

Information Distortion & Bullwhip Effect

Supply Chain Management

Bullwhip effect

- The bullwhip effect is a well-known symptom of **coordination problems** in (traditional) **supply chains**
- It refers to the **effect** that the amount of **periodical orders amplifies** as one moves upstream in the supply chain towards the production end.
- The term was first coined around 1990 when Procter&Gamble perceived erratic and amplified order patters in its supply chain for baby diapers. The effect is also known by the names **whiplash** or **whipsaw effect**.

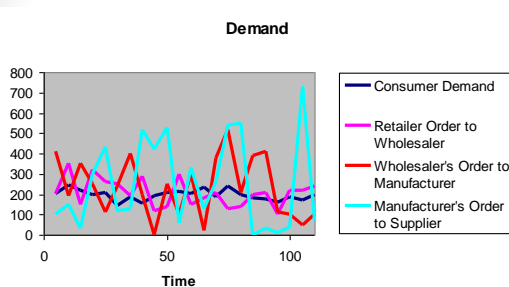
The Bullwhip Effect – Distorted Information

- The **amplification** of uncertainty and order overstatement that cascades upstream through the nodes of the supply chain.
- The **variance of orders** is greater than that of *sales*, and the distortion increases as one moves upstream.

Bullwhip Effect

- Distorsi informasi merupakan salah satu kendala untuk menciptakan efisiensi pada supply supply chain
- BULLWHIP EFFECT → Demand and sale pada **peritel relatif stabil** namun permintaan/aliran barang dari **produsen ke suplier/distributor** sering sangat **fluktuatif**
- Semakin ke hulu semakin fluktuatif

The Bullwhip Effect



Penyebab Bullwhip Effect

Demand Forecast Updating

Order Batching

Fluktuasi Harga

Rationing and Shortage Gaming

Demand Forecast Updating

- Peramalan pada satu periode tertentu dan perlunya **updating** terus menerus
- Kebijakan **reorder point** atau **order up-to level** → menyebabkan **variabilitas order** pesanan ritel lebih besar dibandingkan dengan permintaan pelanggan akhir
- **Model ramalan** yang digunakan juga dapat berpengaruh terhadap intensitas bulwhip effect.

Order Batching

- Ukuran pemesanan yang jumlahnya kecil sering tidak efisien dalam ongkos sehingga dilakukan pemesanan dalam jumlah besar dalam satu satuan waktu
- Produksi juga sering dilakukan sistem batch, jumlahnya besar dalam satu satuan waktu, serta pengirimannya pun jumlahnya besar dalam satu satuan waktu untuk menghindari ongkos yang tinggi
- Order mingguan atau 2 mingguan dari peritel lebih fluktuatif dibandingkan penjualan ke pelanggan akhir.

Fluktuasi harga

- Adanya diskon → menyebabkan perubahan permintaan → seperti forward buying
- Produksi dapat saja kekurangan saat ada harga khusus pada pelanggan akhir
- Pada saat harga normal → Stok diperitel banyak → pemesanan ke distributor dapat distorsi selama 2-3 bulan.
- Stok menumpuk → Ongkos produksi meningkat

Rationing and Sortage Gaming

- Rationing → Permintaan lebih tinggi dari persediaan
- Permintaan sering tidak terpenuhi 100%
- Peritel sering berusaha untuk meningkatkan permintaan
- Kasus seperti ini sering terjadi saat menjelang hari raya dan tahun baru (Tidak setiap saat)
- Pada saat persediaan cukup dari peritel maka pelanggan merubah pesanan atau membatalkannya.

Bullwhip Causes

The bullwhip effect is mainly caused by three underlying problems:

- a lack of information
- the structure of the supply chain and
- a lack of collaboration.

1) Lack of information

- No information except for the order amount is perpetuated up the supply chain.
- Without actual customer demand data, all forecasting has to rely solely on the incoming orders at each supply chain stage.
- In reality, in such a situation traditional forecasting methods and stock keeping strategies contribute to creating the bullwhip effect.

