THE IMPACT OF VENDOR MANAGED INVENTORY (VMI) ON THE BULLWHIP EFFECT IN SUPPLY CHAINS

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Abstract:
The rapid development of the Internet has dramatically changed the traditional definitions of manufacturer, suppliers and customers. Newer approaches to supply chain management attempt to organize the supply chain as a network of cooperating intelligent agents. Vendor Managed Inventory (VMI) is a centralized link between suppliers and customers that enables faster and less complex transactions. This research is focused to compare the performance of a VMI supply chain with a traditional supply chain and the aim of this paper is evaluate the impact these two alternative structures have on the “Bullwhip Effect” generate in the supply chain.

Keywords: Supply Chain Management, VMI, Bullwhip Effect

1 Vendor Managed Inventory (VMI)
Information sharing plays vital roles in inventory management, particularly in VMI (Vendor Managed Inventory) system. VMI is essentially a distribution channel operating system whereby the inventory at distributor/retailer is monitored and managed by the manufacturer/vendor (NACHIAPPAN et al., 2005). Information sharing between supply chain members is necessary for implementing VMI (ANGULO et al., 2004) and, with VMI, the supplier inventory level, so as to ensure the predetermined customer service level. In such a relationship, the supplier takes the replenishment decisions for the buyer, dispatching a quantity of product that may be variable quantity which leads to product availability and improved customer service level without increasing stock outs. An effective VMI can be achieved by integration
technology, enabling network application, customizable replenishment logic, and linkage to internal applications. In this relationship, buyers relinquish control of key resupply decisions and sometimes even transfer financial responsibility for the inventory to the supplier.

In a VMI partnership, the supplier, usually the manufacturer but sometimes a reseller or distributor, makes the main inventory replenishment decisions for the consuming organization. This means that the vendor monitors the buyer’s inventory levels (physically or via electronic messaging) and makes periodic resupply decisions regarding order quantities, shipping, and timing (Waller et al., 1999). According to Disney & Towill (2003), vendor managed inventory is one practical way of seeking to obtain the benefits of echelon elimination. VMI is a supply chain strategy whereby the vendor or supplier is given the responsibility of managing the customer’s stock.

According to Pires (2004), VMI it is a practical where the supplier has the responsibility to manage the customer’s inventory, including the replenishment process. In this sense, VMI can be understood as a new version or as a "evolution" of the old practical of consigned inventory, however now inserted in an environment business with higher level of contribution.

To Nachiappan et al. (2005), VMI is a centralized link between suppliers and customers that enables faster, less complex transactions without creating individual lines of communication for every business relationship.

According to Disney & Towill (2003), VMI is a supply chain strategy where the vendor or supplier is given the responsibility of managing the customer’s stock.

VMI is a fundamental change in the approach for solving the problem of supply chain coordination. Instead of just putting more pressure on suppliers' performance by requiring ever faster and more accurate deliveries, VMI gives the supplier both responsibility and authority to manage the entire replenishment process (Kaipia et al., 2002).

To Kaipia et al. (2002), vendor managed inventory is a recent alternative for the order-delivery process. The fundamental change is that the ordering phase of the process is
abolished, and the supplier is given both authority and responsibility to take care of the entire replenishment process.

The essence of the VMI is the responsibility of the supplier in become available the necessary material to the customer to be used when and how much it will be necessary (PIRES, 2004).

1.1 Objectives and benefits of VMI:

To Nachiappan et al. (2005), the objectives of VMI are:

- Increased sales, improved CSL, increased gross margins, reduced overall inventory in supply chain, stabilized vendor's production, control of the bullwhip effect, solidified customer loyalty through development of a long-term trustworthy relationship and improvement of overall information system capabilities.

According to Angulo et al. (2004), the benefits of a VMI partnership are:

- Reduced costs due to better resource utilization for production and transportation,
- Improved service levels due to better coordination or replenishment orders,
- Reduced lead time and increased inventory turns,
- Reduced inventory stock outs by increasing inventory visibility,
- Higher selling space productivity obtained by optimizing inventory.

To Gandhi (2003), the main benefits of VMI are given below:

- **Lower customer Inventories**: under VMI, the supplier is able to control the lead time component of the order point better than a manufacture/supplier with a host of suppliers can ever hope to do. Additionally, with inventory review, the need for safety stocks on the supplier side is dramatically reduced.

- **Better Forecasts**: occur because of demand information sharing. Better forecasts result from having a more stable demand distribution pattern. The demand is reflected in more frequent orders for the same parts and therefore variability of demand in business.
Reduced costs: occur because of the reduction in the demand volatility downstream of the supply chain. VMI helps dampen the peaks and valleys of production, allowing smaller buffers of capacity and inventory.

Improved Service: with VMI, coordination of replenishment orders and deliveries across multiple suppliers helps to improve service level.

VMI brings a number of benefits to all parties participating in the supply chain (DISNEY et al., 2003): Impact of demand: the impact of demand amplification is dampened as the manufacturer now receives a direct view of end consumer demand patterns and can use this in forecasting. Cost benefits: cost benefits can be generating through a reduction in buffer stocks at the buyer and supplier and a more efficient use of production facilities, Increase profits: VMI can, in the long run, increase the profitability of both the supplier and buyer in the supply chain.

Pires (2004) presents some advantages of the VMI:

Supplier’s advantages:
1. Better customer service and greater "loyalty" of the customer,
2. Better coordination of demand,
3. Better knowledge of the market,

Customer’s advantages
1. Lower costs with inventory and capital cycle
2. Better supplier’s service
3. Simplification of the management of the inventories and the purchases

2 The Bullwhip Effect (BWE)

One important mechanism for coordination in a supply chain is the information flows among members of the supply chain. These information flows have a direct impact on the production scheduling, inventory control and delivery plans of individual members in the supply chain.

