TURKISH AVIATION ACADEMY

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Operations & Logistics Management in Air Transportation

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Air Transportation Management

M.Sc. Program

Air Transportation Systems and Infrastructure

Strategic Planning

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Beergame
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Beer Game Debriefing

With matterial adopted from Beergame Debriefing, by Kai Riemer, http://www.beergame.org; Lee et al. (1997)

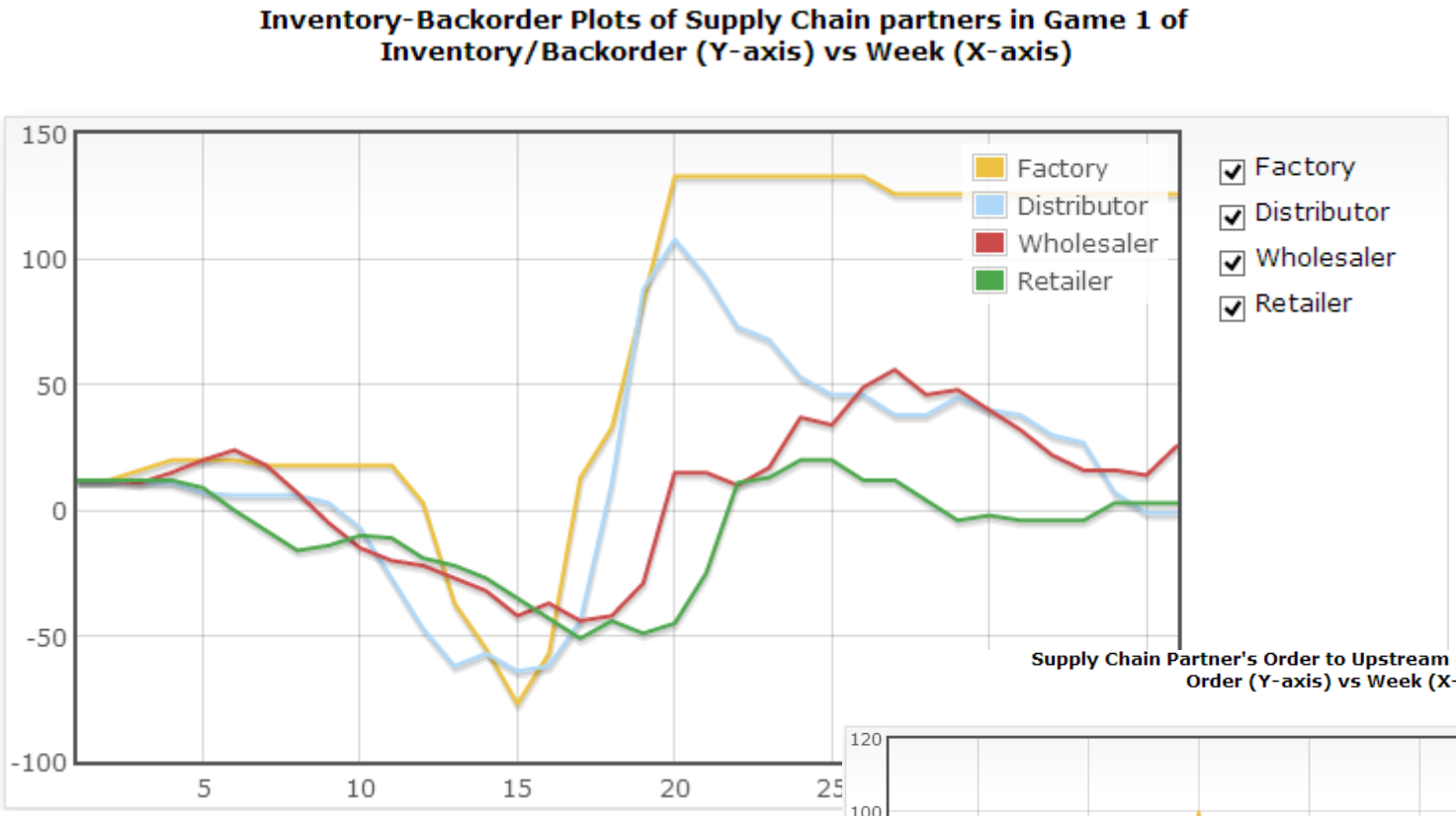
Experiencing the effects of systems dynamics

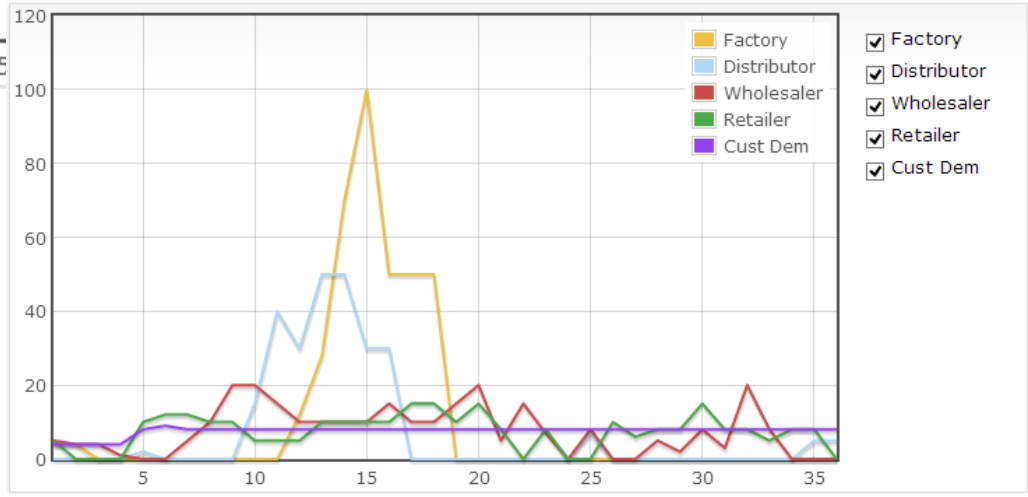
- Did you feel yourself controlled by forces in the system from time to time? Or did you feel in control?
- Did you find yourself "blaming" the decision makers next to you for your problems?
- Did you feel desperation at any time?

Some questions for discussion

- What, if anything, is unrealistic about this game?
- Why are there order delays?
- Why are there production delays? Shipping delays?
- Why have both distributor and wholesalers? Why not ship beer directly from the factory to the retailer?