2) Supply chain structure

- The longer the lead time, i.e. the longer it takes for an order to travel upstream and the subsequent delivery to travel downstream, the more aggravated the bullwhip effect is likely to be.
- Hence, the longer the lead time is, the more pronounced an order will be as a reaction to an increase in forecasted demand (especially in conjunction with updating the safety stock levels, see above), which again contributes to the bullwhip effect.

3) Local optimisation

- Local optimisation, in terms of local forecasting and individual cost optimisation, and a lack of cooperation are at the heart of the bullwhip problem.
- A good example for local optimisation is the batch order phenomenon. In practice, ordering entails fixed cost, e.g. ordering in full truck loads is cheaper than ordering smaller amounts. Furthermore, many suppliers offer volume discounts when ordering larger amounts.

Causes of Bullwhip Effect

- Local information and decisions at each node
- Different forecast mechanisms at each node
- Information and communication lead time
- Production and distribution lead time
- Order “padding”
- Batch/opportunistic purchasing
- Unsynchronized ordering policies

Impact of Bullwhip

- High inventory/lost sales/backlog cost
- Low operational efficiency
 - underutilization
 - overtime
- Poor customer service levels
- Unnecessary capacity investment
- Swings in working capital
- Blaming others; frustration, helplessness

Fast and Rich Information sharing

Information is distorted and late



Information is fast and more accurate, factory reacts more responsively



Demand, stock level, events, irregular patterns, etc.

Information is Distorted and late, make inappropriate response

Day 1
Promotion takes place

Day 5, stock run out, order larger and earlier than normally

Day 7, distributor deliver larger and earlier

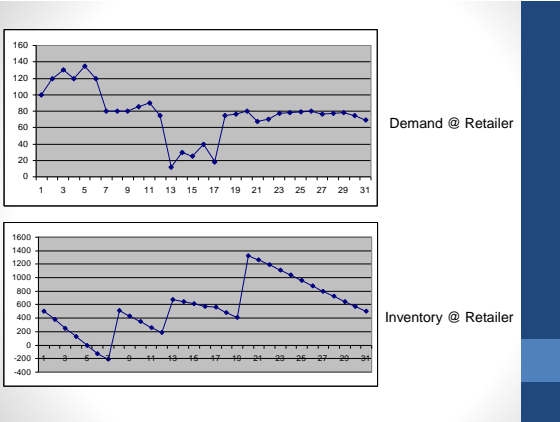
Day 10, distributor runs out of stock, order larger quantity to factory

Day 11, factory increase production volume through overtime

Day 8, promotion ends

Day 17, distributor receives large delivery from factory

Day 20, retailer receives large delivery from distributor, while demand disappear



Bullwhip Causes and Countermeasures

Order Batching

- High order cost ⇒ Electronic data interchange (EDI) & computer aided ordering (CAO)
- Full truck load economies ⇒ 3rd party logistics; assorted truckloads
- Random or correlated ordering ⇒ Regular delivery appointments

Shortage Gaming

- Proportional rationing scheme ⇒ Allocation based on past sales
- Ignorance of supply conditions ⇒ Shared capacity and supply information
- Unrestricted orders & free return policies ⇒ Flexibility limited over time; capacity reservations

Bullwhip Causes and Countermeasures (cont.)

