A DECISION SUPPORT SYSTEM FRAMEWORK for VENDOR MANAGED INVENTORY in SUPPLY CHAIN MANAGEMENT

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ABSTRACT

This paper presents an ongoing research on the initial development of a decision support system (DSS) framework for Vendor Managed Inventory (VMI) in general consumer goods supply chain. A conceptual intelligent DSS framework provides a holistic framework to perform analytical assessments of the data generated from VMI software. First, a fundamental objective hierarchy for VMI and the associated objectives and influencers were developed. Second, the inventory decision module which determines the appropriate stock levels and the sales forecasting module which provides periodical forecasts at each product level were proposed. Third, functions include parameter estimation, updating, and forecasting system performance assessment were presented. Lastly, by integrating the modules and functions described above, the DSS development framework was proposed. This paper contributes to the retailing industry by proposing a more efficient and effective way of improving their supply chain’s efficiency in order to gain competitive advantage.

Keywords: Decision support, supply chain management, vendor managed inventory

INTRODUCTION

With the continuing weakness in the global economies has lead to the reduction in profit margins for many industries. Moreover, the strategic importance of the supply chain management is increasingly recognized because companies have faced a growing cost competition and customer demands. As a result, more companies are collaborating with their supply chain partners to improve their supply chain’s efficiency to gain competitive advantage. One of the solutions that has been widely adopted is vendor managed inventory (VMI), also known as vendor-managed replenishment or consignment inventory. However, not all retailers are able to successfully implement VMI. According to Schenck and McInerney[5], "One of the key issues for failure in the implementation of VMI is the lack of integration with key decision-support and reporting systems within retailer and manufacturer organizations” It’s often that the data is printed out and then re-keyed into order-management systems. The valuable data that can help influence a trading partner's production,
replenishment and shelf strategies continues to remain in the VMI software, underutilized [7]. This practice continues to hinder the growth of VMI; thus critical mass, and the real benefits, are not being realized by most of the industry.” This illustrates the importance of the integration of the decision support system (DSS) with the VMI process.

This paper presents a DSS framework for VMI between general consumer goods retailers and their manufacturing suppliers. To develop a general VMI DSS framework, existing works on VMI in the apparel supply chain and the characteristics of the general consumer goods supply chain were examined. The framework was developed based on knowledge from literature review and observations of the current conditions in industries.

**LITERATURE REVIEW**

**Vendor Managed Inventory**

According to Tyan[6], the motivation behind a VMI system is that both the retailer and supplier work together to maximize the competitiveness of the supply chain and the most obvious benefits of VMI are inventory cost reduction for the retailer and total cost reduction for the supplier. Moreover, the productivity and service level improvement can result in larger profit margin and increase in sales. Achabal et al. suggested that a key business motivation for developing VMI replenishment systems is to develop a deeper partnership between the vendor and the key retail accounts. Some of the specific goals and benefits proposed by Achabal et al. [1] for this system are to:

**Goals:**
- Give the retailers’ customers the best opportunity to purchase the vendor’s products.
- Help the retailers manage their inventory more effectively.
- Assist the vendor in production scheduling.

**Benefits for the retailer:**
- More effective inventory management and less uncertainty regarding inventory turnover and customer service levels. The VMI system provides a way to set and achieve performance targets for both these goals.
- A cost-effective way to obtain sales forecasting and inventory management services. As the vendor’s analysts implemented the system across many retailers, economies of scale were achieved in both the development and the customization of the models. This lead to a VMI forecasting system that was more accurate and developed at a lower cost than could be realized by any individual retailer.

**Benefits for the vendor:**
• VMI provides a method for the vendor to increase the availability of their brand in stores, relative to competitors’ brands, and still meet the retailers’ budgetary open-to-buy constraints.

• Retailers’ orders are often misleading data for production planning. Orders do not provide accurate information about which merchandise sells more rapidly and which styles stocks out in midseason, for example. Furthermore, less popular styles and colors are typically sold eventually through markdowns. Relying on actual sales data also prevents the “bullwhip effect” [4], that occurs when time lags, coupled with batch orders from the retailer, tend to amplify demand fluctuations as they go up the supply chain.

