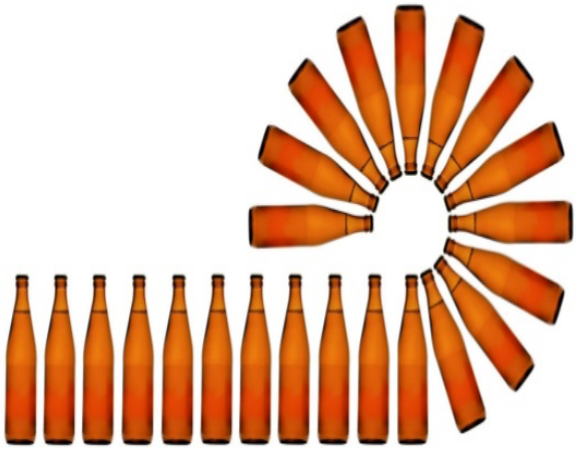
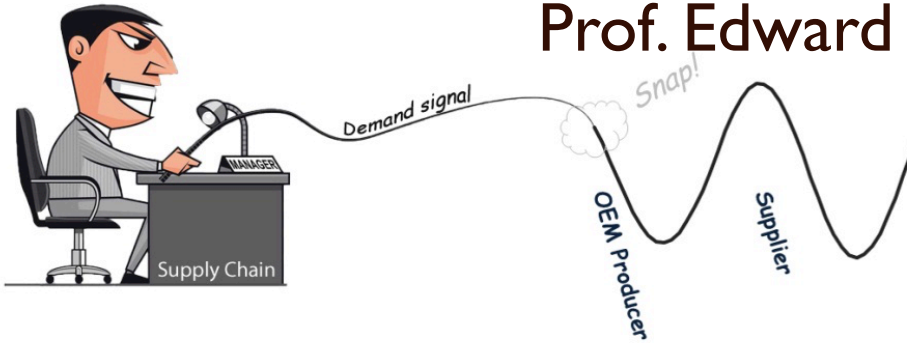
Week 5:



Why is Supply Chain Choreography Difficult? The Beer Game and the Bullwhip Effect

MIS 3537: Internet & Supply Chains

Prof. Edward (Ed) Beaver



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The rules: On the Clock

Last Week (Intro)

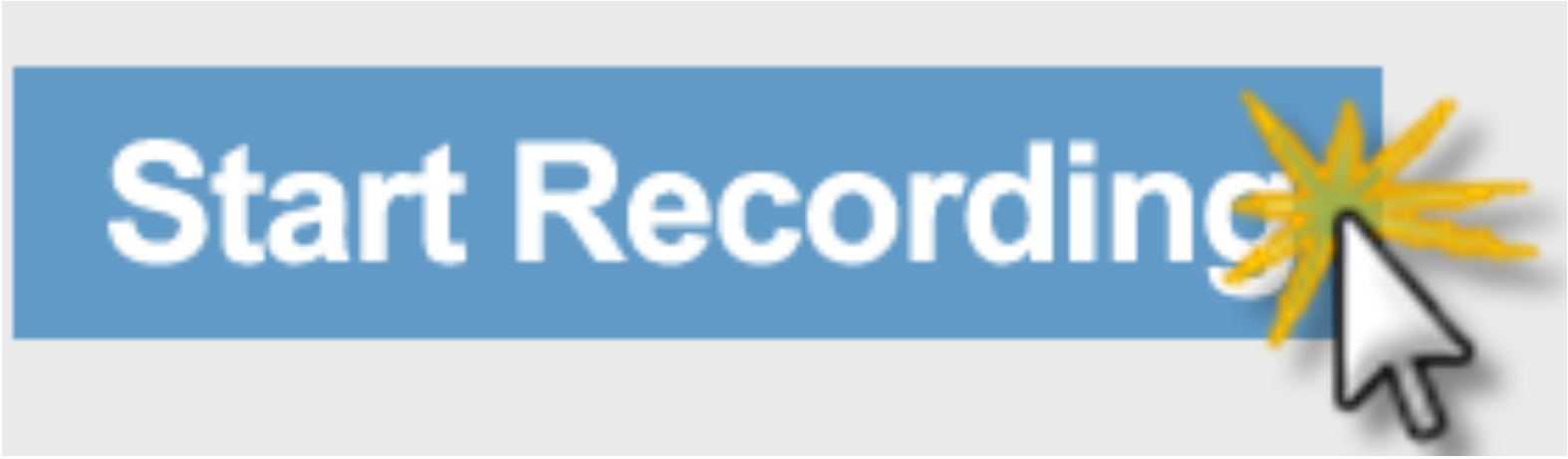
- I gave you as much time as you need
- Proceed to next week when all orders have been placed