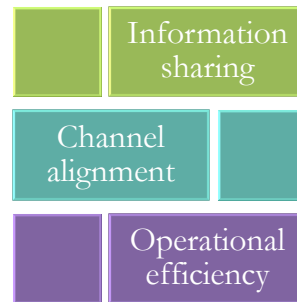
Fluctuating Prices

- High-low pricing ⇒ Every day low pricing (EDLP)

Demand Signaling

- No visibility of end demand ⇒ Access point of sale (POS) data
- Multiple forecasts ⇒ Single control of replenishment or vendor managed inventory (VMI)
- Long lead time ⇒ Quick response or lead time reduction

Avoiding the 'Bullwhip' effect



Information sharing

- Barcoding, electronic data interchange tau teknologi lainnya yang dapat mentransmisikan data penjualan POS
- Collaborative, planning, forecasting dan replenishment

Channel Alignment

- Memperpendek dan merubah struktur supply chain
- Order online system

Operational Efficiency

- Pengurangan ongkos-ongkos tetap
 - Untuk bisa pengiriman dalam batch kecil dibandingkan besar
 - Waktu setup dikurangi → Just in time
- Menciptakan stabilitas harga
 - Pengurangan harga secara kontinu sehingga tidak menimbulkan forward buying
 - Informasi promosi dari perusahaan harus diterima transparan pada seluruh chain

- Pemendekan leadtime
 - Mengubah struktur atau konfigurasi supply chain, mengubah modus transportasi, atau cara inovatif seperti cross docking dan perbaikan manajemen penanganan order, penjadwalan produksi maupun pengiriman lebih baik.

Ways to Reduce Variability and Uncertainty

- Close collaboration with business partners, information sharing with technology
- Reduce fixed cost components (setup cost, transportation policies, outsourcing, standardization)
- Recengineer the supply chain (shorten lead time, use local suppliers)
- New business models (such as Dell's direct model)
- Better planning capabilities



Collaborative Planning, Forecasting and Replenishment (CPFR)

Traditionally :

- Each function and each supply chain channel could have different forecast figures
- Plans are developed in isolation from other supply chain channels
- Minimal communication and coordination between channels takes place for corrective actions when actual production deviates from the plan

CPFR

PRINSIP :

- SC channels menggunakan forecast yang sama untuk seluruh kegiatan mereka
- Mereka juga meng-exploit supply process constraint
- Contoh : short order cycle dengan long production cycle. Caranya bisa dengan memperpendek manufacturing cycle atau memperpanjang order cycle sehingga terjadi sinkronisasi

Kenapa CPFR penting ?

- Setiap channel punya informasi yang berbeda (kalau informasi tersebut dibagi, akurasi forecast bisa ditingkatkan)
- Contoh : setiap channel punya program promosi yang berbeda, sedangkan manufaktur punya informasi kapasitas

A Leading Pilot

- Wal-Mart vs Warner Lambert
- Now Wal-Mart is engaged with some 600 trading partners
- Benefits :
 - ❑ Promotional planning improvements
 - ❑ Service level increases
 - ❑ Reduction in inventories
 - ❑ Better warehouse utilization
 - ❑ Better capacity allocation

Langkah “Beer Game”

1. Terima kiriman (persediaan bertambah) dan majukan inventory in transit satu periode. Pabrik memajukan work in process satu periode
2. Lihat incoming orders dan kirim sebanyak yang diminta. Kalau permintaan lebih besar dari inventory, kirim sebanyak stock yang tersedia
3. Catat inventory atau backlog pada record sheet. Backlog adalah akumulasi kekurangan yang harus dipenuhi. Semua permintaan harus dipenuhi (tidak ada lost sales)
4. Majukan order satu periode. Pabrik mengambil bahan baku sebanyak yang tertulis di “production request”
5. Tentukan besarnya pesanan dan catat dalam record sheet (Pabrik memesan ke lantai produksi/production request.)

Bullwhip dapat menyebabkan masalah dalam rantai pasokan antara lain:

- (1) persediaan yang berlebihan di seluruh rantai suplai keseluruhan;
- (2) perkiraan produk yang buruk,
- (3) kapasitas yang tidak cukup atau berlebihan;
- (4) layanan pelanggan yang buruk karena ketidaktersediaan produk atau backlogs panjang;
- (5) perencanaan produksi yang tidak pasti;
- (6) biaya yang tinggi untuk koreksi ; dsb.