VMI vs. Order Based Fulfillment
By Vicky W. Shen MLOG 2005

Introduction
This executive summary is for the Thesis “VMI vs. Order Based Fulfillment”. The thesis addresses the inventory fulfillment process for W. R. Grace. The analysis evaluates how vendor managed inventory compares with the current order based fulfillment in meeting customer demands and cost. VMI is an order process fundamentally different, leading to an uncertainty of how the new system will impact the process both financially and operationally. The problem that is addressed is how should W. R. Grace quantify the changes and evaluate the results while providing the same or better service level?

The approach taken utilizes the total relevant cost model to determine the total relevant operational costs. Two fulfillment approaches are compared, the VMI fulfillment process with consignment and the VMI without consignment. VMI with consignment employs consignment inventory. To develop this thesis it is important to understand some basic background information, including the company’s distribution operation.

Background
W. R. Grace is a specialty chemical manufacturer and distributor. The company has 5 plants, 17 distribution centers and more than 4,000 customers. There are over 100 different products that are categorized into 9 groups. Grace had an annual sale of approximately $2 billion in 2004. The sales from the first quarter of 2005 shows a 17.8% increase, primarily as a result of increased sales volumes from refining technology products and increased price due to energy costs. The average delivery volume of one distribution center is 5.5 million gallons.

The Webster distribution center resides in a service region located in New England. It provides service to 164 customers, covering 961 different tanks at 235 locations. The service area of Webster DC is over 26 thousand square miles. It is one of Grace’s distribution centers that are being seriously considered to adopt VMI. Webster
DC operates 3 trucks on a regular basis. Sales wise, Webster has an annual delivery volume of 1.53 million gallons.

**Overview of W. R. Grace’s Supply Chain**

Grace has a typical supply chain includes raw material purchasing, manufacturing and distribution. Grace utilizes a centralized SAP transaction server for transaction data and transaction processing. Its current fulfillment process begins when the orders come in. According to Grace, 90% of orders are initiated by the customers and entered into the database by sales personnel, and the rest 10% of orders are entered by customers themselves. Those customers have permission to the system and can enter orders on a weekly, biweekly or monthly basis.

Grace’s dispatcher team is centralized and in charge of determining trucking routes for the entire company. With data of orders and trucking information a week head, they decide the daily trucking routes from each DC. According to Grace the majority of orders, around 97 to 98%, have a window of a week to fulfill. The rest are orders entered with emergency status and need to be fulfilled by the end of the second day. Trucking routes are organized to maximize trucking utilization and efficiency. Whenever possible, emergency orders are worked into the next day’s regular trucking routes. When an order (emergency or not) cannot be fit into a trucking route before it reaches its fulfillment time window, a delivery routing failure occurs. (Dror and Trudeau, 1988) In this company, the situation is dealt by sending an extra trip. Emergency orders usually do not come with any additional charges to customers.

**Vendor Managed Inventory**

Vendor managed inventory (VMI) is the practice of retailers making vendors responsible for determining order size and timing, usually based on receipt of retail point of sale and inventory data. (Richardson, 2004) The vendor makes the replenishment decision for its customers based on shared information and inventory policies. (Angulo, Nachtmann and Waller, 2004) As VMI is a planning and management system that is not directly tied to inventory ownership, (Fox, 1996) when VMI is in practice, instead of the customer monitoring its sales and inventory for the purpose of triggering replenishment orders, the vendor assumes responsibility for these activities and gains access to its
customers’ inventory information, receive withdrawal and current balance information and monitor its customers' inventories, and decide when and how much inventory should be replenished at each customer.

**Consignment**

Consignment occurs in some VMI practices. Generally, the change of ownership happens at the same time of change of inventory location, and the ownership of the inventory is transferred to the vendor on receipt of goods. However, a different practice that involves consignment is developing and gaining popularity among VMI relationships. (Adel, 1996) In consignment, consignment inventory is in the possession of the customer, but is still owned by the vendor. (Piasecki, 2004) In other words, some of the vendor’s inventory is in the customer’s possession (in customer’s store or warehouse) and it allows them to sell or consume directly from the vendor’s stock. The customer purchases the inventory only after it has been resold or consumed.

**Approach**

This chapter describes the methodology used to analyze the costs and benefits associated with the implementation of VMI, consignment or a combination.

The fundamental methodology is to quantify the all possible costs and benefits and transform them into monetary values for evaluation. Some of the costs and benefits from VMI are not readily measured in dollars and need to be translated by functions.

Therefore, the first step is to define cost functions of various operation procedures based on previous research and literature. They include inventory carrying cost functions at Grace as well as at customers’ sites, transportation cost function, distribution center maintenance cost function and payment cycle capital opportunity cost function.

The next step is data collection to gather adequate and sufficient data. Grace has offered transaction data from the entire company from the transaction server. The transactional data contains information about every customer, distribution center, time of delivery, size of order and type of product delivered. The data covers 1 year and 10 months span of period. From the data, further information is obtained to determine the
customers demand patterns, ABC analysis of products, ABC analysis of customers, and etc. Examples include the average of each chemical’s yearly consumption, the seasonality of each chemical, average order size, and average frequency. Current inventory data for Webster is collected directly from the distribution center. Data and statistics of truck routing, inventory management and finance are collected from various sources in Grace.

The next step is to set up a benchmark for later analysis. The overall cost of the current fulfillment process is determined within the thesis scope using the cost functions defined in the previous step. The inputs into those functions are extracted from the data collected in the first step.

The next step is to determine the cost when VMI is implemented. Different customers, depending on their demand pattern and demand sizes, may encounter very different results. The VMI or consignment strategies adopted by Grace may also vary to suit different customers. For example, for customers with mainly fast moving items with steady demand, a repetitive ordering amount can be set up and monitored by Grace. To customers who currently have very long payment cycles, Grace can negotiate for a shorter cycle to reduce tied up inventory capital. In order to take accounts of all possible outcomes, various scenarios are set up and modeling and simulations are run. For daily distribution and transportation, in an effort to achieve more efficiency and convenience, a scenario which is enabled by the adoption of VMI is set up to calculate the new transportation cost. Transportation cost analysis is done at distribution center level.

The results of all scenarios are compared against the cost incurred by the current process to decide whether VMI and consignments are worthy alternatives to Grace’s current process based on findings from the analysis done in previous steps. In arriving to the decision, the break even analysis is utilized to provide a crystal clear picture for Grace. The breakeven analysis tells what scenario is able to at least compensate the operating cost of managing VMI. The results are also meant to be used as guidelines that will help determine future cases on an individual customer to customer basis.
**Recommendations**

Overall, VMI can be a valid strategy. It can improve operating efficiency by reducing inventory cost at both Grace and the customers. Managed directly from distribution center, it can eliminate duplicate processes. However, not all customers can provide equal benefit to Grace. Some differentiated strategies must be considered.

Customers whose demand is consisted mostly of large quantities are the best candidates for consignments. The savings from inventory carrying cost, payment term and transportation cost are all positive.

Customers with average demand do not provide as much savings in inventory carrying cost. However, transportation cost under VMI can be reduced by altering the order sizes to improve the overall trucking capacity utilization.

Customers whose demand patterns are mostly consisted of far and in between orders are not good candidates for VMI. Neither better planned vehicle routing or order size adjustments are likely to make any meaningful difference. Therefore, to implement either consignment VMI or simple VMI is just to incur more cost with little benefit in return. When a customer is mainly consists of C items, there is very little room for improvement with VMI with or without consignment.