Results of the game: basic setting (1-4, 9)





Bullwhip effect → problems

- High inventory levels
- Low service level (back orders)
- High cost
- High demand fluctuation causes more problems.

Bullwhip effect → problems

- Variation in demand along the supply chain requires
  - Shipment capacity
  - Production capacity
  - Inventory capacity
- to cope with peaks.

- Most of the time this capacity will be idle.
  - There's significant cost and investments attached!

- In the end: high overall cost in the supply chain
  - But competition between supply chains and networks, not just between individual companies!

Real world examples

- Procter and Gamble's diapers (1997)
- Barilla's pasta supply chain (1994)
- Soup manufacturer (1997)
- TV set industry (1968)
- Machine tool industry (2000)
- Semiconductor equipment – PC industry (2005)

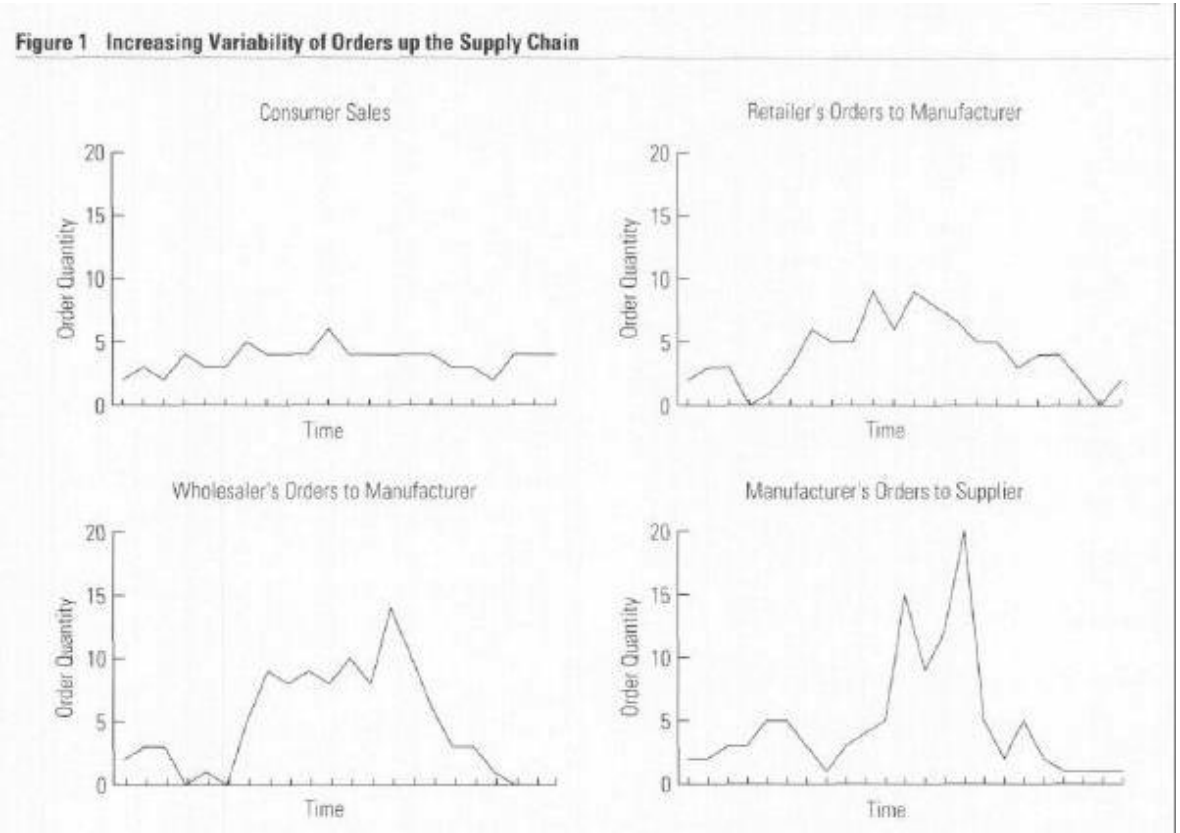


Figure 2 Higher Variability in Orders from Dealer to Manufacturer than Actual Sales

