Improved Optimality of Vendor Managed Inventory

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Abstract

In the current scenario, due to the emerging world of e-commerce, the bar of customer expectation and satisfaction is placed at a higher position than it used to be and the foremost requirement of every customer is to get their order delivered as soon as possible. An alternative to the delivery of the order is, the customer can pick up the order at Vendor Managed Inventory (VMI) location. Vendor Managed Inventory is a set of techniques for managing the inventory and in this, the supplier mainly holds the inventory for the distributors. This paper demonstrates ways by which customers can have access to orders on the same day via VMI. We will incorporate the study of VMI in day-to-day deals between the customers and suppliers, providing information regarding various aspects such as Inventory planning, forecasting, customer service etc. Here the primary focus will be on improving VMI and providing solutions to the current problems related to VMI which would result in mutual benefits to the customers and suppliers. In the recent scenario, VMI mostly benefits the customers; however, with optimization of VMI, the supplier can achieve desired profits.

Keywords
Supply chain, Inventory, Vendor Managed Inventory, VMI, e-commerce

1. Introduction

1.1 Background Research

Vendor Managed Inventory is abbreviated as VMI. VMI is a concept in which the vendor or supplier is responsible for the Planning and Control of the inventory for the buyer. The vendor has the access to the demand requirement or data of the buyer or retailer and is considered responsible for maintaining the appropriate level of inventory for the buyer or retailer (Han, Lu et al. 2017). One of the responsibilities of the vendor is also to determine the replenishment policies and maintaining the optimum inventory level for the retailers (Han, Lu et al. 2017). In VMI, the buyer or retailer will not have any capital tied up in inventory, the buyer will not have his money invested in the inventory and will not hold the inventory holding or storage costs as it will be managed by the supplier. The liability of managing stock levels at the point of sale is on the supplier (Disney and Towill 2003). To consider an example, a tire manufacturer, i.e. supplier, produces and supplies tires to an automaker, i.e. buyer. As per the standard inventory policy, the automaker manages its own inventory and places a purchase order with the tire manufacturer whereas, in VMI, the tire manufacturer needs to monitor the automaker's inventory level and material demand and is responsible for tires supply to the automaker (buyer) in a timely way to avoid the lack of raw materials. As shown below, Figure 1 shows a diagram which compares Normal Replenishment System with Vendor Managed Inventory.

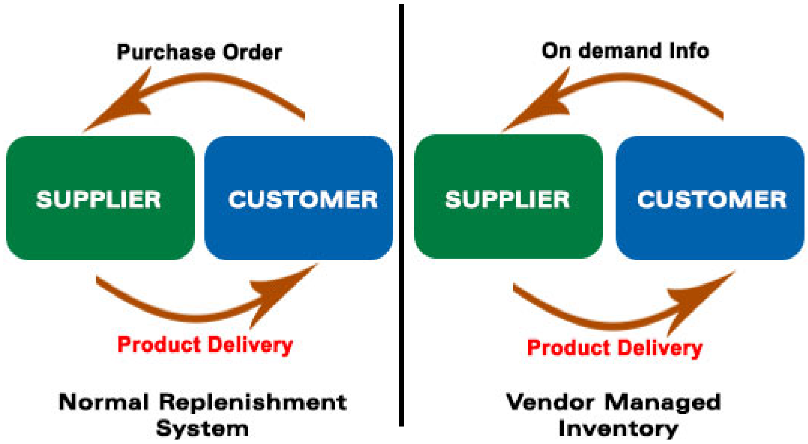

Figure 1. Comparison of Normal Replenishment System and Vendor Managed Inventory (GeoStarSupplyChain 2015)