This Week (Round 1)

- There will be a timer (upper right of screen)
- If counter is zero without your input, system will reuse previous decision

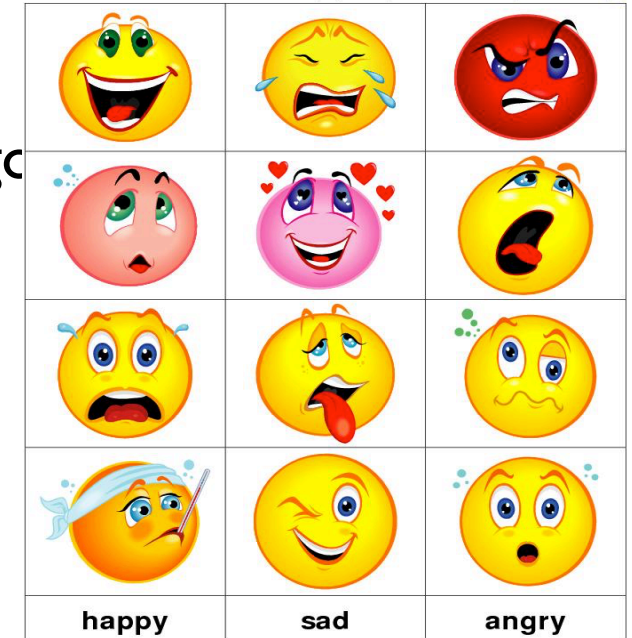
Let's play the game!

Break Time


Start Recording

Your thoughts

- How are you Feeling?
  - What are your raw impressions?
  - Call out some adjectives
    - frustrated, confused
    - anxious (what's happening next)
    - broke
    - Couldn't 'not talk' - wha't go
    -
    -



Your thoughts

- What were your individual costs? What was the total supply chain cost?

- What could have helped you bring down the costs?

Strategies

- While playing the simulation – what did you focus on?
  - Strategies pursued?
  - Successful – why, why not?
  - Did you change strategy?

Would you best Identify yourself as:

Isolationist ('best I can be') or

Cooperative (help other chain participants)

Learning Objectives

- Have some fun with the beer game
- Understand the "bullwhip effect"
- Learn what causes the effect
- Learn ways to counteract the bullwhip

The "Pampers" problem

Pampers – a P&G product

- What Drives Consumption of Pampers?

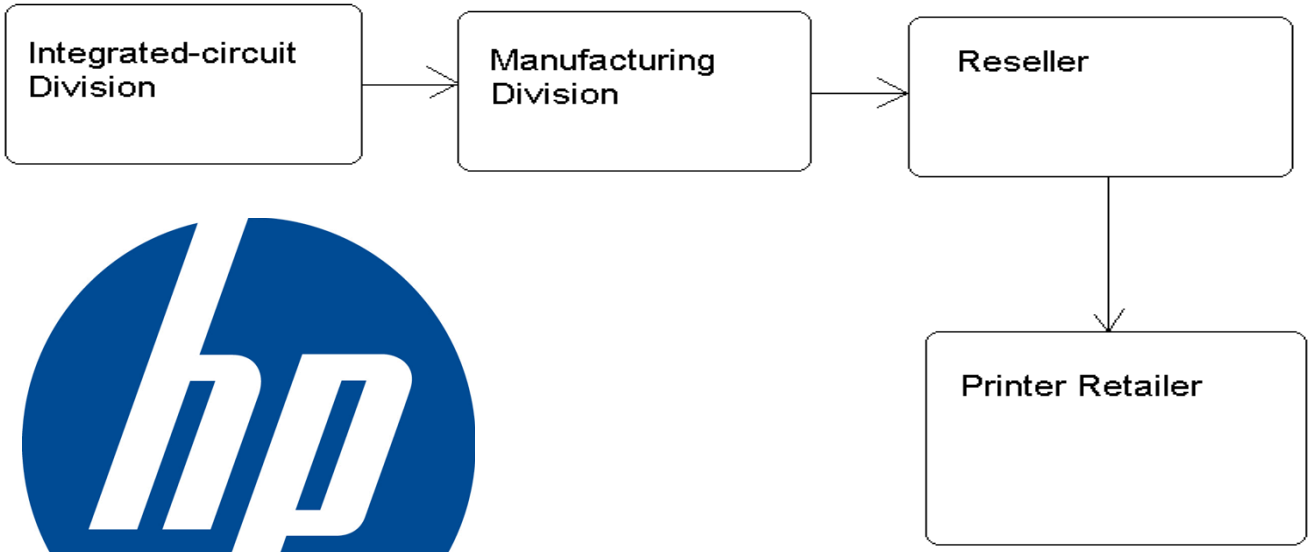
The "Pampers" problem

Pampers – Real World Supply Chain

- Mild fluctuations in retail sales --> excessive fluctuations at distributor level
- The orders of materials to the Pampers' suppliers, e.g.: 3M, fluctuated even more
- Yet, Pampers were "consumed" at the same steady rate
- What explains the variability?