The Bullwhip Effect (BWE) where the orders’ variability is amplified in each echelon of the supply chain: from retailer to distributor, from distributor to manufacturer and from the manufacturer to the suppliers (CHOPRA & MEINDL, 2003).
Bullwhip Effect is the amplification of the demand (order) variance up the supply chain, from customer to factory, as demand information passes back through the supply chain (CHATFIELD et al., 2004). The phenomenon is shown in Figure 1.

Distorted information from one end of a supply chain to the other can lead to tremendous inefficiencies: excessive inventory investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation, and missed production schedules (LEE et al., 1997).

According to Lee et al. (1997), the bullwhip effect refers to the phenomenon where orders to the supplier tend to have larger variance than sales to the buyer, and the distortion propagates upstream in an amplified form.

Lee et al. (1997) identified four major causes of the bullwhip effect - Demand forecast updating, the rationing gaming, order batching and price variations. Demand forecast updating refers to the situation where demand is non-stationary and one uses past demand information to update forecasts. The rationing gaming refers to the strategic ordering behavior of buyers when supply shortage is anticipated. When fixed order
cost is nonzero, ordering in every period would be uneconomical, and batching of orders would occur. Finally, price variations refer to non-constant purchase prices of the product.

To Chatfield et al. (2004), the bullwhip effect has a number of baneful consequences on the operation of a supply chain. Because of the higher variance, more safety stocks have to be carried with consequently more investment, extra production capacity, and increased storage space.

3 The impact of Vendor Managed Inventory on the Bullwhip Effect

A supply chain is a system consisting of material suppliers, production facilities, distribution services, and customers who are all linked together via the downstream feed-forward flow of information (orders). In a traditional supply chain each “player” is responsible for his own inventory control and production or distribution ordering activities. According to Disney et al. (2003), in a traditional supply chain, each company operates individually, with interactions between them limited to just feed-forward flow of physical products and the feedback flow of information, in the form of orders and cash. As a consequence of the structure, the traditional supply chain suffers from long lead-times, multiple decision points, unclear information and minimal synchronization.

The lack of visibility of end customer demand causes a number of problems. The most evident is the Bullwhip Effect, as shown in Figure 2, due to the structure of the ordering decisions with its lead-time for deliveries. The retailer as a result of forecasting customer demand introduces extra fluctuations into the pattern of demand. The distributor, whose forecast is based on the orders of the retailer, then increases these variations further. This effect continues up the supply chain, resulting in a significant distortion of the actual customer demand by the time the manufacturer receives the orders.
With VMI, the supplier controls the buyer’s inventory level, so as to ensure that predetermined customer service levels are maintained. In such a relationship, the supplier takes the replenishment decisions for the buyer, dispatching a quantity of product that may be fixed or variable. Replenishment occurs when the stock level at the buyer reaches a specified level, based on both the average demand during the transportation lead-time and safety stock to cover for demand variations. Consequently, there is no passing of orders between the two companies. For VMI to be successful it is necessary for a large amount of information to be transferred between both parties, particularly data regarding end user sales and inventory levels at the buyer. A simple diagram of a VMI supply chain can be found in Figure 3.
To Pires (2004), Table 1 summarizes the results of an executed simulation, reporting the main impacts of VMI in the causes of the bullwhip effect. Two situations are compared: the same Supply Chain using and not using the logic of VMI.

Table 1: The impact of VMI on causes of the Bullwhip Effect

<table>
<thead>
<tr>
<th>Cause</th>
<th>Traditional Supply Chain</th>
<th>VMI Supply Chain</th>
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<tbody>
<tr>
<td>Demand Forecast</td>
<td>It can be reduced only with supply costs two times bigger</td>
<td>In a well projected system it is easy to reduce this cause in the supply chain for the level of the effect in only two subsequent echelons</td>
</tr>
<tr>
<td>Update</td>
<td></td>
<td></td>
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<tr>
<td>Shortage Gaming</td>
<td>It can provide a significant &quot;contribution&quot; to the bullwhip effect</td>
<td>It can be completely prevented with the use of the VMI due to change in the nature of the relationship in the SC</td>
</tr>
<tr>
<td>Racing</td>
<td></td>
<td></td>
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<tr>
<td>Order Batching</td>
<td>It can provide a significant &quot;contribution&quot; to the bullwhip effect. However this can be</td>
<td>It can be completely prevented with the use of VMI due to the structure of the flow of information</td>
</tr>
<tr>
<td></td>
<td>reduced if the deliveries occur constantly and if the batch sizes be variable</td>
<td></td>
</tr>
<tr>
<td>Price Fluctuations</td>
<td>It requires considerable increases of capacity to provide rise in the customer service</td>
<td>It requires lower capacity to answer a request of increase in the customer service level.</td>
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<td></td>
<td>level.</td>
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4 Conclusions

VMI is an approach which reduces the information across the partners of supply chain, guarantying tangible benefits such as the increase in buyer profit, vendor profit, decrease in sales price and contract price an intangible benefits such as reduced inventory, replenishments, stock outs, and the most important, VMI helps to reduce the Bullwhip Effect.

The management of inventory by the supplier continues to draw attention in many industries. In this paper was addressed the benefits of VMI, showing the impact of VMI on the Bullwhip Effect.

It is of fundamental importance to shift the responsibility and authority of the replenishment decisions to the supplier. When the supplier decides the delivery lot size and timetables, the entire chain from supplier’s process to customer’s process can be optimized, but the lack of trust between the trading partners and the uncertainty about the potential benefits of VMI are difficult obstacles.

VMI systems attest to the efficiencies attainable through consolidated information processing.

References:


