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The Beer Distribution Game: Debrief

Supply Chains Driving Strategic Advantage
January 3, 2011
MIT, Cambridge, MA

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Deputy Director – MIT CTL

Debrief Plan

How did you feel while playing?

Were there any problems? If so, what?

What caused these problems?

What are some solutions to these problems?

Announce winners

Analysis

How Did You Feel While Playing?

Were there any problems? If so, what?

What are some solutions?

So who won?

• MIT Midwinter Ale Co.	$3,626
• Pitchers	$2,571
• Spencer's Beer*	$2,567
• Ice Cold	$2,412
• Brewskies	$1,685
• Fatter Tire	$830
• Average	$2,282
• Average (worst)	$15,000+

* Expert table

How do most teams do?

- Top scores $1,000
- Worse scores $15,000 and up
- Average $2,000

- Best possible **$200**

A Mystery:

Why do smart, well-intentioned people perform so poorly?

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Most people deal with systems at the level of …

Events

Event Thinking…

Saturday, May 14, 2005

Union divided over how to reverse membership drop

WASHINGTON – … Labor leaders cite many reasons for the decline: The global economy, trade agreements, … poor enforcement of labor laws, and Republican tax policies that squeeze the middle class.

Ron Fournier, The Associated Press

Event Thinking…

Union Membership Drops to Record Low

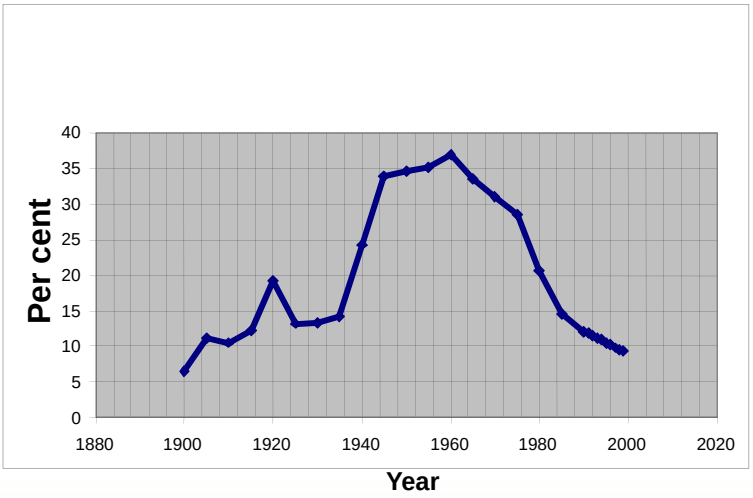
"Much of the decline is coming from shifts in the economy," said Greg Denier, a spokesman for Change to Win, a federation of labor unions. "Thousands of jobs are being outsourced or lost to technological changes."

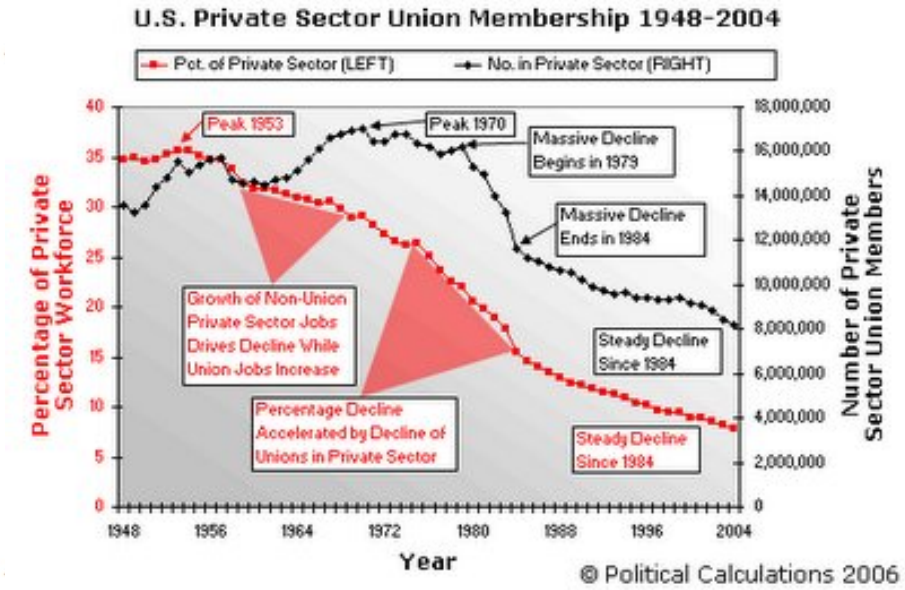
"The unions are losing so many members each year because their jobs are being outsourced and they are organized in shrinking sectors of the economy, like autos, steel and textiles," said Gary Chaison, a labor specialist at Clark University in Worcester, Mass.