Vendor managed inventory is also known as consignment inventory. It has been largely adopted by Wal-Mart, Kmart, Dillard's, Department Stores, HP, JCPenney, and Shell (Dong and Xu 2002). The most important issue in designing a VMI system is how to ensure optimal inventory planning, such as decision-making at the inventory level and replenishment frequency (Han, Lu et al. 2017). Normally forecasting and replenishment functions are also borne by the supplier, freeing the customer/ buyer from managing the supply chain (Dong and Xu 2002). VMI also results in reducing the lead time required for delivering orders. his paper will be focusing on the issues related to VMI and the solution which could be carried out (Achabal, McIntyre et al. 2000). As shown below, Figure 2 shows Basic VMI Process

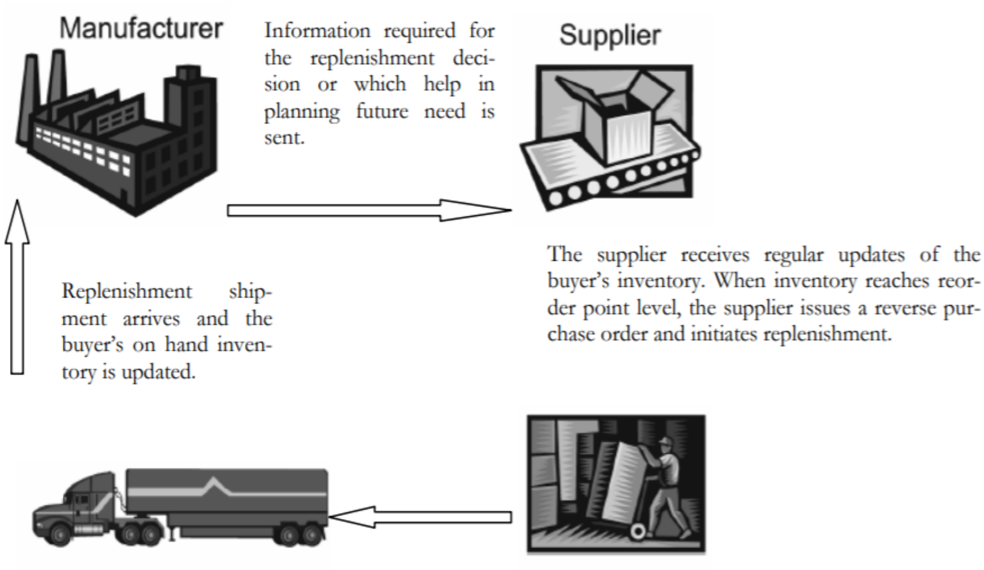

Figure 2. Basic VMI Process (Lundberg, Nowak et al. 2006)

2. Benefits

2.1 To the Supplier/Manufacturer

VMI increases the amount of workload on the supplier as it becomes their liability to manage the inventory, however, there are also certain benefits for the suppliers. Being able to move swiftly with the customer's demand is key for a supplier to become valuable. However, it is very rare for the information to flow down-chain from customer to supplier. But with the use of VMI, a supplier can have a better look at what is in demand and how often. Basically, it helps the manufacturer know how much and when. The customer will order, rather than having a random estimate or producing a fixed amount of products for every period. It allows the manufacturer who is the supplier to produce the product at a pace which would not have excess inventory or lack of inventory. This will also allow the supplier to better plan parts and production, keeping costs lower and inventory properly managed. Another benefit for the supplier is warehousing, by storing inventory for the customer as per VMI, the supplier can store months of inventory free of charge. The supplier can do better utilization of their facility and the customer/buyer will have a steady supply of which it will rarely run out (Lunka 2018).

2.2 To the Customer/Buyer/Retailer

VMI also eases some of the responsibilities of the buyers and provides them with certain benefits(Cai, Tadikamalla et al. 2017). One of the most important benefits of VMI for a buyer is, that it will lower their ordering costs. As it becomes the duty of the manufacturer, to monitor the demand for the product, it will provide optimum order quantity required by the customer/retailer (Khan, Jaber et al. 2016). Another important benefit of VMI to the customer is that it will elevate the service level (Cai, Tadikamalla et al. 2017). Along with this the inventory cost of the buyer is decreased or nullified. The buyer gets improved fill rates from the manufacturer and to the end customer(Yao, Evers et al. 2007). Sales are increased by VMI, as it ensures that products are always in stock and available for purchase. The availability of the product will boost the quality of customer service and create brand loyalty. This results in more returning customers and sales over time(Lunka 2018).