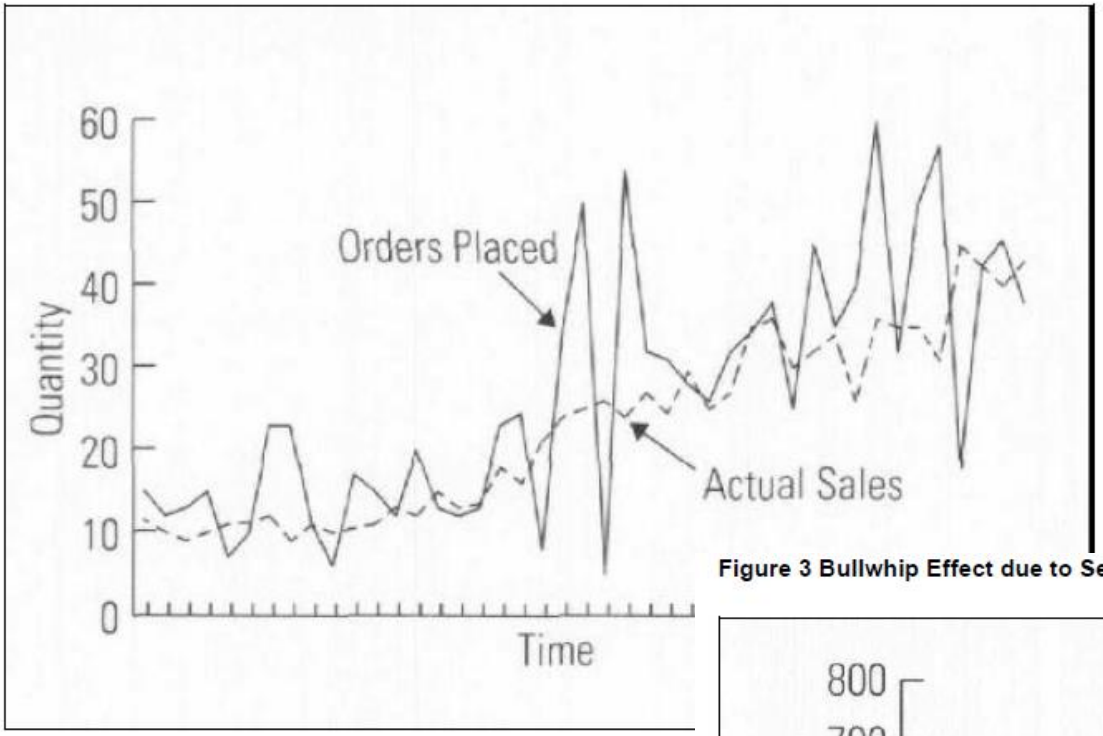
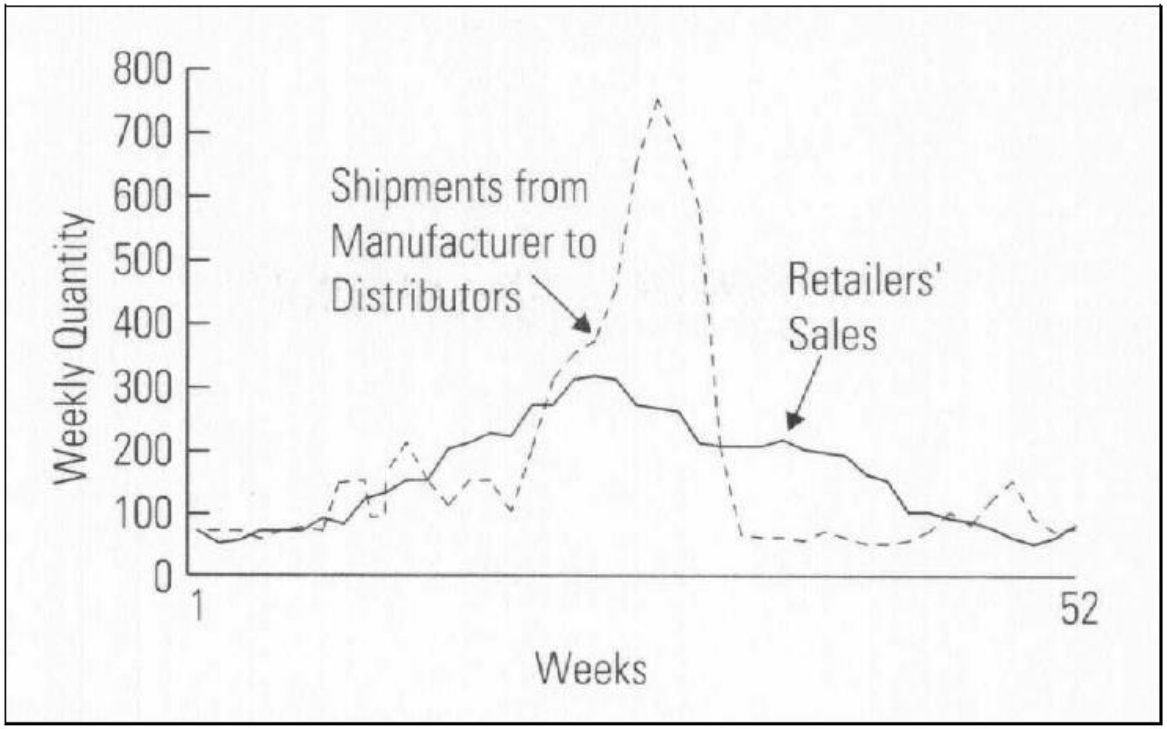


Figure 3 Bullwhip Effect due to Seasonal Sales of Soup



Real world reactions

- A typical organizational response would be to find the "person responsible" (the guy placing the orders or the inventory manager) and blame him.
- But the game clearly demonstrates how inappropriate this response is
  - different people following different decision rules for ordering create similar oscillations.

- We have to change the structural setup!

Factors contributing to bullwhip effect

- **Demand forecasting**
  - Usage of aggregate and thus inaccurate data does not allow for good predictions
  - High variability leads to continuous adaptations of order policies and thus increases variability upstream
- **Lead time**
  - High lead time creates uncertainty
  - Requires high safety stock levels
  - Reduces flexibility and adaptability to unforeseen changes in demand

Factors contributing to bullwhip effect

- **Batch ordering**
  - Batch ordering at one stage in SC leads to observing high variability at next stage upstream:
    - one week large order followed by weeks with no order
    - Contributors: fixed ordering costs, transportation and price discounts
- **Price fluctuation**
  - Stock up when prices are lower → large orders
  - Promotions and discounts
- **Inflated orders**
  - In time of shortages, suppliers place big orders when expecting to be allocated proportionally