At Hewlett-Packard

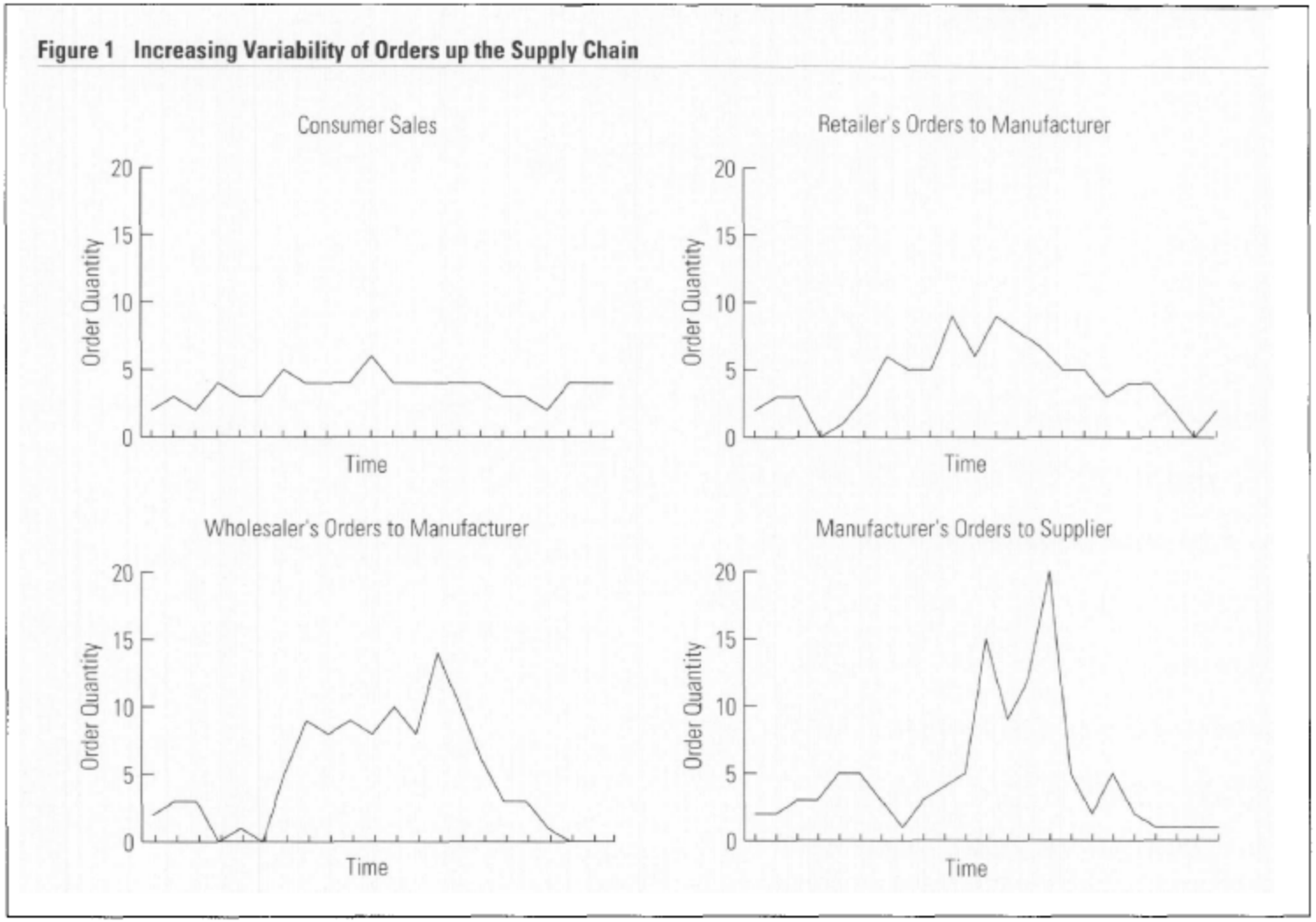
- Similar problem at HP – major printer manufacturer