Ref: Will Lester, Associated Press, Thursday, January 25, 2007

Ref: C. Caplice, January 2007

% Union Membership





Ref: C. Caplice, January 2007

Events are "just" the visible manifestation of patterns…

Increasing Leverage

Events

Patterns of behavior

JOY MINING MACHINERY

Founded in 1920

Pioneer in underground mining equipment

Andre Horn offered CEO post after unprofitable year….

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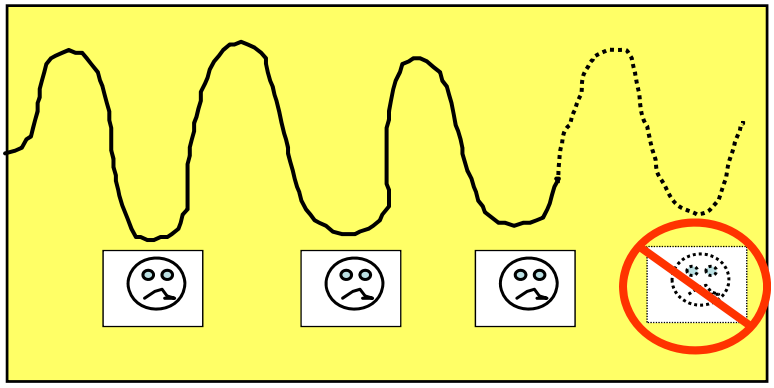
Before he took the job, Horn presented to the Joy Mfg Board….

change in profits



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Ref. J. Hines, MIT

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What patterns did you observe?

Common Patterns

- **Oscillation**
  - Large amplitude fluctuations, average 20 weeks.
- **Amplification**
  - Amplitude and variance of orders increases steadily from customer to retailer to factory
- **Phase Lag**
  - The order rate tends to peak later as one moves from the retailer to the factory.

We call these collective patterns "The Bullwhip Effect"

- "Bullwhip" coined by Prof. Hau Lee (1997)
  - is where "information transferred in the form of orders tends to be distorted and can misguide upstream members in their inventory and production decisions… the variance of orders may be larger than that of sales, and the distortion tends to increase as one moves upstream"*
  - describes the general tendency for small changes in consumer demand to be amplified within a production-distribution system**

* Lee, Padmanabhan and Whang, The Bullwhip Effect in Supply Chains, Sloan Management Review, Spring 1997

** McCullen and Towill, Diagnosis and reduction of bullwhip in supply chains, Supply Chain Management: An International Journal, Vol 7, No 3 2002

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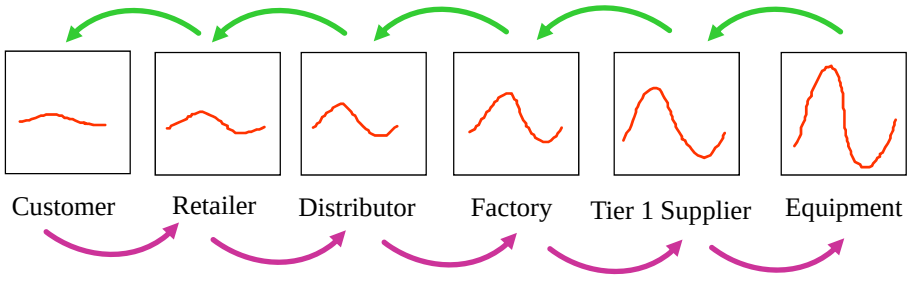
"The Bullwhip Effect"



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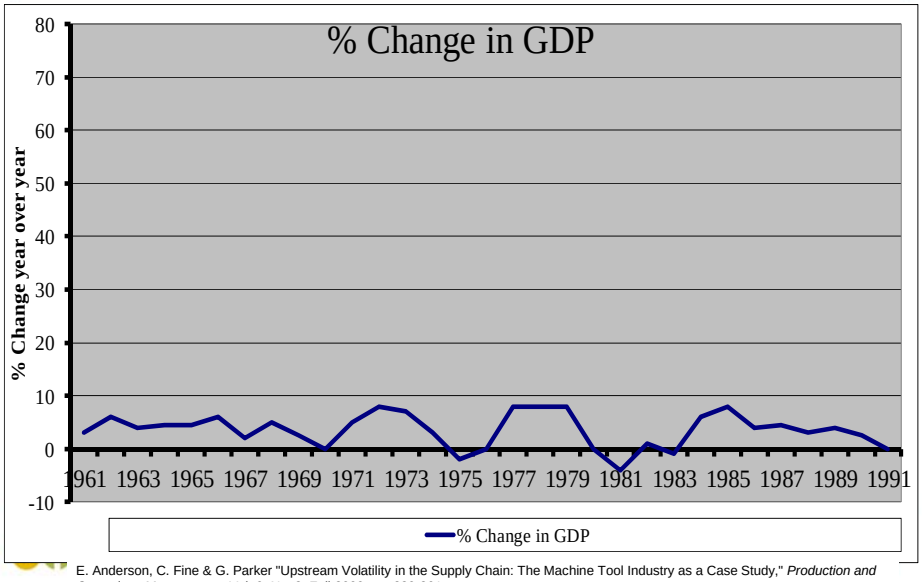
Supply Chain Volatility Amplification: Machine Tools at the tip of the Bullwhip



E. Anderson, C. Fine & G. Parker "Upstream Volatility in the Supply Chain: The Machine Tool Industry as a Case Study," *Production and Operations Management,* Vol. 9, No. 3, Fall 2000, pp. 239-261.

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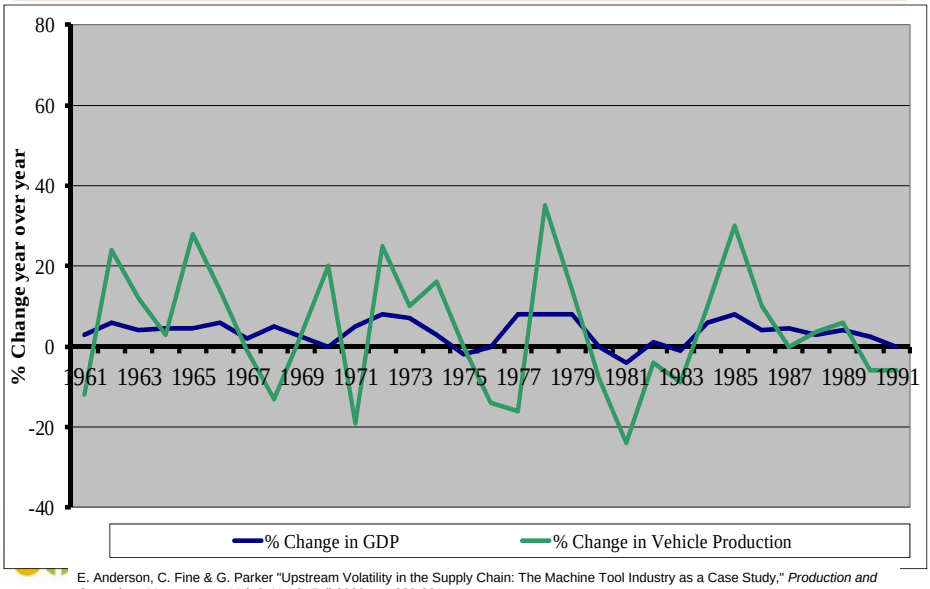