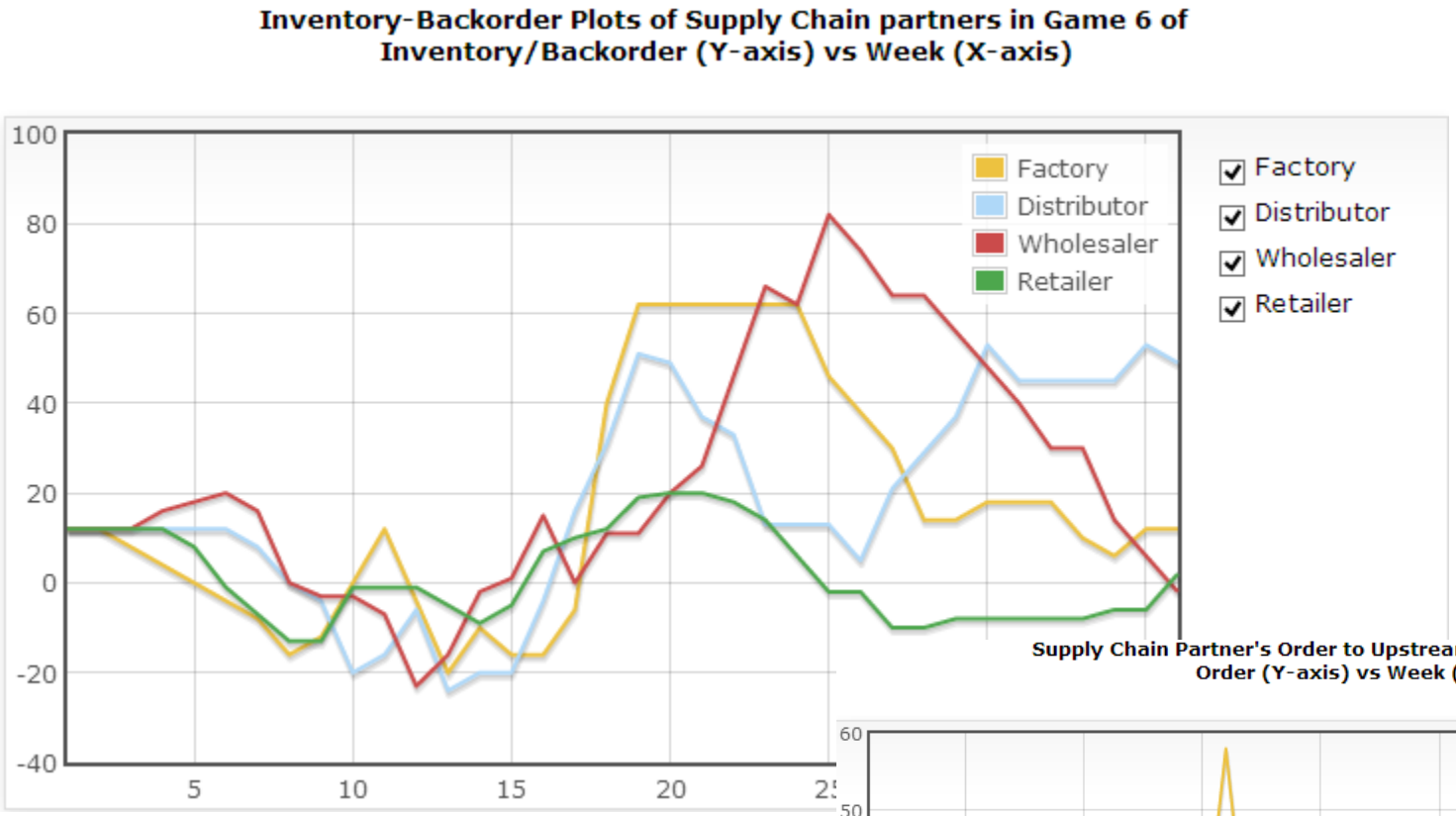
Lessons

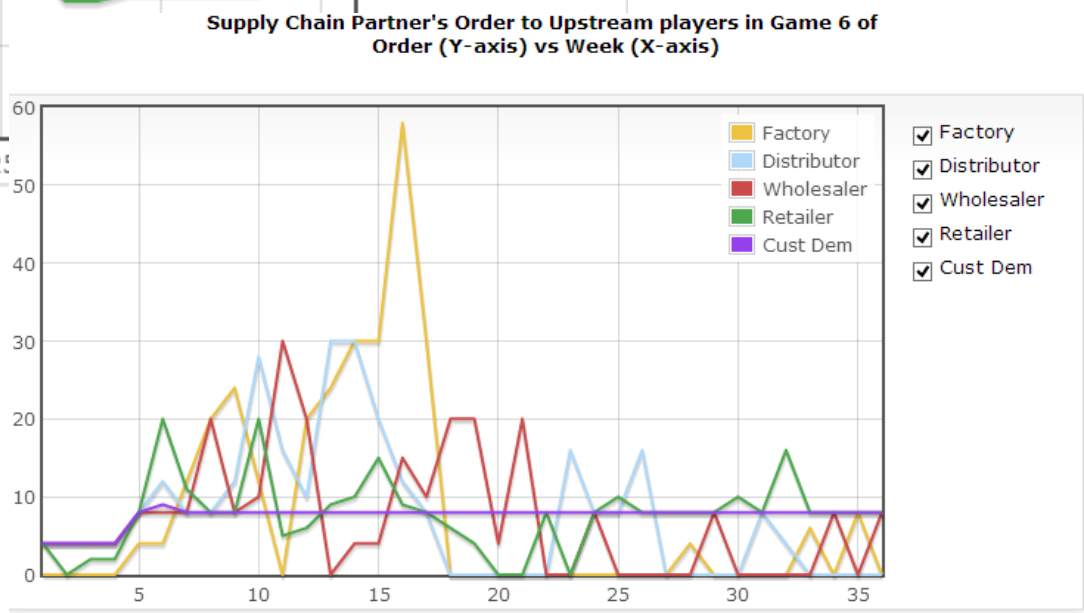
- In traditional supply chains information about consumer demand is only passed up the supply chain through the orders that are placed
  - Or using aggregated figure
- Information is therefore lost
- High Buffer stocks result
- Even if each party acts “optimally” individually the result is less than optimal for the whole supply chain
- Result is higher prices, less sales.

BUT:

- Competition is now supply chain against supply chain and Network against network

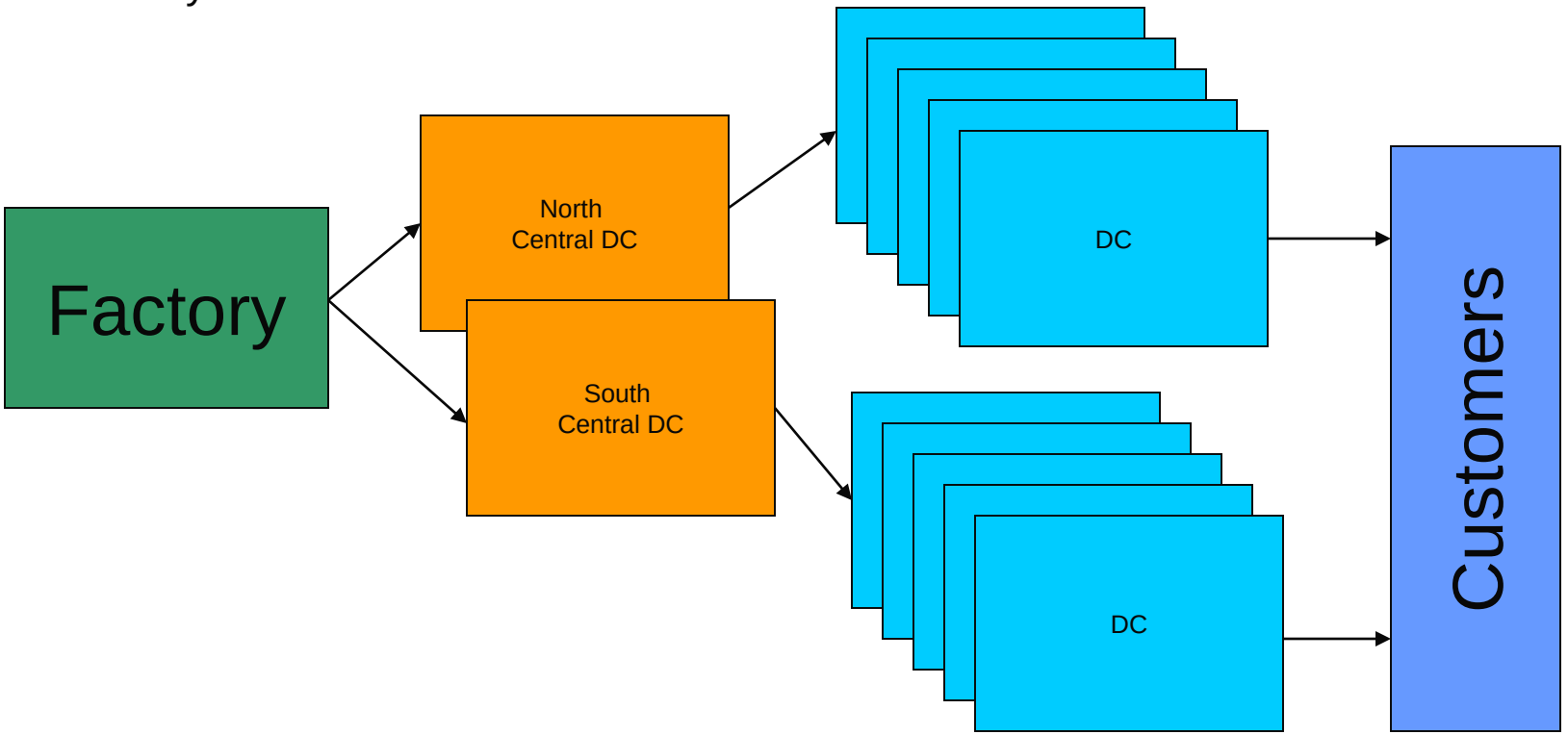
Results of the game: information sharing (5-8)