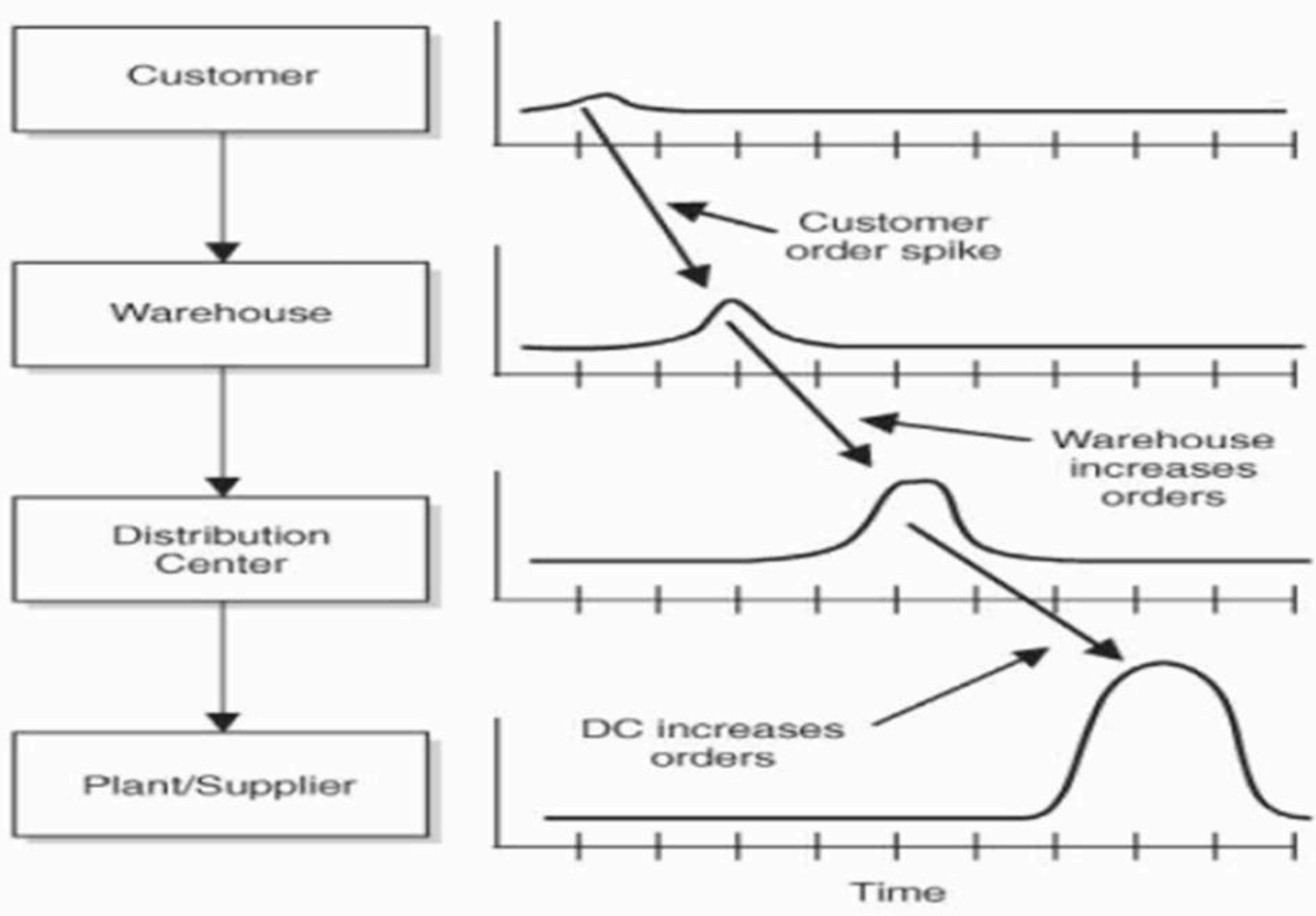
Fluctuations at HP

- Some fluctuations at retailer level are understandable
- More fluctuations at reseller level
- Much greater fluctuations in manufacturing division's orders to the Integrated Circuit division

Fluctuations along the chain

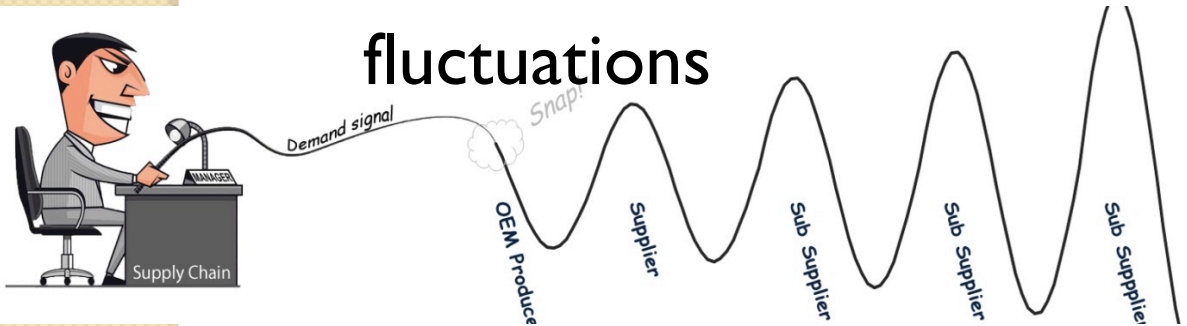


Fluctuations along the chain



Fluctuations along the chain

- Consumer sales are relatively stable
- The retailer's orders show more variability
- The wholesaler's orders show even more variability
- The manufacturer's orders show much greater fluctuations



