CHAPTER IV

Review of Literature

4.1 Introduction
A literature review is a body of text that aims to review the critical points of current knowledge including substantial findings as well as theoretical and methodological contributions to a particular topic. Literature reviews are secondary sources, and as such, do not report any new or original experimental work.

Most often associated with academic-oriented literature, such as a thesis, a literature review usually precedes a research proposal and results section. Its ultimate goal is to make the reader up to date with current literature on a topic and forms the basis for another goal, such as future research that may be needed in the area. A well-structured literature review is characterized by a logical flow of ideas; current and relevant references with consistent, appropriate referencing style, proper use of terminology and an unbiased and comprehensive view of the previous research on the topic. The literature review in this chapter deals with studies conducted all over the world by researchers on the usage of VMI, RFID and other related technologies on the improvement of the management of the supply chain.

VMI is actually not a new strategy as it was conceptually discussed by Magee (1958) during the process of designing a production control system as follows:

“Frequently there is argument as to who should control inventories. For example, should it be the sales organisation or (some) other unit that draws on the stocks and wants to be sure they are there, or the operation that supplies the stock point and wants to feed it economically? There is probably no resolution to this question as stated; the difficulty is that both have a legitimate interest. It is possible to
restate the question slightly and reach a solution. The user has to be sure the material that he requires will be there. He has corresponding responsibility to state what his maximum and minimum requirements will be. Once these limits are accepted as reasonable, the supplier has the responsibility of meeting demand within these limits, making whatever use he can of the flexibility the inventory provides. Thus both have a share in the responsibility for and control over a stock unit. One specifies what the maximum and minimum demands on the stock unit will be; the other has the responsibility of keeping the stock unit replenished but not overloaded as long as demand stays within the specified limits.” This is arguably the first written account of VMI.

4.2 Studies on simulations and implementations of VMI

Gerber (1991) in a survey on hospital materials management stated that VMI achieved higher penetration than just-in time and stockless methods. Another survey of the mass retail industry by Andel (1996) found that VMI programs would multiply in the next few years. Burke (1996) and Cottrill (1997) claims that vendor managed inventory is the wave of the future and the concept will revolutionize the distribution channel. A lot of computer-based simulation studies on VMI have been undertaken over the years by Van Ackere, Larson & Morecroft (1993), Mason-Jones & Towill (1997), Lambrecht & Dejonckheer (1999a,b), Waller, Johnson & Davis (1999), Kaminsky & Simchi-Levi (1998).

Heard (1994) and Jan Holmstrom (1998) studied the use of technology in implementing VMI in business. They understood that more than the complexity of the technology, the success is determined by the cooperation and the communication of the processes to the stakeholders. A standard SAP R/3 system and EDI was modified to be used for VMI in the study.

Holmstrom (1998) has shown through experiments that VMI could be enabled via fax, emails and spreadsheets even in an era when IT infrastructure was in its nascence.

Cooke (1998) describes a number of firms that have abandoned VMI after taking it up. According to a grocery products retailer, ‘‘the farther you go up the supply chain, the harder it is to see what’s going on.’’ Disney et al. (2001) have implemented VMI in a supply chain with data from an ERP system and a spreadsheet based decision support system.

Boyson, Corsi & Verbraeck (2003) in association with US Department of Defense developed an e-supply chain portal to facilitate end to end supply chain management in complex organizations as the Department of Defense (DoD), United States.
4.3 Studies on the effects of information sharing & supply chain relationships in VMI Systems

There is a large amount of literature available on the topic of channel coordination. Thomas and Griffin (1996) provide a comprehensive view of the topic. A few other notable studies related to buyer–vendor coordination include Lee and Rosenblatt (1986), Banerjee (1986), Anupindi and Akella (1993), Kohli and Park (1994), and Weng (1995) which analyze the separate or joint optimal ordering policies and/or the optimal pricing/quantity discount schedules. Waller et al. (1999) studied the effects of VMI on supply chains and concluded that it leads to a reduction in inventories, due to increased frequency in inventory reviews, shorter order intervals, and frequent deliveries.