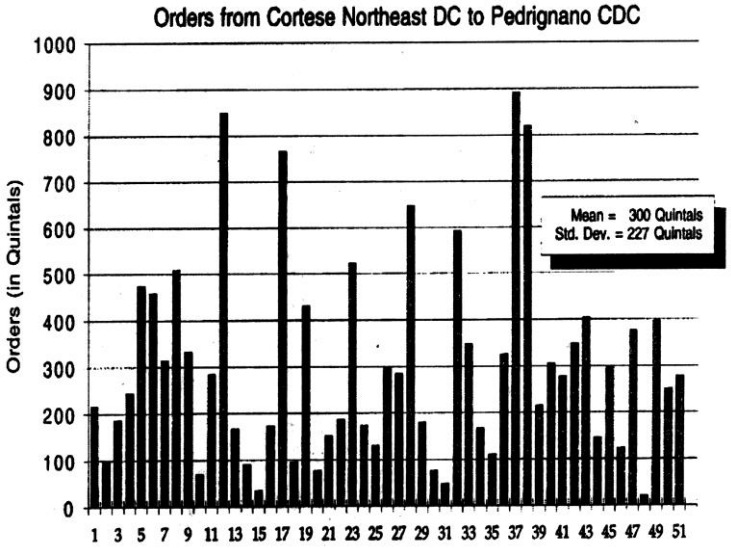


Barilla

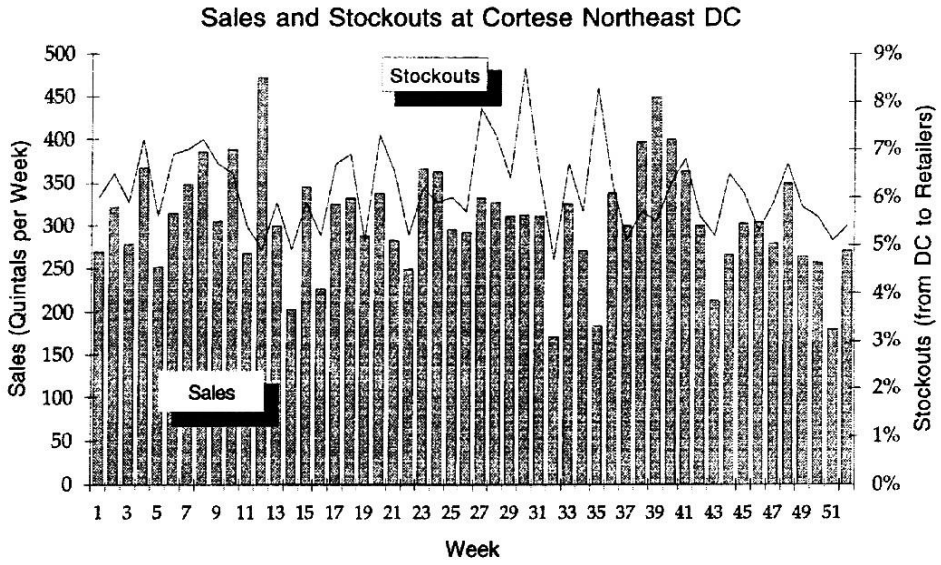
- Manufacturer of “fresh” and “dry” pasta products
- Largest pasta manufacturer in the world with >1000 SKUs
- $2B in sales
- Very stable demand at retail level



The bullwhip effect at Barilla pasta



Upstream variability is much higher (std. dev = 227)



Downstream variability at DC: mean demand is about 300, the std. dev. is about 75