• VMI also reduces the opportunity and incentives for gaming, for example, retailers sometimes intentionally inflate orders when product supplies are limited and proportionally allocated by the vendor.

**DSS FRAMEWORK for VMI in RETAILING**

As the retail supply chain involves many smaller units, such as each retail outlet of a chain store, that operate much like an independent small business, the stages proposed by Chaudhry et al. [2] can be used as a reference for developing DSS for VMI. In order to design a DSS for VMI, it is important to fully understand the objectives and influencers for VMI in General consumer goods retailing.

**Objectives and Influencers of VMI**

The ultimate objective of VMI is obviously to improve profitability. Since VMI is a collaborative process involving the retailers and their suppliers, it is therefore necessary to consider the profitability of both groups of participants.

**Profitability of Retailer**

Profitability of the retailer is determined by sales and cost of the retailer. In the context of VMI, the profit of the retailer is mainly affected by the ability and effectiveness of the inventory management system to optimize inventory cost and maximize sales. To maximize sales, it is necessary to maintain customer service level in terms of availability of goods, maintain at least sufficient quantity of goods to achieve proper presentation at the store shelves, and launch seasonal promotional programs to stimulate and trigger sales around seasonal events such as holidays. Different consumer products may require different strategy but these three factors are universal for most of the general consumer products.

The ultimate question that a VMI DSS should address is “What quantity of each SKU should be ordered for each ordering period?” This is closely related to the current stock level and the target stock level. Whereas the current stock level is a known figure, it is necessary to consider various other factors in order to determine
the target stock level. These factors are 1) open-to-buy budget of the retailer; 2) inventory turnover requirement of the retailer; 3) target customer service level at the retail outlets; 4) minimum inventory level required to properly present the goods at the retail outlets; 5) available production capacity of suppliers; and the forecasted demand until the next order period. To come up with a demand forecast, it is necessary to consider factors including 1) baseline sales or de-promoted sales which is the sales figure without special promotion effort; 2) seasonal effect that captures the periodic variations in sales that are affected by seasonal events such as holidays and back-to-school; 3) marketing efforts include all factors affecting sales that are controllable by the retailer, such as price, advertising and in-store presentation.

Based on the above and using the method suggested by Clemen & Reilly [3], we can develop a fundamental-objective hierarchy for VMI in general consumer goods retailing as shown in Figure 1 and an influence diagram as shown in Figure 2. Examination of the objectives and influencers described in Figure 1 and Figure 2 shows that they are applicable to the apparel supply chain as well as most general consumer goods.

![Figure 4, Fundamental-objective hierarchy for VMI:](image-url)
Parameter Estimation and Updating

Parameter estimation provides initial values for the parameters of the forecasting model. After developing a forecasting model, linear regression can be performed using historical sales data that includes all seasonal variations. Stepwise regression should then be applied to identify the coefficient values that had significant sales impact. The frequency of sales forecast should be selected based on the operations of the retailers, particularly how the sales data is captured and updated.

Parameter updating smoothes the initial values for the parameters of the forecasting model generated by the parameter estimation process to adjust for changes in sales patterns over time. Parameters estimated by regression on the past sales data would not be able to reflect any changes in market conditions or promotional strategy for the current season. Also in the case of new products, the regression estimates can only be based on sales of similar, but not identical, products in the previous periods. As such, various methods have been used for parameter updating in retail sales forecasting systems. Some examples are exponential smoothing and discounted least squares. Testing should be done using historical data to determine the effectiveness of these methods for a particular situation.

DISCUSSION

Whereas VMI and DSS are both well researched topics, there appears to be no specific framework developed for the development and implementation of consumer
goods VMI DSS. If the result of this research is able to derive a universal framework for such purpose, it would be a significant academic contribution with real commercial value. However, it would be impossible to include all possible categories of consumer goods in a single study. Therefore, the result of this study can only be considered applicable for the most common consumer goods which supply chains are same or similar in nature to apparel, consumer electronics, toys, and furniture. Moreover, different supply chains or even different companies in the same industry may have very different influencers for inventory decision making that could affect the compatibility of the framework. It may be difficult to generalize in this regard. Nevertheless, we believed that this framework can bring the world one step closer to a more effective and efficient way of developing and implementing VMI DSS for consumer goods retail supply chain.

REFERENCES


