

An Empirical Study on Causes responsible for Bullwhip Effect in Pharmaceutical Manufacturing Sector

Shweta Mogre*

Dr. V. K. Jain**

Dr. P. K. Jain***

***Assistant Professor, Pioneer Institute of Professional Studies, Indore**

*****Principal, Pioneer Institute of Professional Studies, Indore**

Abstract

Demand variability increases when it moves downstream to upstream in a supply chain, this is called the 'Bullwhip effect'. There are several causes due to whom this effect is occurs. In this paper we are trying to identifying these causes which are responsible for bullwhip effect and suggest some strategies for reducing the Bullwhip Effect.

Introduction:

In Present scenario Customers want more quality, design, innovation, choice, convenience and service, and they want to spend less money and effort. Also, making optimal decision under uncertain conditions is a challenging task for industries. In industries the supply chain consists of so many layers but managers make decisions on the basis of localized information and decisions are hidden from other members of the chain. This creates the information distortion; the gap between the forecast and reality is large and leads to product shortfalls or inventory excess. This variation in demand–delivery cycle is called bullwhip effect. It is an important phenomenon in supply chains.

As one moves up in a supply chain i.e. away from the consumer demand the volatility in demand increases. Customer demand is rarely stable, manufacturer must forecast demand to fulfill the requirement of customers. But forecast may or may not be true and error arises. This effect is also known as whiplash or whipsaw effect and it can be reduced if actual demand of customer goes to supplier. Then the supplier can adjust their production schedule and as a result; inventory reduced significantly. The bullwhip phenomenon was first described by Forrester in 1958, after that in 1980's, it is identified through simulation approach. It is well-researched topic in the area of Supply Chain Management. Now a day's large amount of literature is available on bullwhip effect and its impact on the supply chain performance.

Bullwhip Effect:

The bullwhip effect on the supply chain occurs when changes in consumer demand causes the companies in a supply chain to order more goods to meet the new demand. The bullwhip effect usually flows up the supply chain, starting with the retailer, wholesaler, distributor, manufacturer and then the raw materials supplier. This effect can be observed through most supply chains across several industries; it occurs

because the demand for goods is based on demand forecasts from companies, rather than actual consumer demand.

The Bullwhip is an observed phenomenon of various industries. Small changes in consumer demand can result in large variations in orders placed upstream. The first recorded documentation of this phenomenon is probably due to Forrester, (1958) in industrial dynamics, he called it “Demand Amplification”. Historically, the Bullwhip Effect had been accepted as a normal occurrence of the order-to-delivery cycle. It is observed that the order pattern in upstream direction is highly variable than downstream. The amplification in order variation may cause irrational decision-making (Lee et al., 1997). Figure indicates the variation in demand between different stages of supply chain.

Figure 1

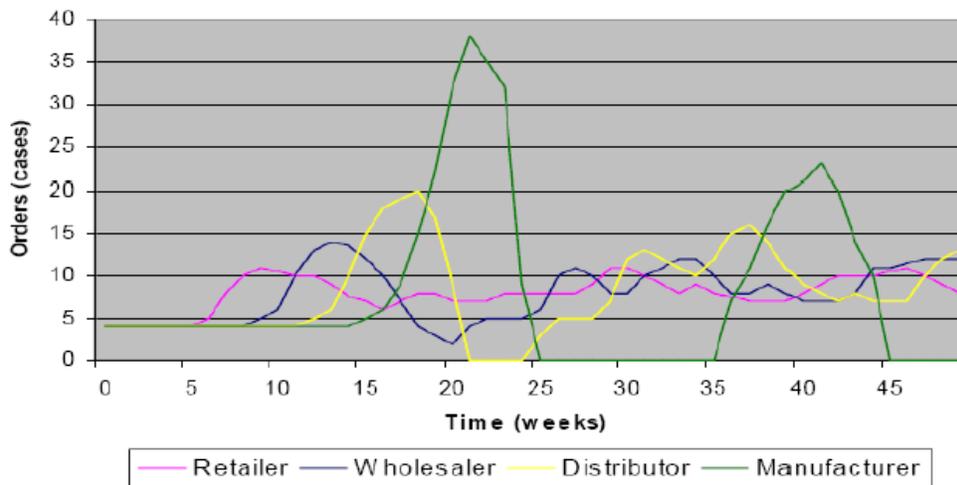


Figure: variation in order pattern in bullwhip effect

(Ackere, V., Larsen, A., Erik Reimer - Morecroft, John, D.W., 1993)

The bullwhip is characterized by oscillations of orders at each level of the supply chain and an amplification of these oscillations farther up the chain away from the marketplace (Croson and Donohue, 2003). The Beer Game developed at MIT is very popular in many business schools and executive seminars and is very useful for illustrating the bullwhip problem (Sternan, 1989). The real meaning of the bullwhip effect is that orders to suppliers tend to have larger variance than sales to the buyer. This topic becomes more complex when there are more chains in the supply chain. This distortion of demand is amplified when demand is passed upstream. Lee et al., (1997) first exposed the term “Bullwhip” when they visited Procter and Gamble in the early 1990’s. After that they realized the occurrence of bullwhip effect in so many industries and found that it is unavoidable.

