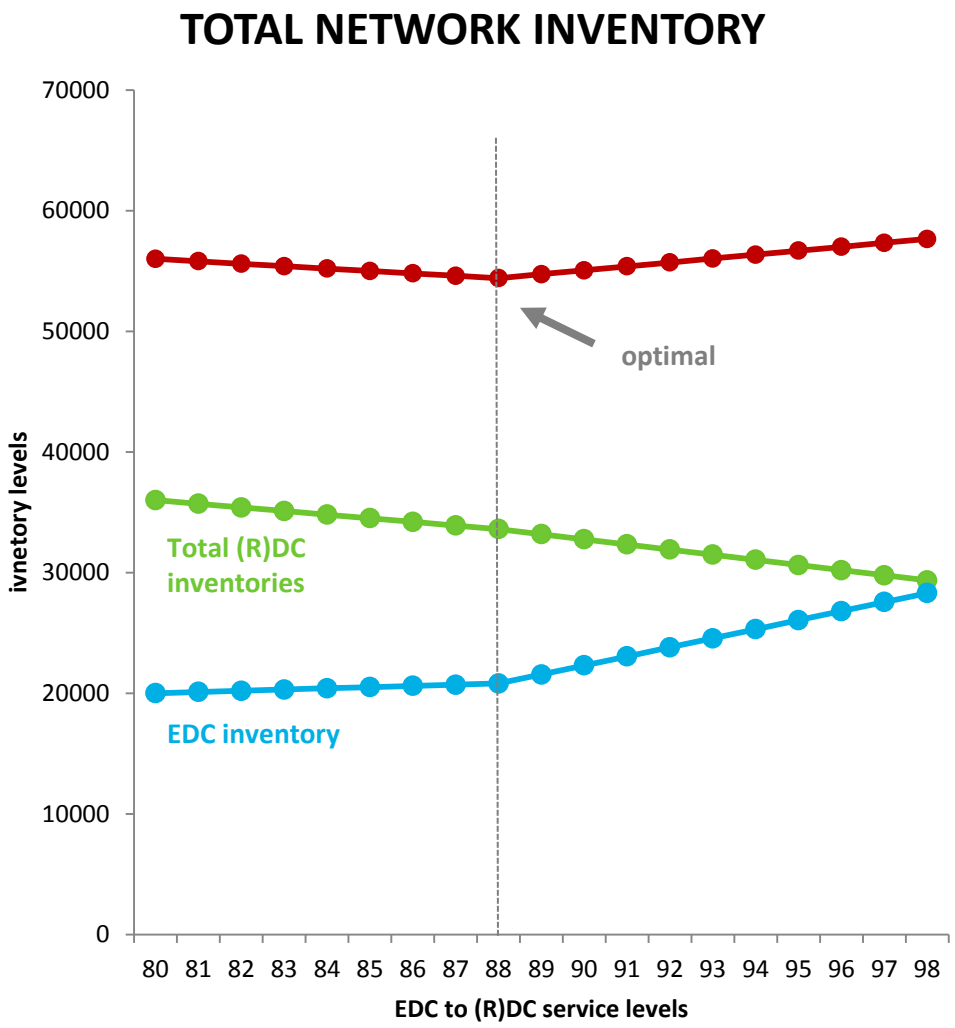


MULTI-ECHELON APPROACH SHOULD

- Avoid multiple independent forecast updates in each echelon.
- Account for all lead times and lead time variations.
- Monitor and manage the bull-whip effect.
- Enable visibility up and down the demand chain.
- Synchronize order strategies in all echelons & correctly model the interactive effects of alternative replenishment strategies of one echelon on another.
- Offer differentiated service levels.

Tackling the bull-whip effect

DETERMINE THE MINIMUM NETWORK INVENTORY OVER ALL ECHELONS



How it worked out for Philips

ELIMINATION OF THE BULL-WHIP EFFECT

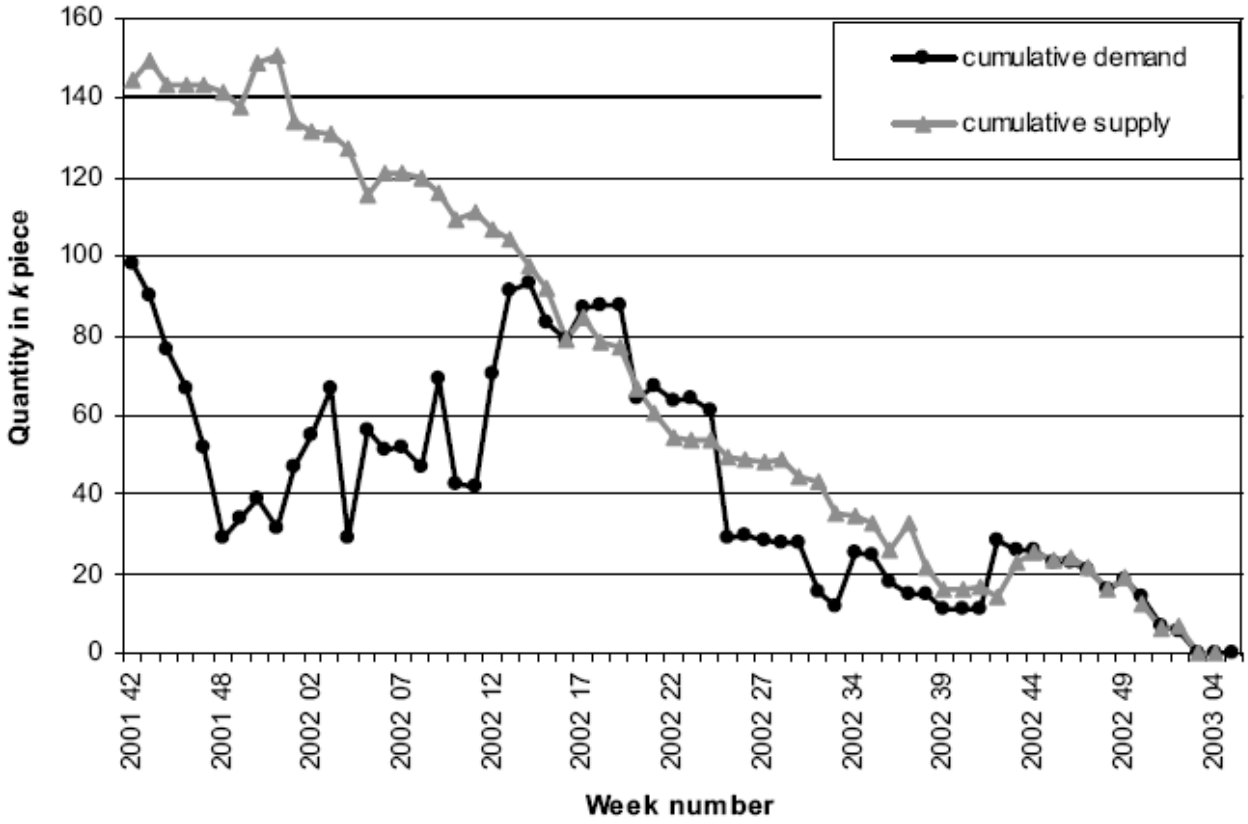


Figure 3: In a successful ramp-down at the end of the life cycle of a product, as a consequence of the new planning process, the gap between demand and supply decreased (first half of the graph), and then supply started following demand closely (second part of the graph) with almost no obsolescence at the end of the life cycle.

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