



BULLWHIP EFFECT IN SUPPLY CHAIN

In market place, product demand is not always constant; it largely varies due to change of customers' behavior and several other factors including the local and global economy, contemporary fashion, duration of peak sale season, weather and so on. Consequently, the demand fluctuates at the retail store, gradually propagate towards the suppliers, and then, at the manufacturer. The effect of demand variability that occurs at the customer level grows sharply over the wholesaler, and dramatically over the distributor and finally peaks at manufacturer facility. Since demand variability initiates from downstream at the customer level, gradually reach to upstream at the manufacturer level, resemble the phenomenon of a bullwhip, called the bullwhip effect. Figure 1 shows how small changes in the customer demand form a bullwhip effect in supply chain. Although bullwhip effect is perceived as an unavoidable effect of demand variation, there are substantial studies and efforts initiated by the researchers and companies to find the root cause of the demand variation, and initiative to minimize the ripple effect.

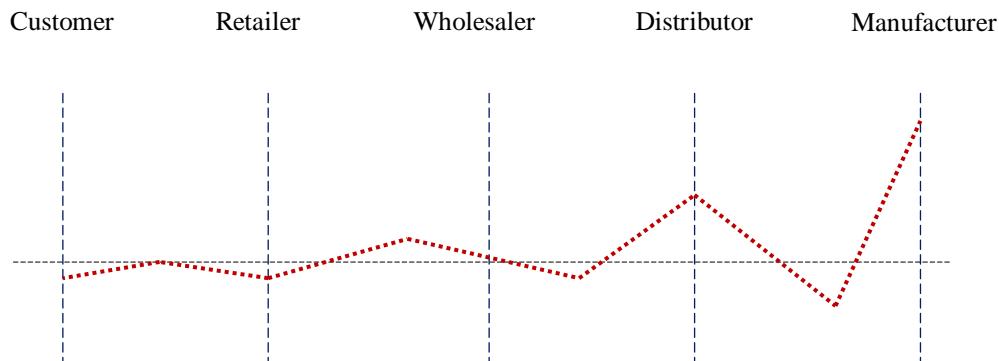


Figure 1: Bullwhip Effect in Supply Chain due to Demand

The bullwhip effect occurs due to overreaction of demand fluctuations, not because of the amplification of demand. When demand fluctuates at the customer level, there create a mismatch between the supply and demand. The ordering quantity either makes excessive inventory or shortages, which propagate to the bullwhip effect in the supply chain. The essence of the bullwhip effect is the orders amplification at the manufacturers' level due to changes made at the buyer. Demand amplification and production fluctuations increase waste of resources and costs. For a large supply chain, it is difficult to control demand amplification and the bullwhip effect.

Identifying ways to control the bullwhip effect requires the experience of how to rapidly react to market and demand changes, agile decision making. Innovative companies have found ways to control the bullwhip effect and improve their supply chain performance by coordinating information and planning along the supply chain. In the literature, the bullwhip ratio is defined as the ratio of variance of the orders realized by the manufacturer to the variance of the demand observed by the retailer.

$$\text{Bullwhip ratio} = \frac{\text{Var (Order)}}{\text{Var (Demand)}}$$

Traditionally, there is bullwhip effect, when bullwhip ratio > 1.