3. Issues Related to VMI

The following papers are studied and issues related to each of them were identified as mentioned below.

In first issue addressed in the paper, "The value of Vendor Managed Inventory in an autocorrelated demand environment" by Zainab BELALIA Fouzia GHAITI, the author's study is based on a two-echelon supply chain, in which customer demand follows a first-order autoregressive process (AR(1)). Theoretically, they mentioned that the value of VMI decreases when the demand autocorrelation is very high. Also, previously it was mentioned that in order to get highest benefits from VMI the demand autocorrelation increases. In the Yao and Dresner (2008) model, VMI allows the manufacturer to have a variable replenishment frequency, denoted by 'g', from 1 to an infinite number, according to the supply chain constraints. They theoretically claimed that the inventory reductions for both the manufacturer and the retailer with VMI are increasing in the autocorrelation factor of demand, for any positive value of replenishment frequency, g. But it is true only for some values of replenishment frequency.

Here, it needs to be kept in mind that that the AR(1) model follows: $Dt=d+\rho Dt-1+\epsilon t$. The numerical results by the author show that, for $0< \rho <0.9$, the value of VMI increases according to demand autocorrelation for any given, $g>0$, where g is replenishment frequency. But for strongly autocorrelated demand with $\rho > 0.9$, the numerical results are consistent with theoretical findings.

Secondly, an issue may arise when there is an absence of upper stock limit at the retailer, the vendor would be benefited by supplying as many units to the retailer without considering the optimum quantity to be supplied, which would have reduced its order costs and opportunity costs arising from out of- stock situations at the retailer (Mateen, Chatterjee et al. 2015). On the other hand, for the retailer/buyer, the inventory holding cost will be increased and it might exceed its available storage space (Mateen, Chatterjee et al. 2015).

Thirdly, both the vendor and buyer are manufacturers who try to achieve an inventory as small as possible or even a zero inventory: it is, therefore, difficult to manage inventory coordination between them (Han, Lu et al. 2017). This situation may arise when the vendor is responsible for the supply of raw material and the buyer is a manufacturer (Han, Lu et al. 2017).

The last issue of this paper is discussed in "Evaluating vendor-managed inventory (VMI) in non-traditional environments using simulation." by Peter B. Southard, Scott R. Swenseth. The author studied the economic benefit of using technology-enabled VMI system that would justify the spending of money necessary to create the infrastructure to support it. Later on, their study found that VMI alternatives outperformed traditional delivery methods. Thus using such technology could be economically justified in many logistics problems dealing with variable demand patterns through the cost savings created.

4. Suggested Solutions

After necessary statistical analysis and theoretical findings, the authors came upon solutions regarding the issues mentioned previously as follows:

The solution to the first issue is that to have maximum benefit, when implementing VMI, careful examination of inventory savings for strongly autocorrelated demand products must be done by both the partners. Although, this might not hold true for some industry or for some other supply chain configuration. Moreover, analysis of profitability must be done by partners by considering all the parameters that have an impact on the supply chain. It was observed that the performance of the supply chain can be improved by VMI for a certain range of high autocorrelated demand products.

The solution to the second issue in the previous section is suggested in the paper "VMI for single-vendor multi-retailer supply chains under Stochastic Demand", by "Arqum Mateen, Ashis Kumar Chatterjee b, Subrata Mitra" is that it is important to consider an upper stock limit at the retailer and penalty for the vendor for oversupply. Here over-supply will be determined on the basis of space available with the retailer for storage(Mateen, Chatterjee et al. 2015). The vendor will be penalized whenever replenishments exceed this upper stock limit(Mateen, Chatterjee et al. 2015). Considering the upper stock limit provided by the retailer, the authors- Moncer Hariga a,n, Mehmet Gumus b, Abdelkader Daghfous, formulated a mixed integer nonlinear program in order to minimize the total supply chain cost(Hariga, Gumus et al. 2014).