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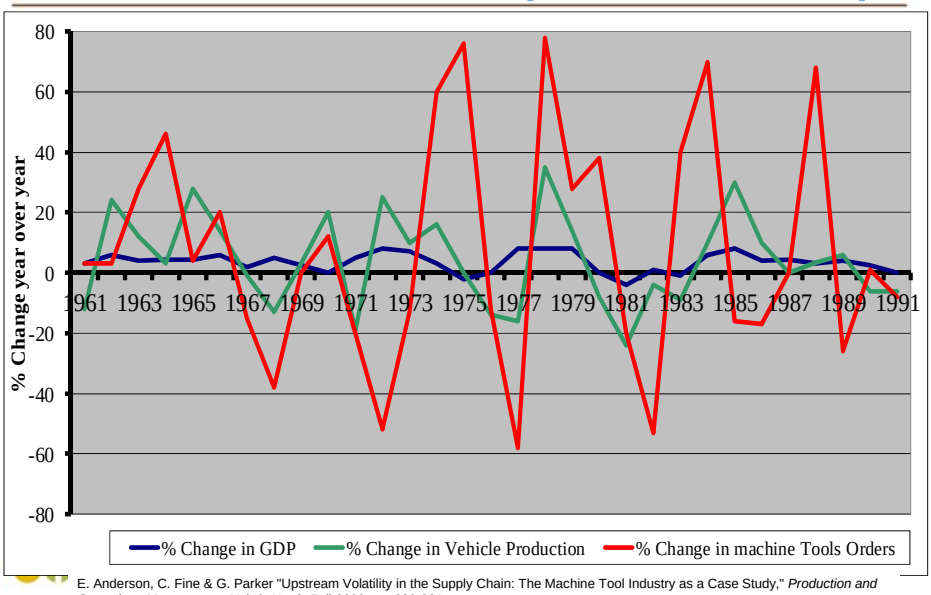


E. Anderson, C. Fine & G. Parker "Upstream Volatility in the Supply Chain: The Machine Tool Industry as a Case Study," *Production and Operations Management*, Vol. 9, No. 3, Fall 2000, pp. 239-261.

What patterns exist in your Supply Chain?

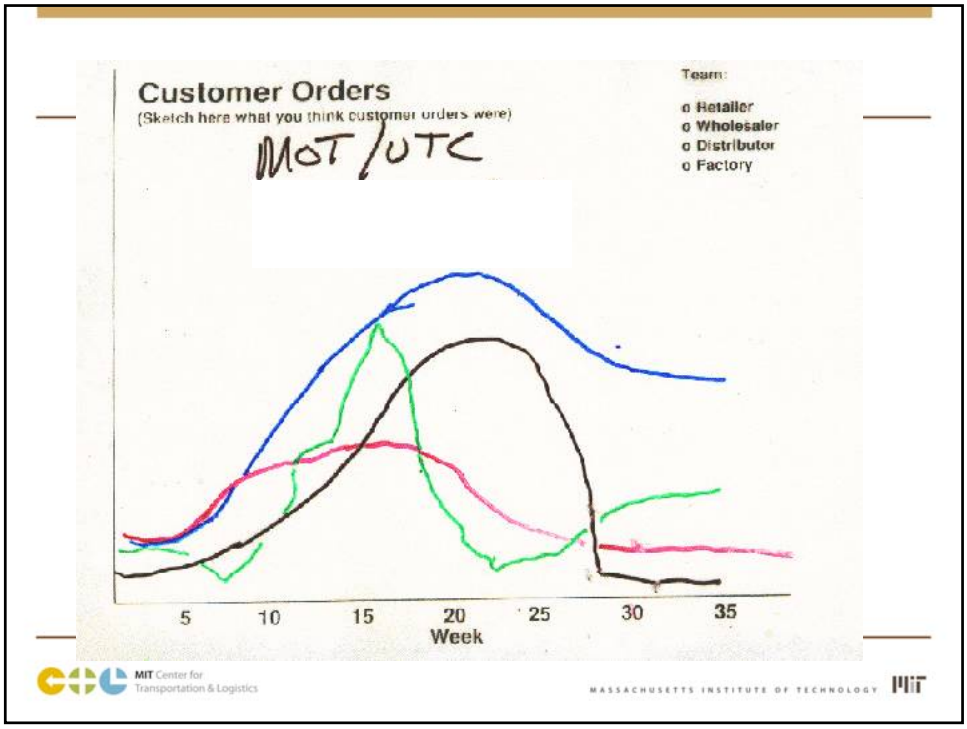
- **Oscillation**
- **Amplification**
- **Phase Lag**