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Fluctuations along the chain

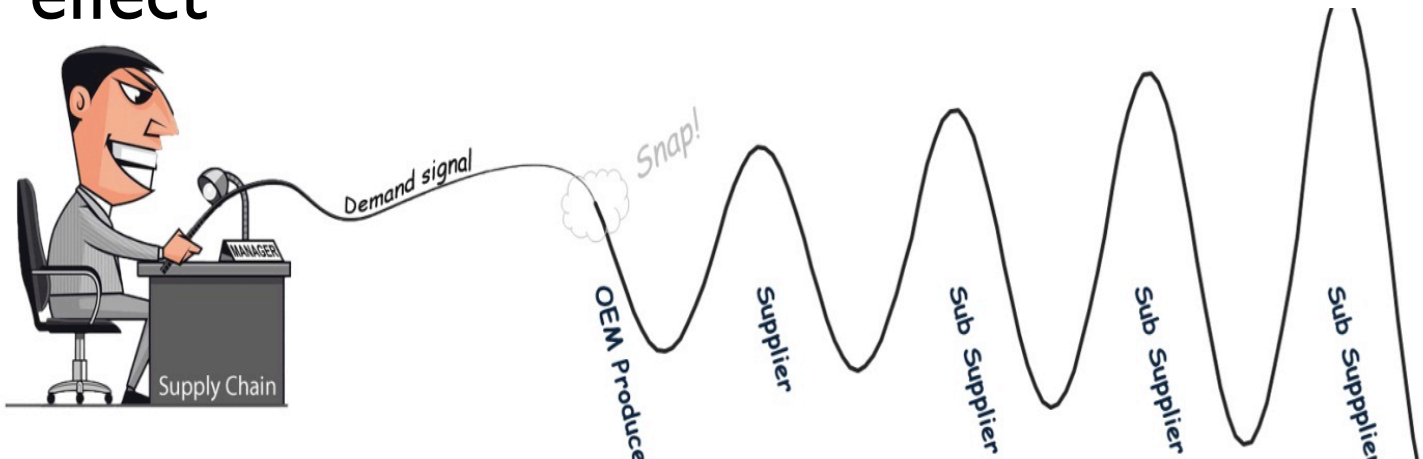
Three main patterns emerge:

- Oscillation: inventory/ backlog goes down, then up
- Amplification: height of oscillations (and hence costs) increases the farther away one is from the end customer
  - The distributor usually illustrates significant oscillation because the factory is buffered by having no limits on capacity
- Lag: the swings (generally) happen later in time and increase as one goes farther away from the end customer