Pharmaceutical Manufacturing Sector in Indore:

The pharmaceutical industry develops, produces, and markets drugs or pharmaceuticals for use as medications. Pharmaceutical companies may deal in generic or brand medications and medical devices. They are subject to a variety of laws and regulations that govern the patenting, testing, safety, efficacy and marketing of drugs.

Globally, India ranks 3rd in terms of volume and 14th in terms of value. According to Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, the total turnover of India's pharmaceuticals industry between 2008 and September 2009 was US\$21.04 billion. Mumbai, Hyderabad and Ahmedabad are the major pharmaceutical hubs of India. While the domestic market is worth US\$13.8 billion as of 2013, and is expected to reach US\$49 billion by 2020.

The government started to encourage the growth of drug manufacturing by Indian companies in the early 1960s, and with the Patents Act in 1970. However, economic liberalization in 90s by the former Prime Minister P.V. Narasimha Rao and the then Finance Minister, Dr. Manmohan Singh enabled the industry to become what it is today. This patent act removed composition patents from food and drugs, and though it kept process patents, these were shortened to a period of five to seven years.

The lack of patent protection made the Indian market undesirable to the multinational companies that had dominated the market, and while they streamed out. Indian companies carved a niche in both the Indian and world markets with their expertise in reverse-engineering new processes for manufacturing drugs at low costs. Although some of the larger companies have taken baby steps towards drug innovation, the industry as a whole has been following this business model until the present.

India's biopharmaceutical industry clocked a 17 percent growth with revenues of Rs.137 billion (\$3 billion) in the 2009-10 financial year over the previous fiscal. Bio-pharma was the biggest contributor generating 60 percent of the industry's growth at Rs.8,829 crore, followed by bio-services at Rs.2,639 crore and bio-agri at Rs.1,936 crore.

Table 1

Top 10 Publicly Listed pharmaceutical companies in India by Market Capitalization as of July 2015

Rank	Company	Market Capitalization 2015 (INR crores)
1	<u>Sun Pharmaceutical</u>	2,17,636

2	<u>Lupin Ltd</u>	84,193
3	<u>Dr. Reddy's Laboratories</u>	63,779
4	<u>Cipla</u>	52,081
5	<u>Aurobindo Pharma</u>	42,454
6	<u>Cadila Healthcare</u>	38,677
7	<u>Glenmark Pharmaceuticals</u>	29,047
8	<u>GlaxoSmithKline Pharmaceuticals Ltd</u>	28,587
9	Divis Laboratories	24,847
10	<u>Torrent Pharmaceuticals</u>	22,320

About Area of Research Study:

Indore is located in the western region of MP. Major industrial areas surrounding the city include the Pithampur Special Economic Zone (SEZ) and the Sanwer Industrial belt. The SEZ of Indore has spread over 1,038 hectares of land. The SEZ has attracted investment of over US\$ 200 million so far. The industries located in the SEZ include textile, pharmaceuticals, automobile & auto ancillary, metallurgy and leather.

For the purpose of this research study pharmaceutical manufacturing companies nearby Indore city were selected. Self Designed Questionnaire was used for collecting Primary data for finding the causes responsible for bullwhip effect.

Data Analysis, Interpretation and Results:

To find out the foremost causes, which are responsible for Bullwhip Effect Questionnaire consisting of 23 statements related to causes responsible for Bullwhip Effect was executed. The results obtained from the collected data are as follows:

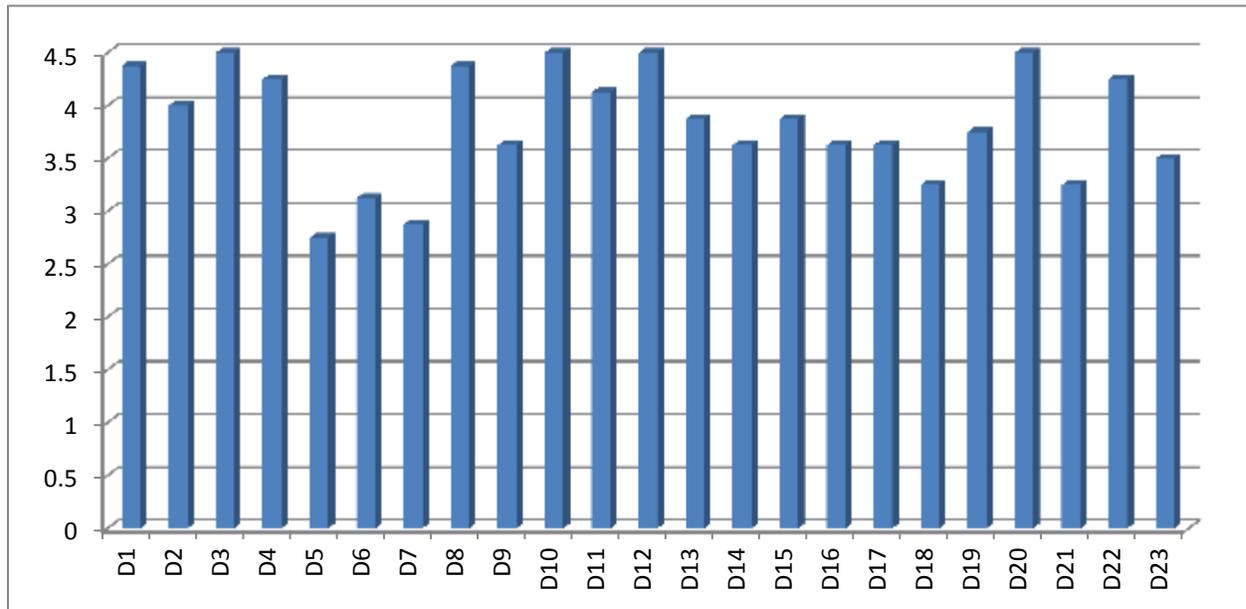
Table 2

Causes	Percentage of Respondents				
	Highly Responsible	Responsible	Can't say	Less Responsible	Not Responsible
Price of Materials	38%	62%	0%	0%	0%
Financial stability of suppliers	25%	50%	25%	0%	0%
Material lead times too long	50%	50%	0%	0%	0%
Trust between you and your suppliers	25%	75%	0%	0%	0%
Cost of replacing outdated technology	25%	0%	0%	75%	0%
Capacity limitations due to capital funding	37.5%	0%	12.5%	12.5%	37.5%
Output based on customer's forecast to plan	0%	62.5%	0%	25%	12.5%
Labour problems – availability of skills	37.5%	62.5%	0%	0%	0%
Labour problems – time-consuming to resolve	0%	75%	12.5%	12.5%	0%
Capacity limitations due to customer order fluctuation	75%	12.5%	0%	12.5%	0%
Reducing cycle time	25%	62.5%	12.5%	0%	0%
Balancing inventory levels	75%	12.5%	0%	12.5%	0%
Integrating information systems internally	0%	87.5%	12.5%	0%	0%
Capacity limitations due to availability of skilled labour	37.5%	25%	0%	37.5%	0%
Integrating technology with suppliers and customers	37.5%	37.5%	0%	25%	0%
Cancellation of orders	37.5%	25%	0%	37.5%	0%
Excessive and slow-moving inventory due to cancellation of orders	12.5%	62.5%	0%	25%	0%
Rapid changes in demand (in terms of quantity patterns)	25%	25%	0%	50%	0%
Advance communication about	0%	87.5%	0%	12.5%	0%

Causes	Percentage of Respondents				
	Highly Responsible	Responsible	Can't say	Less Responsible	Not Responsible
market demand					
Too dependent on business of a particular customer	50%	50%	0%	0%	0%
Trust between you and your customers	25%	25%	0%	50%	0%
Relationship with customers	25%	75%	0%	0%	0%
Little or no assistance from customers in complying with their requirements	25%	37.5%	0%	37.5%	0%

Figure 2

Mean of Responses



As per the study the most responsible causes for bullwhip effect are Long Material lead time, Capacity limitations due to customer order fluctuation, Balancing inventory levels and Too dependency on business of a particular customer. Whereas Cost of replacing outdated technology and Output based on customer's forecast are the least responsible causes for Bullwhip effect in Pharmaceutical manufacturing companies nearby in Indore City.