Common Patterns in Supply Chains

- **Oscillation**
  - **Factory output, orders received each day, cycle times, demand variation,**
  - **Delaying purchases to meet volume requirements (truckload quantities for discounts, efficient order quantities)**
- **Amplification**
  - **The Bullwhip Effect – Pharma, Electronics, Machine Tool industries**
  - **Ex. Eastman Chemical: a 10% sales variation required 45% extra capacity to supply**
- **Phase Lag**
  - **Manufacturer cycle time is 6 weeks & cannot respond to retailer 1 week forecast**
  - **Lag from order receipt to release to supplier**

Questions about patterns

- Who did the worst on each team?
- Was the experience the same or different for each team?
- What did the demand patterns by customer look like?


Customer Orders
(Sketch here what you think customer orders were)
MoT/UTC
Team:
o Retailer
o Wholesaler
o Distributor
o Factory
5
10
15
20
25
30
35
Week
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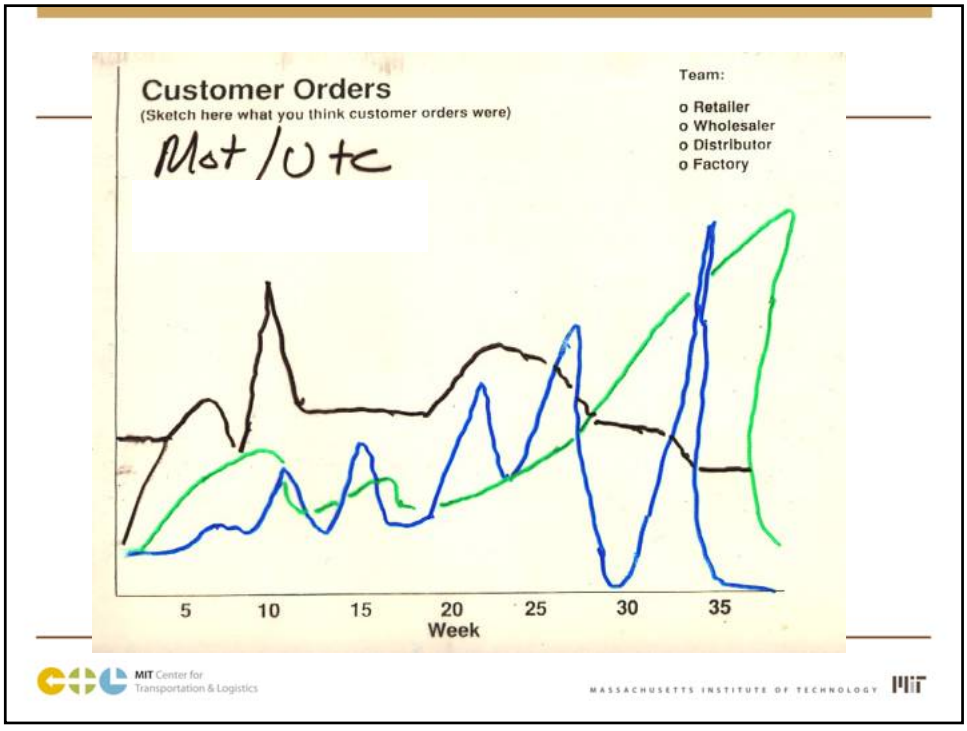
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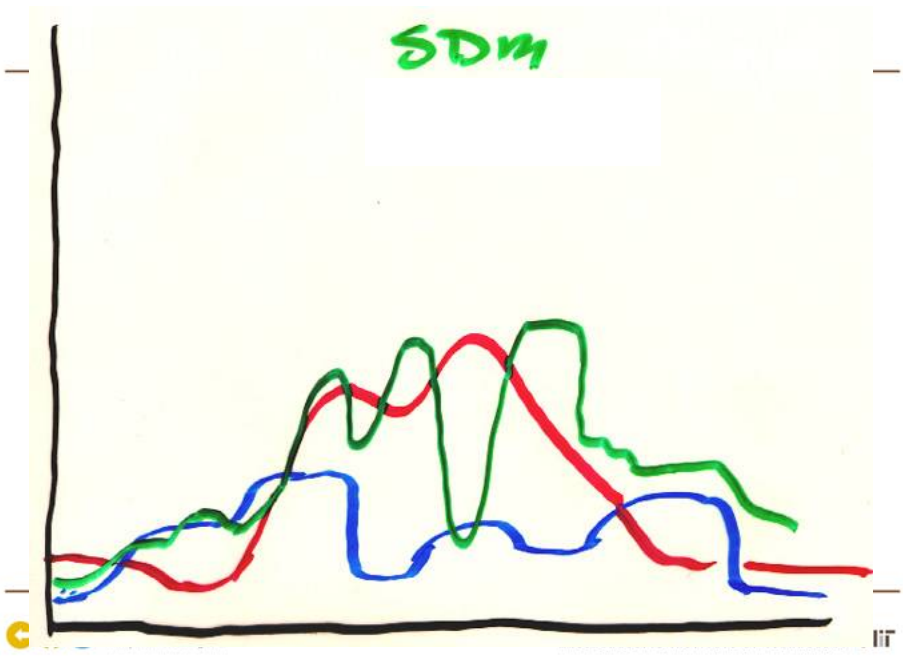