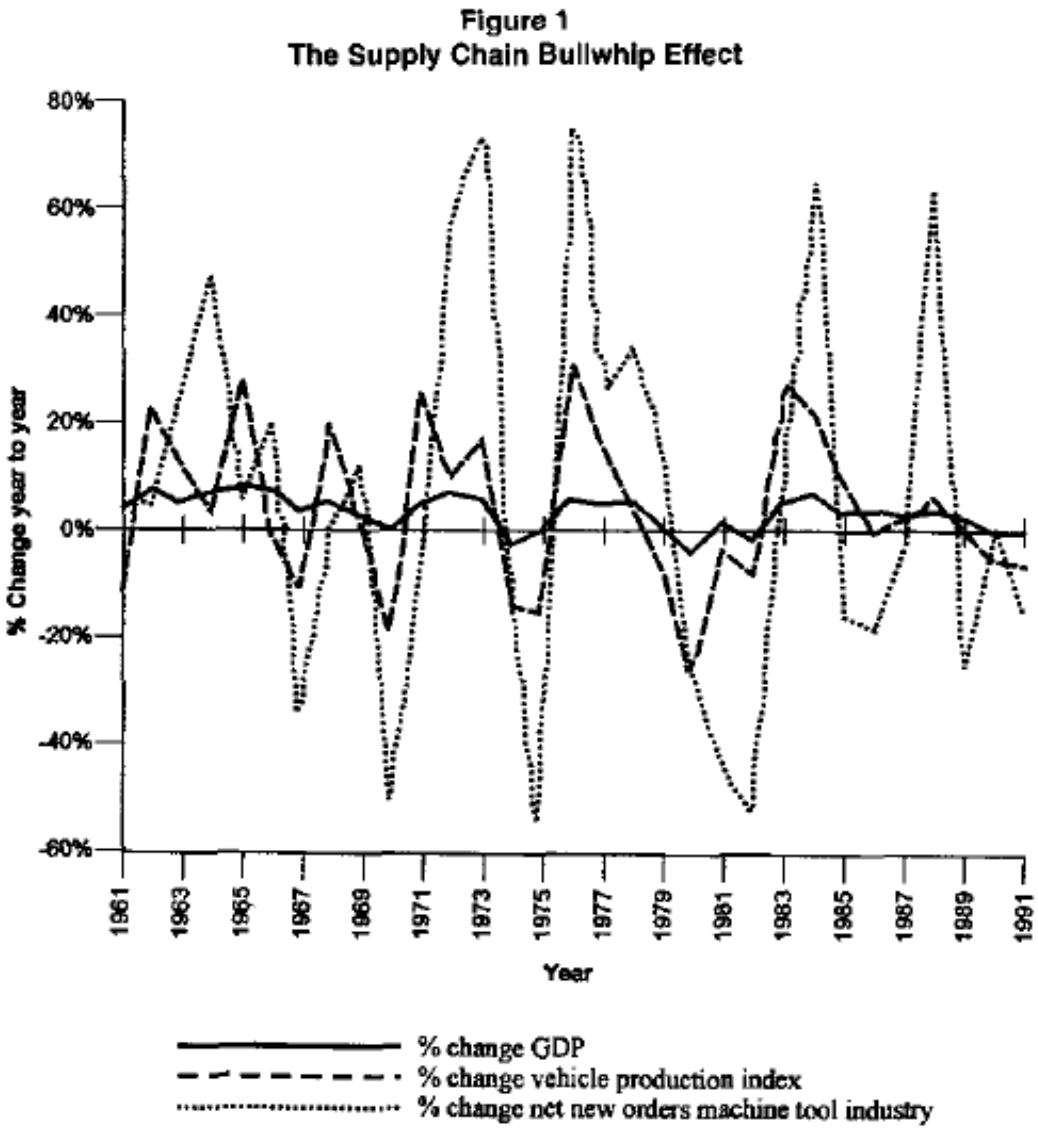
The bullwhip effect

- Distorted information from one end of the supply chain to another creates a fluctuation in how the various entities behave

- The resulting variability in forecasts, orders and inventory levels is called the "bullwhip effect"



Forrester effect



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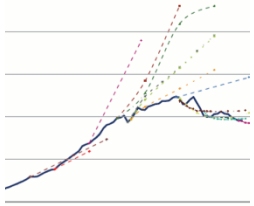
Learning Objectives

- Have some fun with the beer game
- Understand the "bullwhip effect"
- Learn what causes the effect and
- Learn ways to counteract the bullwhip

What causes the bullwhip effect?