These results were more or less supported by Cachon and Fisher (2000), who in one of the well known studies on Information Sharing in supply chains compared a traditional supply chain lacking a full information policy with that of a supply chain that fully shared information. They found that supply chain costs were on an average 2.2% lower in the supply chain with full information policy, with the maximum difference being 12.1%. They also found that cutting lead times into half by information sharing reduced costs by 21% on an average and cutting the batch size into half reduced the average costs by 22%. They also found that implementing IT for smoothening the physical flow of goods reaped more benefits than using IT to improve information flow. Their single product study had come to a finding that the impact of frequent ordering usually outweighs the benefits of information sharing.
Dong, Xu & Evers (2000) analytically examined the possibilities of improving supply chain performances through better information sharing and consistent forecasting. It also looked seriously at the effects of independent transactions carried outside the purview of the VMI partnership by certain supply chain partners which eventually result in lower efficiencies. It also examined the role of new techniques like VMI, Collaborative Planning Forecasting & Replenishment (CPFR) in improving supply chain coordination.

Dong and Xu (2002) did a study on the impact of VMI on a supply chain. They found that VMI always generates a higher profit for the buyer, whereas the supplier's profit always varies. VMI was found to reduce the total cost of the supply chain in the short run. It was also found that the supplier's profit rose in greater proportions in the long run than in the short run.

Kaipia et al (2002) in another analytical study had arrived at similar conclusions regarding the effect of frequency of ordering and information sharing on the efficiency of a supply chain. Bruce and Ireland (2002) state that inaccurate data and differences in technologies employed by suppliers and buyers restrict the benefits realized from VMI.

Gerchak and Khemlnitsky (2002) in their study in 2002 observed possible patterns of underreporting and cheating that may creep into systems that utilize VMI. The study was based on newspaper retailing where some retailers underreport sales in situations where the unsold copies are not to be returned. This will bring errors in the publisher’s forecasting system and the publisher runs into losses in the short run. The
study astonishingly found that in the long run, systems where forecasts & sales reports were manipulated reached optimality and coordination in forecasting was lesser in systems which were truthful in this kind of business. This throws up avenues for future research as to whether VMI and the accuracy of forecasting are related to a particular industry or not.

Cheung and Lee (2002) found that VMI system extracted a lot of value and cost savings by coordinating shipments, whereby VMI suppliers were able to deliver to their customers at higher frequencies without increasing transportation costs.

Tyan and Wee (2002) studied the latest innovations related to information sharing and retailer – supplier partnerships in the Taiwanese grocery industry. The power relations between the suppliers and retailers as well as the degree of collaboration were also studied. VMI implementations were seen to range from pure VMI (where the supplier decides the inventory) to CPFR (where the retailers and suppliers sit together and exchange data and agree upon the inventories).

Choi et al (2002) had conducted a study on Supplier – Supplier relationships to find out their implications for buyer-supplier relationships, which also gave interesting insights to the supply chain dynamics. It looked at possible ways to reduce the disorienting effects of supplier-supplier relationships for the smooth functioning of a supply chain and how it can be translated into better buyer-supplier relationships.

Simpson et al (2002) also researched on a similar area about relationships and their effect on supply chain performance. Pohlen and Goldsby (2003) in an interesting study differentiated between the interchangeably used terms – Supplier
Managed Inventory (SMI) and Vendor Managed Inventory (VMI) & studied the concept of Economic Value Added (EVA) in both the cases. SMI involves the flow of components and raw materials inbound to the manufacturing process, whereas VMI involves coordinated management of finished goods inventory outbound from the manufacturer, distributor to a retailer or reseller.

Pohlen and Goldsby (2003) also suggested that VMI is unlikely to succeed without established & well entrenched relationships built on trust and mutual benefit, as VMI needed alignment of functional performance with processes that are spread across multiple companies.

Kuk (2003) conducted a study on VMI adoption in electronics industry based on hypotheses framed for variables – organizational size, employee involvement and logistics integration and their effects on VMI values. It was found that organizations with high employee involvement and logistics integration succeeded more in the VMI implementation. VMI was seen to benefit smaller organizations more than the larger ones as per the study.

Another study by Holmstrom et al (2003) had the researchers conduct a discrete event simulation to examine how a manufacturer can combine traditional non VMI data along with VMI sales data to understand the impact on production efficiencies. The study focused on multiple customers compared to the single customer model by Disney and Towill. This simulation study also identified that products with low replenishment frequencies had a better chance of benefiting from increased visibility due to information sharing in VMI systems.
Jung et al (2004) studied the effects of varied environmental factors in sharing of information for VMI implementation on the profitability. In their simulation experiments, all the factor combinations were simulated. The cost reductions in VMI were on an average at 5.8%. The main cost reduction in VMI was found at the manufacturer’s end. The results showed that the reductions brought in by VMI can be kept high when the capacity at the manufacturer is high, set-up cost is high at distributor end & the value of expediting cost at manufacturer is high.