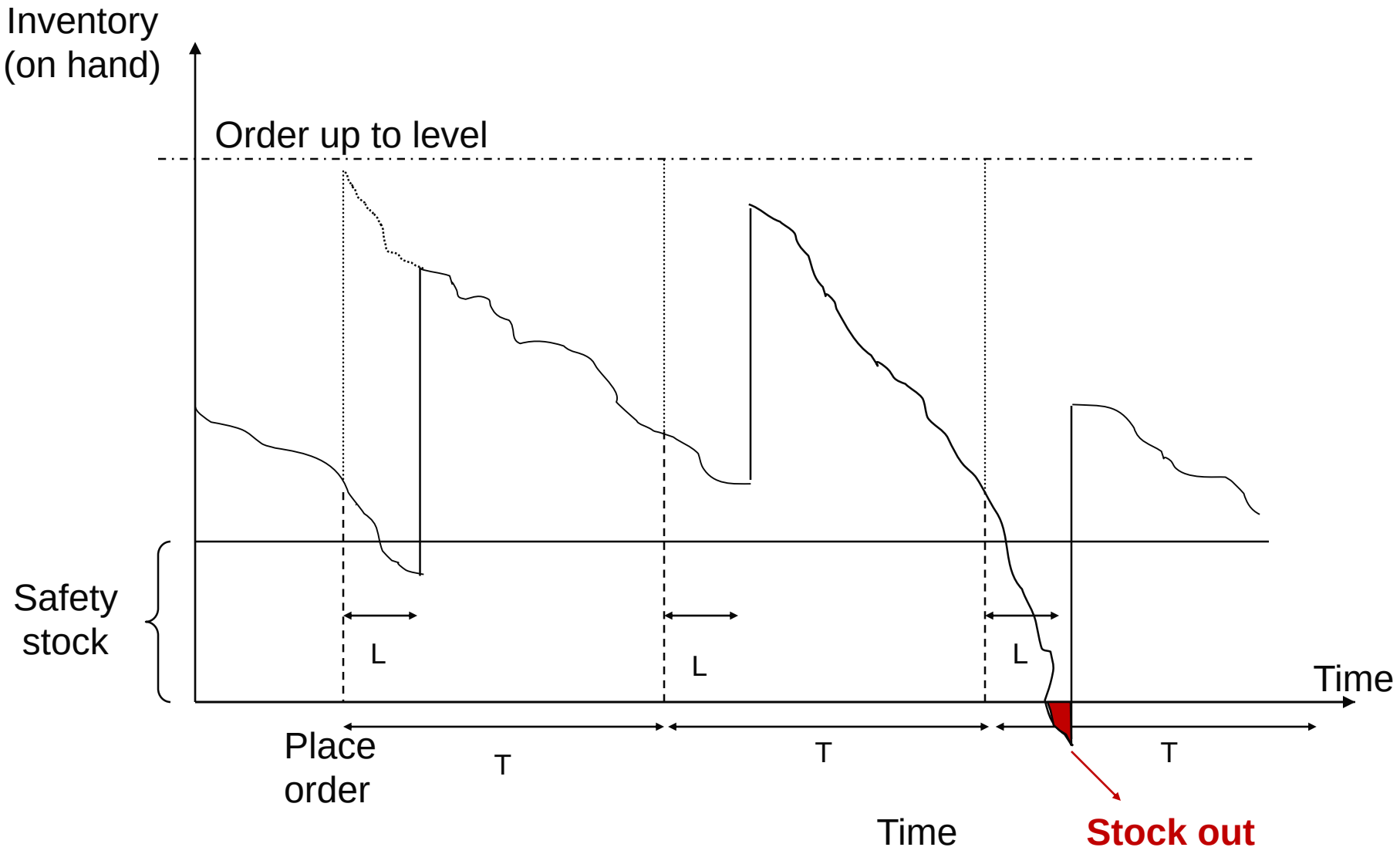
Why was this happening in the Barilla SC?

- Transportation discounts
- Volume discounts
- Promotional activity
- No Min / Max order quantities
- Variety (SKUs)
- Lead time and strange inventory management
- Stock outs (6-7%) cause gaming and over reaction
- Sales Compensation schemes?
- Demand information and Forecasting

Issues emerging

- Production:
  - Quality
  - Increases costs
  - Utilization issues
  - Huge inventory costs
- Central distribution's
  - Inventory costs
  - Forecast and schedule resources such as trucks work force
  - Hiring went up.
  - Utilization issues
- Italians hoard and consume even more pasta