Strategies for Reducing Bullwhip Effect:

Following strategies have been suggested by researcher after reviewing various articles, talking to the respondents and advice taken from various experts that may help the manufacturing sector companies for reducing the Bullwhip Effect and increase their company's performance:

- Maintain price consistency: In this research most important factor which affects the bullwhip effect is Price Fluctuation. Hence for reducing the bullwhip effect one of the useful technique is to maintain prices. There is an immediate impact of price fluctuations on the customer purchases. When prices are lowered due to market conditions, customers order more. Maintaining a consistent price even during market fluctuations decreases the bullwhip effect. Offering products at stable and fair prices can prevent buying surges triggered by temporary promotional discounts. Special purchase contracts can be implemented to encourage ordering at regular intervals to better synchronize delivery and purchase.
- Improving communication and forecasting: Another main cause of Bullwhip Effect is Forecast Error. Hence next step for minimizing the bullwhip effect is, understanding of the customers' demand and planning the inventory consumption. This can be done by improving communication in whole supply chain. Lack of demand visibility can be addressed by providing all key players in the supply chain with access to point of sale (POS) data. Suppliers and customers must then collaborate to improve the quality and frequency of communication throughout the supply chain. They also can share information through an arrangement such as vendor-managed inventory (VMI). Eliminating practices that cause demand spikes, such as order batching, also can help.
- Avoid multiple demand forecast updates: Companies can make demand data from downstream available upstream. Or they can bypass the downstream site by selling directly to the consumer. Also, they can improve operational efficiency to reduce highly variable demand and long resupply lead times.
- Break order batches: Companies can use electronic data interchange to reduce the cost of placing orders and place orders more frequently. And they can ship assortments of products in a truckload to counter high transportation costs or use third party logistics companies to handle shipping.
- Eliminate gaming in shortage situations. In shortages, suppliers can allocate product based on past sales records, rather than on orders, so customers don't exaggerate their orders. They can also eliminate their generous return policies, so retailers are less likely to cancel orders.

Conclusion:

The Manufacturing sector consists of enterprise which is engaged or occupied in transformation of material, substance or component into new products. The economy of every country is supported by

growth of its manufacturing industries. Currently, the manufacturing industries are passing through a phase of very tough competition. The economic environment is becoming harsh. In order to survive, every industry has to strive to improve productivity in all spheres of activity. In this context, it is necessary to each and every manufacturing industry to improve its performance. Hence it is necessary to each manufacturing sector to identify the factors which are directly or indirectly having the impact on performance of manufacturing organization.

The present study shows that Bullwhip Effect is present in all the selected pharmaceutical manufacturing companies of Indore region. Some of the major Strategies suggested by researcher are maintaining the price consistency, improving communication and forecasting, avoid multiple demand forecast updates, break the order batches and eliminate gaming in shortage situations. The findings from this study may be beneficial for manufacturing companies of Indore region and India as well.

References

1. Ravinder Kumar, Singh Rajesh K., Ravi Shankar (2015), Critical success factors for implementation of supply chain management in Indian small and medium enterprises and their impact on performance, IIMB Management Review 27, pp 92-104
2. Jun Shan, Shitao Yang, Shilei Yang and Jin Zhang (2014) ,An Empirical Study of the Bullwhip Effect in China, Production and Operations Management, Vol. 23, No. 4, pp. 537–551
3. Torres Octavio Carranza and Arnold B. Maltz (2010), Understanding The Financial Consequences Of The Bullwhip Effect In A Multi-Echelon Supply Chain, Journal Of Business Logistics, Vol. 31, No. 1, Issue 1,pp 23-41
4. Padma Joshi, Dr. V.K.Jain, (2007), The bullwhip effect: A review of available literature. Published in,” The new paradigms in supply chain management”, Mahakal Institute of Management, Ujjain (M.P.).
5. Padma Joshi, Dr. Ashutosh Pathak, Dr. V.K.Jain, (2007), The Bullwhip Effect: A Conceptual Framework. Published in, ”The supply chain management in global environment,” Mahakal Institute of Management, Ujjain (M.P.)
6. Ravichandran, N., (2006), Managing bullwhip effect: Two case studies. Indian Institution of Management, Ahmedabad, W.P. No. 2006-08-01, August 2006.
7. Geary, S., Disney, S.M., Towill, D.R., (2006), On bullwhip in supply chains-historical review, present practice and expected future impact. International Journal of Production Economics, Volume 101, pp. 2–18.

8. Disney, S.M. and Towill D.R., (2006), A methodology for benchmarking replenishment-induced bullwhip. *Supply Chain Management: An International Journal*, Volume 11, Number 2, pp. 160–168.
9. Wilck, J.H., (2006), Managing the Bullwhip Effect, (accessed from, [http://www.engr.psu.edu / symposium 2006/session- 3D modeling and engineering applications/](http://www.engr.psu.edu/symposium2006/session-3Dmodelingandengineeringapplications/)).
10. Croson Rachel and Donohue Karen (2006), Behavioral Causes of The Bullwhip Effect and The Observed Value of Inventory Information, *Management Science*, Vol. 52 Issue 3, pp323-336