- Demand forecast updating

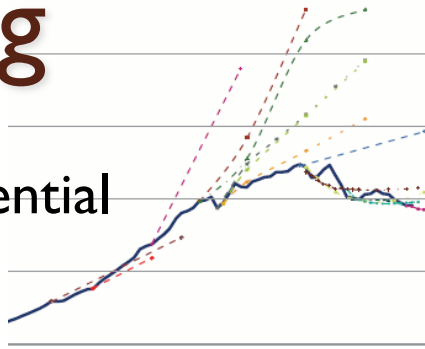


- Order batching

- Price fluctuation

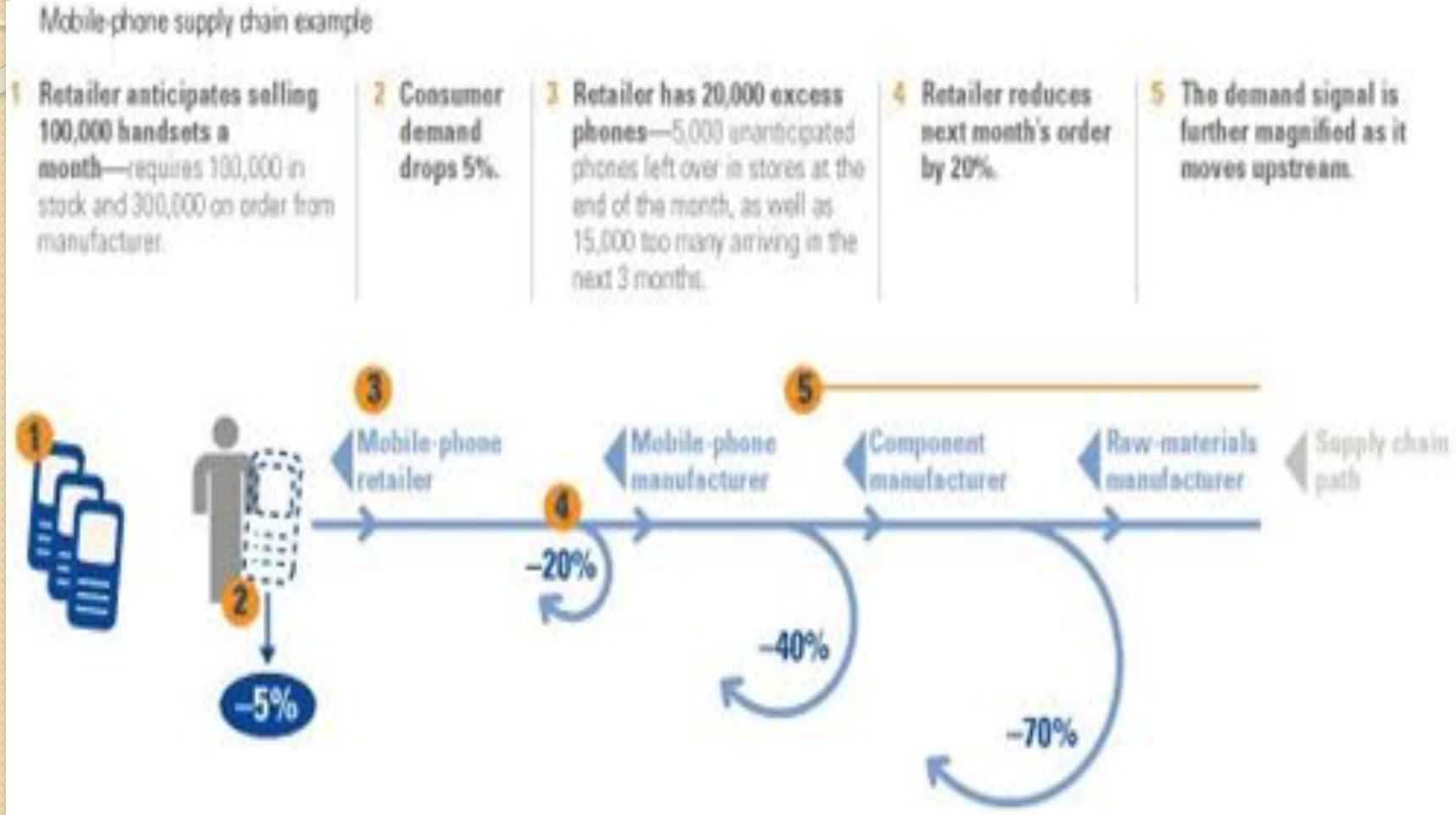
- Rationing and shortage gaming

Demand forecast updating



- Forecasts are generally made using the exponential smoothing technique
- At each level in the supply chain, the input to the demand forecast is the orders from one level below in the supply chain (esp. when level is different company, organization)
- As orders from the level below keep changing, so does your forecast
- Your forecast is the input to the forecast of the entity one level above
- As your forecasts vary, their forecasts vary even more

Demand forecast updating



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Counteract: Avoid multiple demand order forecasts

- What causes multiple demand order forecasts?
  - Forecast from one entity becomes input for higher-level entity
  - Simply put, different entities in the supply chain work with different demand data

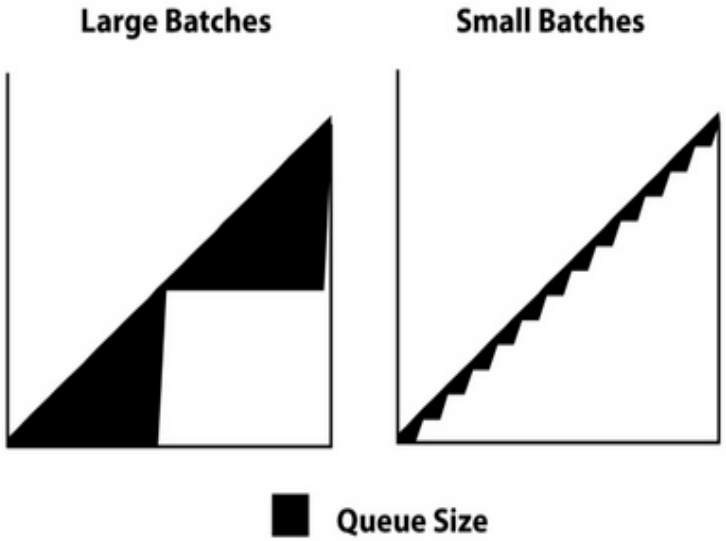
- To counteract
  - Share data
  - Create demand forecasts using same raw data

Avoid multiple forecasts (contd.)