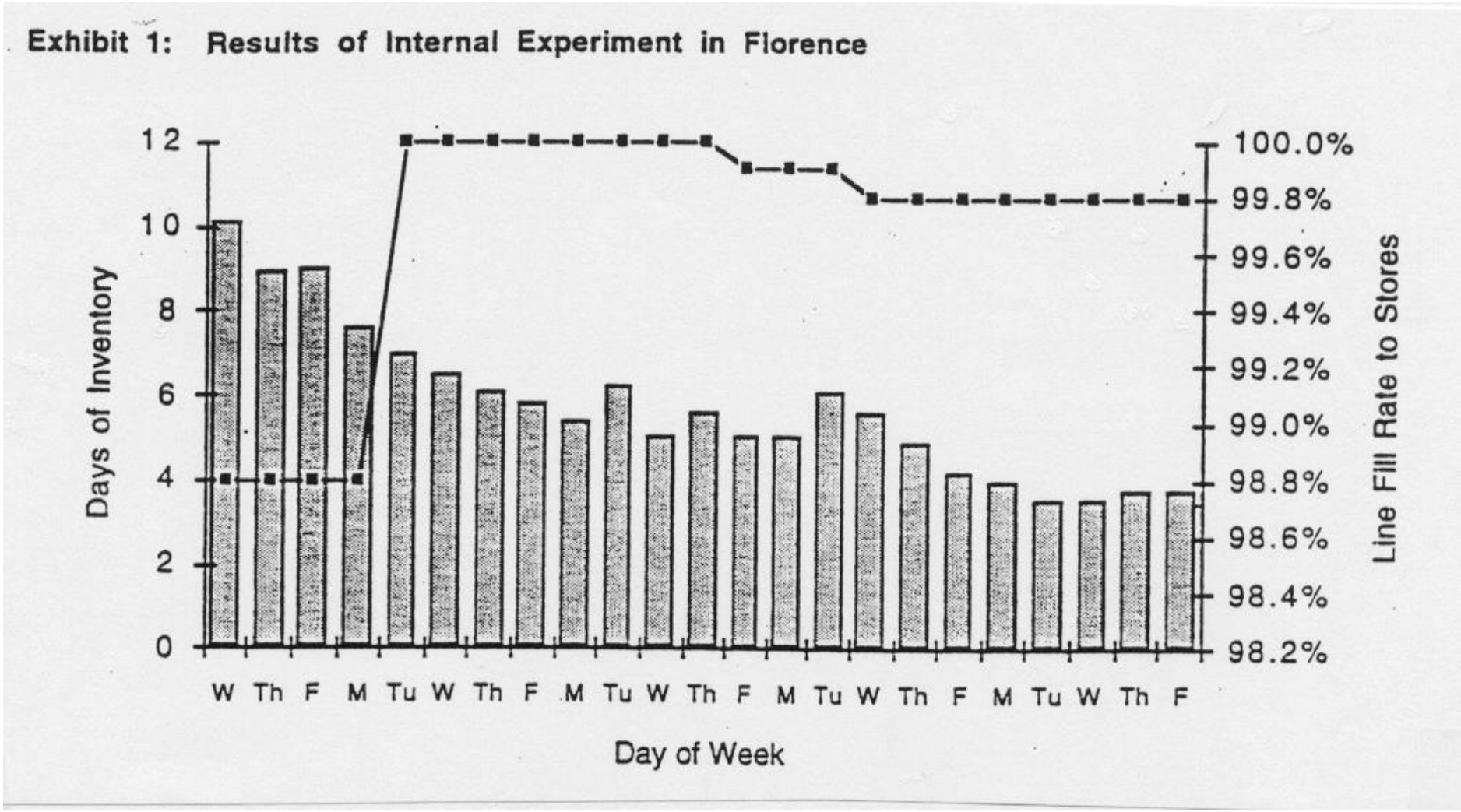
Periodic Review Inventory Model



Proposed solution

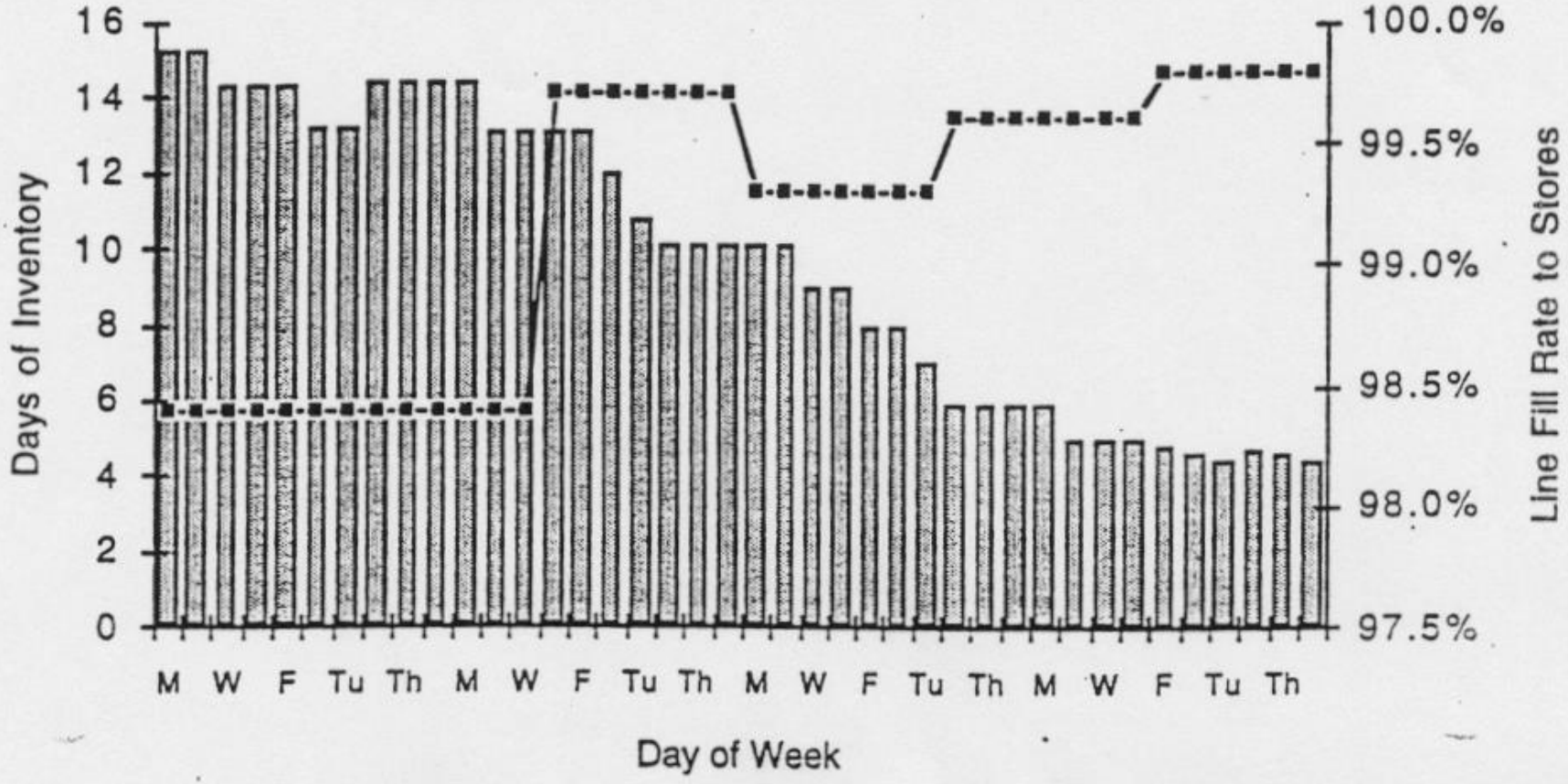
- **Just in Time Distribution (JITD)**
  - Another variation is the Vendor Managed Inventory (VMI)
  - Downstream distribution center (DC) reports inventory and sales data electronically to Barilla on a daily basis.
  - Barilla decides how much and when to ship product to the DC.
- Issues?
  - Internal conflicts
    - Our sales will flatten as we don't push the products
    - If space is freed at distributor, competitors might come in
    - We run the risk of not being able to adjust shipments
  - External conflicts
    - Distributors many be unwilling. Trust?

Run one month Experiment



Run one month Experiment

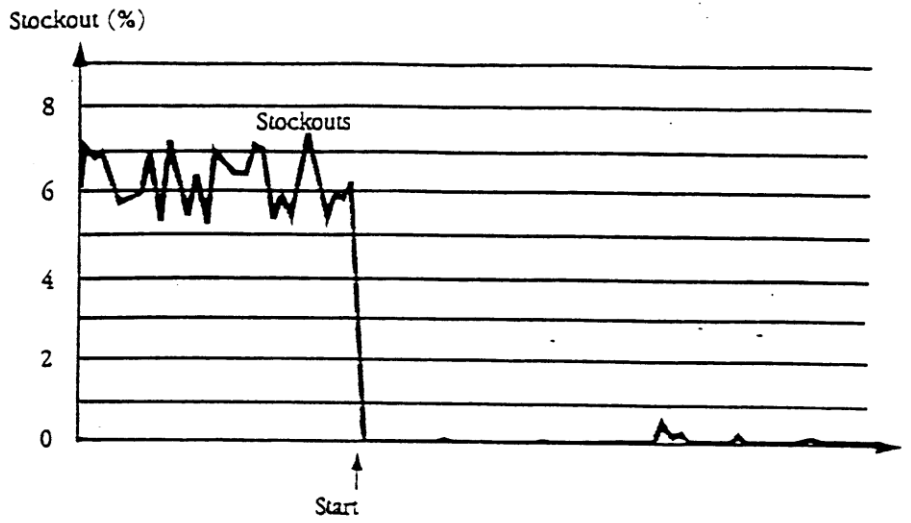
Exhibit 2: Results of Internal Experiment in Milan



