***Supply Chain Management – Bullwhip Effect***

**Bullwhip Effect**

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| Demand Variability Increases Upstream in a Supply Chain |

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| .🡪 Flow of Material 🡪

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| Supplier | 🡪 | Manufacturer | 🡪 | Distributor | 🡪 | Retailer | 🡪 | Customer |

🡨 Flow of Information 🡨. |

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| 🡪 Flow of ***Material*** Downstream 🡪

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| Supplier |  | Manufacturer |  | Distributor |  | Retailer |  | Customer |
| Demand | 🡨 | Demand | 🡨 | Demand | 🡨 | Demand | 🡨 | Demand |
| Variability | (2)3 | Variability | (2)2 | Variability | (2)1 | Variability | (2)0 |  |

🡨 Flow of ***Information*** Upstream 🡨**Bullwhip Effect**

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| Demand Variability (2) Increases Upstream in a Supply Chain |
| (2)3 > (2)2 > (2)1 >(2)0 |

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|  | (2)3 > |  | (2)2 > |  | (2)1 > |  | (2)0 |  |
| Supplier | 🡨 | Manufacturer | 🡨 | Distributor | 🡨 | Retailer | 🡨 | Customer |
| 🡨 Flow of ***Information*** Upstream 🡨 |

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| ***Results due to the Bullwhip Effect*** |
| When a supply chain is based on forecasted demand, (PUSH system),the bullwhip effect will result in:1) Order quantities within the Inventory policies increase upstream.2) Inventory levels from Production orders increase upstream.3) Capacity utilization increases upstream.4) Distribution requirements increase upstream.5) Cost and waste increase upstream. |
| When a supply chain is based on realized demand, (PULL system), ideally, the bullwhip effect is eliminated. (Although often impractical) |

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| 🡪 Flow of ***Material*** Downstream 🡪 |
|  | (2)3 > |  | (2)2 > |  | (2)1 > |  | (2)0 |  |
| Supplier | 🡨 | Manufacturer | 🡨 | Distributor | 🡨 | Retailer | 🡨 | Customer |
| 🡨 Flow of ***Information*** Upstream 🡨 |

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| **Causes of Increase in Demand Variability, 2 , related to the Bullwhip Effect.**1.Forecasting within a base-stock level policy. 2.Lead time (Information & Material). 2 ∝ LT3.Batch ordering. 2 ∝ Q4.Price fluctuations (Forward buying). 5.Inflated orders (Gaming). . . | **Approaches to Cope with** **the Bullwhip Effect.**1.Centralized information2.EDLP (Everyday low pricing)3.EDI (Electronic Data Interchange)4.Cross-docking5.VMI (Vendor managed inventory). . . |
| **Trade-offs that impact the Bullwhip Effect.**1.Large lot sizes reduce ordering cost and small lot sizes reduce inventory carrying cost.2.Large lot sizes reduce transportation costs and small lot sizes reduce warehouse capacity costs.3.Large lead times support transportation and small lead times support inventory handling.4.Large product variety better matches demand and small product variety reduces inventory complexity.. . . |
| **Management of the Bullwhip Effect***Objective: Balance Inventory Costs with Customer Service*1. Planning:-Sequential Planning (Local Optimization)-Integration (Global Optimization)2. Information:-Information Uncertainty (Centralized vs. Distributed Information)-Demand Variability (Forecasting)3. Policies:-Lot Size (Upstream Orders, Downstream Shipments, and Backorders)-Lead Time (Upstream Information Processing and Downstream Material Shipments). . . |