- Tools & techniques
  - Use point-of-sale data
    - The actual sale data becomes the raw data for forecast updates along the system
  - Electronic Data Interchange / Internet
    - EDI or Internet web services ensures that the same data is shared across multiple entities at frequent intervals
  - Computer-assisted ordering

Order batching

- A retailer orders products in batches
- When demand comes in, the retailer does not order immediately, but accumulates demand and then orders again in batches
- This causes a constant ebb and flow



Counteract: Break order batches

- Orders involve paperwork and red tape
- Also companies offer differential pricing between full-truckload and less-than-truckload (LTL) transportation
- How to counteract?
  - EDI
  - Truckloads with different products (Mixed Loads)

Price fluctuation

- On average, 80% of transactions in the grocery industry is "forward buy"
- Forward buying results in price fluctuations
- Also, there are price discounts, quantity discounts, coupons, rebates etc.
- Hence customers buy in quantities that do not reflect immediate needs

- How often have you bought an extra box of corn flakes or an extra bottle of juice because of a temporary price reduction?

Counteract: Stabilize prices

- Problem
  - Forward buying leads to price fluctuations
  - Price discounting leads to uneven demand patterns

- How to counteract?
  - Reduce frequency and level of wholesale price discounting
  - Everyday Low Price / Value pricing strategy

Rationing and Shortage Gaming

- Scenario: Demand exceeds supply
  - Manufacturer can ration product supply
  - If total supply is only 50% of total demand, customers will receive only 50% of their order
  - Knowing this, customers exaggerate their real needs when they order
  - When demand cools, orders get cancelled

Examples: Sales of DRAM chips in the 1980s; disappearance of HP Laserjet orders

Counteract: Eliminate shortage gaming

- Problem
  - Demand exceeds supply
  - Suppliers order more to counteract lower supply

- How to counteract?
  - Do no allocate products on basis of orders alone
  - Allocate in proportion to past sales records

Eliminate shortage gaming (contd.)

- Information sharing
  - "Shortage gaming" arises due to lack of trust
  - Sharing information can help overcome this

- Stop generous return policies!
  - Penalties for returns to manufacturers; this ensures that retailers will not exaggerate needs, and later cancel orders

Summary

Causes of Bullwhip	Information Sharing	Channel Alignment	Operational Efficiency
Demand Forecast Update	• Understanding system dynamics • Use point-of-sale (POS) data • Electronic data interchange (EDI) • Internet • Computer-assisted ordering (CAO)	• Vendor-managed inventory (VMI) • Discount for information sharing • Consumer direct	• Lead-time reduction • Echelon-based inventory control
Order Batching	• EDI • Internet ordering	• Discount for truckload assortment • Delivery appointments • Consolidation • Logistics outsourcing	• Reduction in fixed cost of ordering by EDI or electronic commerce • CAO
Price Fluctuations		• Continuous replenishment program (CRP) • Everyday low cost (EDLC)	• Everyday low price (EDLP) • Activity-based costing (ABC)
Shortage Gaming	• Sharing sales, capacity, and inventory data	• Allocation based on past sales	

Root Beer Game Completion Schedule

- Practice session (completed in class) – *Feb 13*
- Complete Round 1 – in class *February 20*
- Team decision (via e-mail to professor) on Round 2 change – *by February 25*
- Game reset and ready to start Round 2 – *February 27 (see blog post)*
- Complete Round 2 and Submit deliverables – *by March 20*

Root Beer Game: Round 2 Options

Each Team Can make One (1) of the following changes for Round 2

A. Point of Sale (POS) information available to all Roles (not just retailer)
B. Shipping Delay reduced to 1 week from 2
C. Information Delay (Order) reduced to 1 week from 2

Root Beer Game: Note

- The demand pattern may change between the different rounds.
- Intent: play multiple rounds to demonstrate how manipulating certain aspects of the game can influence the performance of the supply chain.

Root Beer Game: Deliverables

One submission per group

1. Complete the performance spreadsheet of your group (link in blog)
2. Short write-up: How you played the beer game. What strategies you employed and how they changed when you played the beer game the second time compared to the first. e.g.
   - What was your strategy in the game for placing orders placing and holding inventory? How did this strategy change for Round 2?
   - How was the communication and cooperation between various players in the group? How did it change from Round 1 to 2?
   - What lessons from the beer game would you give to supply chain managers?

Next week…

- Exam 1
  - Study Guide and sample test posted soon
- What is the 'Internet of Things' ?

  RFID – example technology