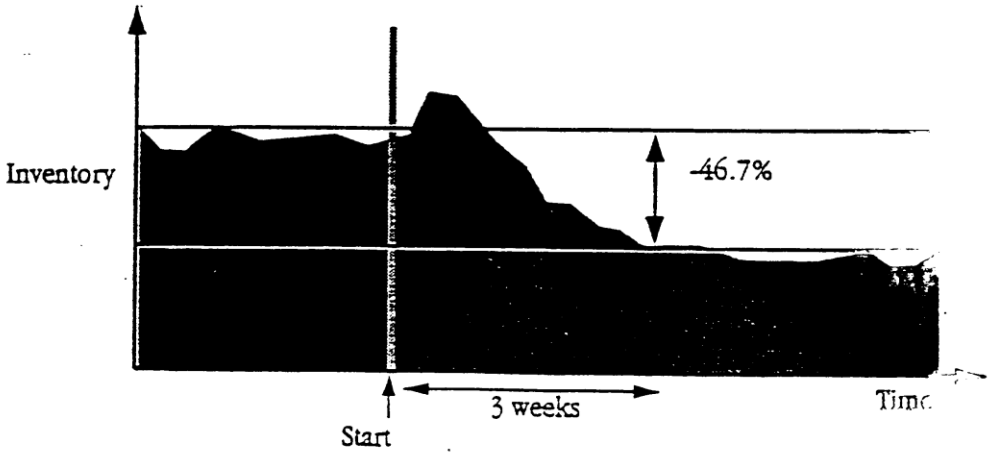
Impact on the DC

Exhibit 1: Results from Test in Marchese Distribution Center

Stockout rate from Marchese DC to Retailers, Before and After Start of JIT Program

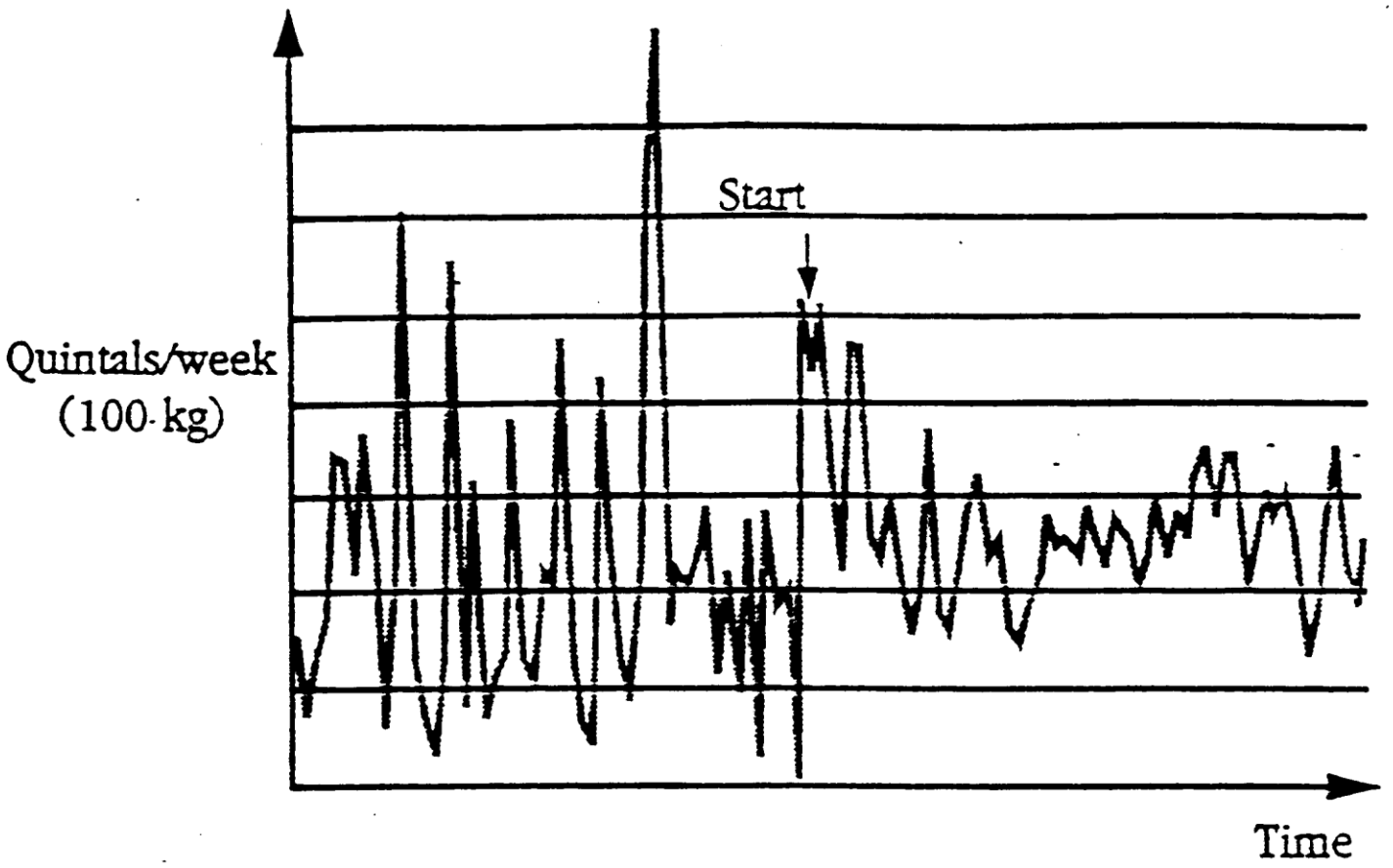


Inventory of Barilla Products in Marchese DC, Before and After Start of JIT Program



"Start" indicates the beginning of operations under the JITD program

Exhibit 2: Shipments from Barilla to the Marchese Distribution Center Barilla, Before and After Start of JITD Program



(Time)

"Start" indicates the beginning of operations under the JITD program