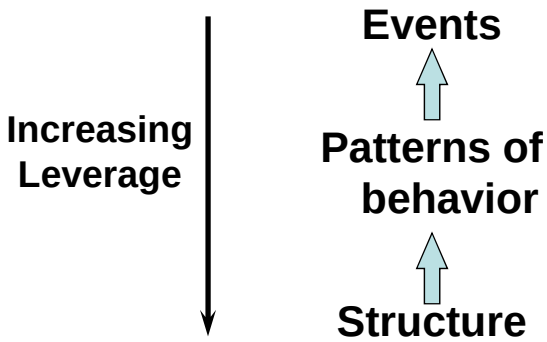
What does this tell us?

- **The oscillations, amplification and phase lag were caused by something internal to the system.**

But the "Estimates" of Customer Demand Indicate

- People are transferring "event orientation" to patterns
- The cause is still a single thing
- The cause is 'out there'

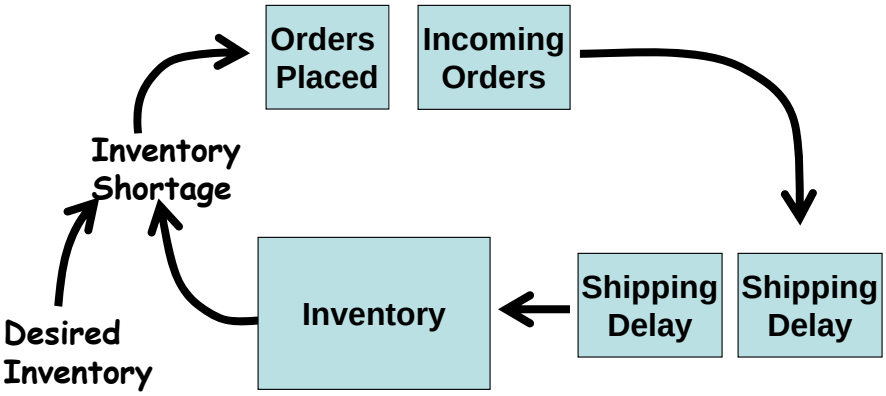
The Ultimate Cause is Structure



The behavior of the players is controlled by the structure of the system

Slide adopted from Dr. Jim Hines, MIT System Dynamics Group

Beer Game Structure



Causal Loop Diagrams

Now that we understand the patterns and structure…..

- What are the structural problems?
- What are some solutions?

What are the structural problems?

What are the structural problems?

- Information lags
- Delivery lags
- Independent forecasting
- Order batching
- Inconsistent incentives
  - Leads to gaming allocations
  - Quarterly sales goals, unit cost factory measure, lowest cost distribution
- Promotions/discounting

What are some solutions?

What are some solutions?

- Collaboration
- Increase visibility
- Use historical data
- Shorter delays
- Eliminate middle-man
- Strategic partnership & information sharing
- Align policies, incentives, perf. measures

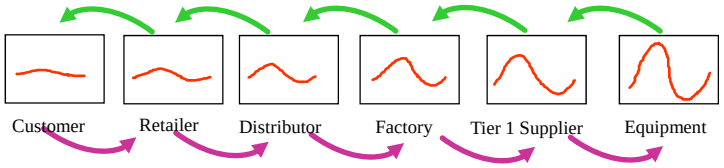
Some suggestions… & cost to implement

- Collaboration
- Increase visibility
- Use historical data
- Shorter delays
- Eliminate middle-man
- Strategic info sharing
- Align incentives, KPIs

Expensive	Inexpensive
√	
√	
	√
√	
√	
	√
	√

These all effect the structure of the system…..

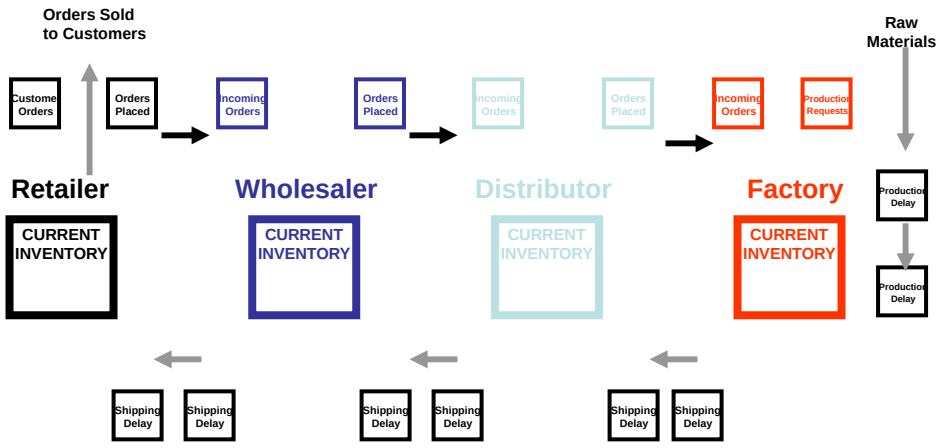
Applying these to "The Bullwhip Effect"



STRUCTURAL PROBLEMS:
Information lags
Delivery lags
Independent forecasting
Order batching
Price fluctuations
Inconsistent incentives
- Gaming allocations
Promotions/discounting

SOLUTION STRATEGIES:
- Reduce Uncertainty
- Reduce Variability
- Reduce Lead time
- Improve Channel Mgt
- Align policies, incentives, KPIs

The Beer Game – The Table



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Thoughts to Leave With

- What caused the problems?
  - Rush to solutions before seeing the problem (oscillations)!
  - Even after seeing the problem we rushed to solutions without understanding the real dynamics (flat demand) and the root cause (structure)
- What will you do when you return to the workforce?
  - Rush to solution?
  - Or will you first determine the root causes?
  - How will you do that?
  - How will you find the big problem in your system?

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Thank you

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Reference Slide

"The Fifth Discipline" by Peter Senge

Available at the MIT COOP (next to Marriott)

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