



Bullwhip Effect

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Bullwhip Effect A.K.A.

- Demand Amplification
 - Forrester Effect (Jay Forrester, MIT)
 - Information Distortion
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4 Major Causes of the Bullwhip Effect

1. Demand forecast updating
 - Future demand is combined with safety stock
 2. Order batching
 - Orders are combined
 3. Price fluctuation
 - Forward buying
 - Quantity discounts
 4. Rationing and shortage gaming
 - Demand exceeds supply
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Lot Size and Silo Optimization

“One of the main causes of the Bullwhip Effect ... is the order batching. It is usually explained that this type of behaviour is triggered by rational decisions made in a local context, where the actor tries to minimise own total operational costs.” Hejazi 2006

Remedies

- make demand data at a downstream site available to the upstream site.
 - devise strategies that lead to smaller batches or more frequent resupply.
 - reduce the frequency and the level of wholesale price discounting.
 - allocate products in proportion to sales records
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Countermeasures

“The bullwhip effect results from rational decision making by members in the supply chain. Companies can effectively counteract the effect by thoroughly understanding its underlying causes.”

Lee 1997



Client Sheet metal Example

- Demand allocates stock “below min”
- Purchasing buys an EOQ of blanks
- Blanks are processed in a batch
 - Forming
 - Prep
 - Prime
 - QC
 - Stock

Simulation

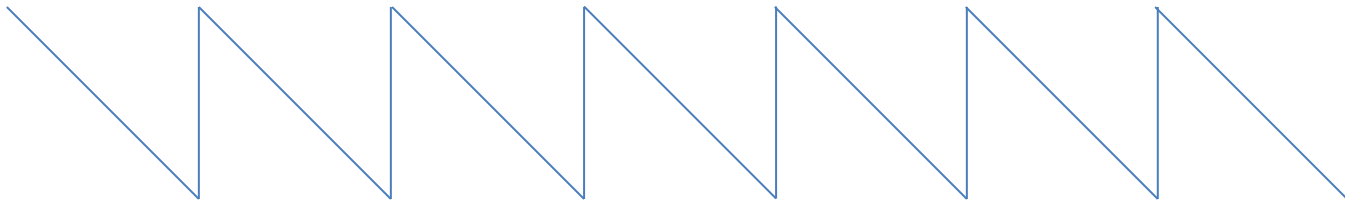
Batch 10 Pieces

Elapsed time 1st piece

Elapsed time 10 pieces

Number of defects

Smooth demand



The Planning Loop

“Traditional Manufacturing requires long lead times to resolve conflicts between various jobs or activities that require the same resources.

“Managers...trapped in the planning loop often respond by asking for better forecasts and longer lead times.

“The only way to break the planning loop is to reduce the consumption of time throughout the system.”

Stalk 1988



Reduced Batch Simulation

	Batch 10	Batch 5	One-Piece-Flow
Elapsed time 1 st piece			
Elapsed time 10 pieces			
Number of defects			

Manufacturing Cycle Efficiency

“In a traditional manufacturing system, products usually receive value for only .05% to 2.5% of the time they are in the factory.”

Stalk



Full Truck Load Vs. LTL

- Transportation costs affect batch sizing
- Large batches are ordered to obtain FTL
- Trend is to mix smaller orders of different products to maintain transport efficiency
- What is the driver for laser cut parts lot size?
 - Sheet size & thickness
- Ideas?
 - Keep EOQ but spit into smaller jobs for manufacturing
 - Kit parts of the same thickness to fill a sheet

Review

- Small fluctuations in demand get amplified
- Rational decisions have adverse effects
- Long lead times become longer lead times
- Batch processing leads to inefficiencies
- Strategies to reduce lead time are critical to:
 - Load smoothing
 - Working Capital
 - Cash Flow
 - Morale

References

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