The solution to the second issue in the previous section is discussed in the paper "Tri-level decision-making for decentralized vendor-managed inventory" by Jialin Han, Jie Lu, Guangquan Zhang. 3PL distributors can be given the power to control and manage the distribution of raw material and inventory of the buyers through VMI hubs. VMI hubs can be defined as the warehouses that are geographically near to the buyers, which are owned or hired by the 3PL-distributors. In order to respond to the buyers' material demand efficiently, the distributors tend to store the raw material in these VMI hubs closed to their own buyers (Han, Lu et al. 2017). In addition, to reduce stock-out risk and respond to the fluctuation in production, the vendor/manufacturers and buyers/retailers are required to hold a certain amount of inventory as a backup inventory using their independent warehouses (Han, Lu et al. 2017). As shown below, Figure 3 shows the relationship between Vendor, Distributors and Buyers.

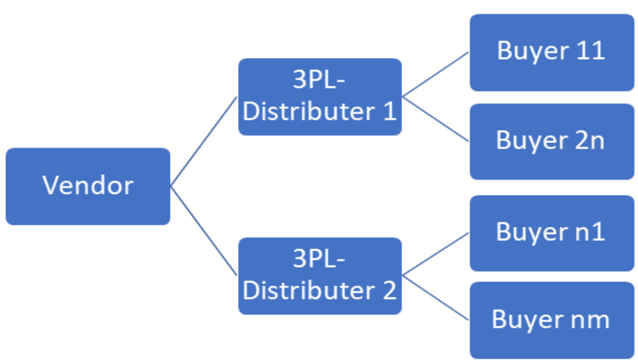

Figure 3. 3PL distributors control and manage the distribution of raw material and inventory

The last issue in the previous section could be solved by proving that there exists technological benefit of VMI, the authors compared a base model with six different types of technological advance model like First Come-First Serve (FCFS), Next Closest (NC), Fixed Interval 1 (weekly milk run) (FI1), Fixed Interval 2 (bi-weekly milk run), Keep Full Basis (KF), and Monitored Fuel level (MFL). They compared the mean and standard deviation of all the models using a paired t-test. In terms of stock-out, the analysis showed that all the six technological methods were performing better than the base model. In terms of Farm fuel delivery and holding cost, the alternative methods were found out to be more significant than the base model. This finding shows that the economic benefit of using such technology-enabled VMI system would justify the spending of money and it could be economically justified in many logistics problems which deals with variable demand patterns through the cost savings that are created. It should be noticed here that, VMI reduced the costs in farms delivery routes simulated as well as improved the customer service levels.

5. Conclusion

This paper on VMI addresses the various problems which could occur in VMI and also provides the solutions regarding the model. It also explains various benefits to retailer and vendors due to VIP and the overall advantage of it to the supply chain. The objective of this paper is to improve the VMI system which could be achieved by taking into consideration various challenges in the VMI incorporated supply chain that are mentioned in this paper. Along with this challenges there has been a brief discussion on the solution required by each of the challenges. We have incorporated the issues which were highlighted by other papers in our research and have provided suitable solutions for each of the issues. With online software, vendors can easily access data of the inventory sent to their customers. Hence, vendors have total control over when to replenish stock, resulting in an accurate forecasting of the demand adjusting their production rate along with reducing the on-shelf obsolete inventory for the retailer, creating a situation of mutual benefit for both vendors and retailers.
This paper address various problems which may arise in VMI and solutions to such problems are also provided. This paper is strongly recommend to understanding the obstacles in VMI and overcoming it.

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Biographies

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