The Beer Game

Demonstrating Important Concepts In Supply Chain Management

What is your game experience?

Problem or difficulty encountered:

• Retailer?
• Wholesaler?
• Distributor?
• Factory?

The Bullwhip Effect:

Without accurate information about incoming demand/order, how did you decide your ordering quantity?

(1: over or under? 2: in what percentage?)

• Retailer?
• Wholesaler?
• Distributor?
• Factory?
The Bullwhip Effect:

The Dynamics of the Supply Chain

Order Size vs. Time

Source: Tom McGuffry, Electronic Commerce and Value Chain Management, 1998

Impact of bullwhip effect ...

- Order variability is amplified up the supply chain; upstream echelons face higher variability
- Given increasingly globalized chain network, the whole chain waste can be tremendous
  - increased safety stock
  - inefficient allocation of resources
  - increased transportation costs
  - increased manufacturing costs
  - reduced service level
  - reduced profitability
  - ...

Source: Tom McGuffry, Electronic Commerce and Value Chain Management, 1998
It is important

- to understand the main factors contributing to the increase in variability (the causes of Bullwhip Effect) in the supply chain
- To identify techniques and tools that will allow us to control the bullwhip effect

Some causes in reality …

- Promotional sales
- Inflated orders
- Order batching
- Long cycle time
- New sources
- Behavior
- …

Fundamentally, lacking of coordination and information sharing

Quantifying Bullwhip Effect …

Why it is needed ??

\[
\frac{\text{Var}(Q)}{\text{Var}(D)} \geq 1 + \frac{2L}{P} + \frac{2L^2}{P^2}
\]

We conclude …

- When \( L \uparrow \), the ratio ?
- When \( P \uparrow \), the ratio ?

How to cope with bullwhip effect ?

- Reduce variability and uncertainty
  - Sharing information (What info? How to share? With whom? What costs? How to measure the value? How to share the value?... -- thinking of the beer game)
  - POS
  - ... year-round low pricing
- Reducing lead time (-- quick response !!)
  - EDI
  - cross docking
- Alliance arrangements
  - Vendor Managed Inventory (VMI)
  - on-site vendor representative
  - ...
**Coordination in a Supply Chain**

- The **key** to the success
- The **challenge** to SCM

- Different stages of a supply chain have objectives that conflict as each stage has a different owner
- Lack of coordination results each stage of the SC only optimizes its local objective without considering the impact on the complete chain
- Without coordination, local optimization is ineffective
- Coordination requires all stages of the chain take actions together to increase total supply chain profits

**Obstacles ...**

- Operational Obstacles
  - Batching
  - Rationing Game
- Pricing Obstacles
- Incentive Obstacles
- Information Processing Obstacles
- Behavioral Factors
- Market competition
- ....

**Role of Information in Supply Chain Success**

In modern supply chain, information replaces (?) or reduces?) inventory.

**Information Technology in a Supply Chain: Legacy Systems**
Information Infrastructure: Required Technologies

- Basic EDI communication system
- Perpetual inventory system
- Technology to share forecast information
- Technology to transfer promotional and one time orders
- Sales incentives will have to be transferred from shipment driven to consumption driven (EDLP between supplier and retailer)
- ...

Types of SP:

- **Quick Response**: Vendors receive POS data from retailers, and use this information to synchronize production and inventory activities at the supplier. In this strategy, the retailer still prepares individual orders, but the POS data is used by the supplier to improve forecasting and scheduling.
  - Milliken and Company: The lead time from order receipt at Milliken's textile plants to final clothing receipt at several of the department stores involved was reduced from eighteen weeks down to three weeks.

- **Continuous Replenishment**: Vendors receive POS data and use it prepare shipments at previously agreed upon intervals to maintain agreed to levels of inventory.
  - Wal-Mart, Kmart
Strategic Partnering

- **Advanced Continuous Replenishment**: Suppliers may gradually decrease inventory levels at the retailer's store or distribution center as long as service levels are met. Inventory levels are thus continuously improved in a structured way.
  - Kmart
- **Vendor Managed Inventory (VMI) - JITD**
  - VMI Projects at Dillard Department Stores, J.C. Penney, and Walmart have shown sales increases of 20 to 25 percent, and 30 percent inventory turnover improvements.

Requirements for Effective SP

- Advanced information systems
- Top management commitment
- Mutual trust (Confidentiality, Communication and cooperation)

Advantages and Disadvantages of SP

**Advantages**

- Fully utilize system knowledge
  - Consider the partnership between White-Hill-Robins (W-R), who makes over-the-counter drugs such as Advil, and Kmart. W-R initially disagreed with Kmart about forecasts, and in this case, it turned out that W-R forecasts were more accurate because they have a much more extensive knowledge of their products than Kmart does.
- Decrease required inventory levels
- Improve service levels
- Decrease work duplication
- Improve forecasts

**Disadvantages**

- Expensive advanced technology is required
- Supplier/retailer trust must be developed.
- Supplier responsibility increases.
- Expenses at the supplier often increase.
Examples of SP Successes and Failures

- Western Publishing-Golden Books:
  - Western Publishing is using VMI for its Golden Books line of children’s books at several retailers.
  - POS data automatically triggers re-orders when inventory falls below a reorder point.
  - This inventory is delivered either to a distribution center, or in many cases, directly to the store.
  - Ownership of the books shifts to the retailer once deliveries have been made.
  - In the case of Toys R Us, the company has even managed the entire book section for the retailer, including inventory from suppliers other than Western Publishing.

Examples of SP Successes and Failures

- VF Corporation’s Market Response System:
  - The VF Corporation, which has many well known brand names (including Wrangler, Lee, Girbaud, and many others), began its VMI program in 1989.
  - Currently, about 40 percent of its production is handled using some type of automatic replenishment scheme.
  - This is particularly notable because the program encompasses 350 different retailers, 40,000 store locations, and more than 15 million replenishment levels.
  - VF’s program is considered one of the most successful in the apparel industry.

Examples of SP Successes and Failures

- Spartan Stores
  - Spartan Stores, a grocery chain, shut down its VMI effort about one year after its inception
  - One problem was that buyers were not spending any less time on reorders than they did before
  - This was because they didn’t trust the suppliers enough to be able to stop carefully monitoring the inventories and deliveries of the VMI items, and intervening at the slightest hint of trouble.

Examples of SP Successes and Failures

- Spartan Stores (continued)
  - Furthermore, the suppliers didn’t do much to allay these fears. The problems were not with the suppliers’ forecasts; instead, they were due to the suppliers’ inability to deal with promotions, which are a key part of the grocery business.
  - Since they were unable to appropriately account for promotions, delivery levels were often unacceptably low during these periods of peak demand.
Supply Chain Management

- New ways to increase value in business