In a more recent study, Lee et al. (2004) showed that VMI had a major impact on the profit margin of the supplier. These benefits are supported by industry accounts. A 2004 AMR survey of VMI found that VMI adopters had an average 53% reduction of inventory, 30–50% improvement in lead-time, and 2–3% retail in-stock improvement.

In a study in the electronics industry, Kuk (2004) found that VMI requires intensive information and effective database links between supply chain partners. He felt that organizational change required for VMI must be addressed before an IT investment like VMI.

Suo, Wang and Jin (2004) presented a paper in an IEEE International Conference on Systems, Man and Cybernetics investigating how VMI affects a supply chain involving a risk neutral supplier and a loss averse retailer. The study found that a modified quantity-flexible contract helped coordinate the supply chain & that the optimal order quantity with VMI was higher than that without VMI. They
identified that for the study on newspaper retailing done by them VMI improved coordination of supply chain.

Mishra and Raghunathan (2004) study in the grocery and retail sector revealed that VMI increased the competition between manufacturers of competing brands, which results in the retailer benefiting from the competition that rises out of brand substitution. A manufacturer whose brand is out of stock risks losing on sales to a competitor whose brand is stocked. So all manufacturers compete to have a higher stock to satisfy the demand situation. VMI was also found to help transfer the inventory monitoring costs to the supplier.

Lee & Chu (2004) adopted a simulation study of a two member supply chain involving a vendor and a retailer. The supply chain was operated in two ways – one as a traditional supply chain and the other as a VMI supply chain. The expected payoffs of both the systems were studied and compared. They found that transferring the risk and uncertainty of demand to the vendor need not necessarily lead to a higher expected payoff for retailer or a lower one for the vendor as was the result shown by previous studies. They simulated different variables and came to a conclusion that if certain risk variables are manipulated properly, it can result in more or less equally better payoffs for both parties.

Another analytical model developed by Yao et al (2005) show that benefits of cost reduction from the VMI model is based on the ratio of order costs of the supplier to the buyer & the ratio of the carrying charges of the supplier to the buyer. A disproportionate distribution of the benefits between supplier and buyer is also seen.
Another study by Holmstrom et al (2005) focused on different methods of collaboration in the supply chain. They concluded that the effectiveness of a supply chain collaboration depended upon the level of integration of the internal & external operations as well as the alignment of the supply chain in terms of geographical dispersion, demand pattern & characteristics of the product.

In a study by Huang et al (2005), the extra cost for the small supplier who agrees to be part of the VMI supply chain but still gets oppressed due to his lack of sheer size was studied and conditions where the small supplier is also benefited was studied. Motorcycle industry was taken as the example for the study. The study revealed that higher the number of order cycles, the lower is the oppression rate.

Meixell & Gargeya (2005) conducted a very extensive study on all the popular global supply chain models developed over the last many decades. Their study over the past few decades led them to several relevant conclusions. Global supply chain designs need to include the composite supply chain during design including internal manufacturing and external supplier locations. The performance measures used till now have to be improved to include all alternative objectives of the supply chain partners.

Martha Wilson (2005) investigated the effect of transportation disruption on a 5 stage supply chain, using simulation. The greatest impact was found to occur when the disruptions occurred between the warehouse and the first stage supplier. The impacts were found to be lesser for a VMI system when compared to a traditional inventory system. Panayides & So (2005) studied the impact of key organizational
variables like, relationship orientation, organizational learning & innovation on the effectiveness and performance in the supply chain. The study reiterated the belief that supply chain improvements are as much affected by managerial & organizational capabilities as by technical & operational measures.

Sethuraman & Parasuraman (2005) looked at the future of retailing and suggested ways and means to improve personalization of services to customers in retailing sector. They also researched on the level of personalization required and the cost aspects of offering personalized services. Precaution over the problem of over-engineering was also addressed.

Fleisch and Tellkamp (2005) studied the relationship between inventory inaccuracy and performance in a retail supply chain. They considered more error types than the study by Kang & Gershwin and simulated a three-stage supply chain with one product. The results of the study showed that inaccuracies caused by theft seem to have the maximum impact on supply chain performance compared to inaccuracies caused by non-saleable goods or goods with low quality. They suggested use of RFID technology to reduce the impact of the inaccuracy.

The role of governance in supply chain information sharing was studied by Ghosh & Federowicz (2008) by considering issues like trust, bargaining power, coordination and contracts that crop up in information sharing.

Yan & Tang (2009) conducted a study on Pre-distribution and Post-distribution cross docking activities to understand the savings from them. Cross docking is a method of eliminating the inventory levels at the warehouse by not
actually storing goods at the facility but by directly sending from sending dock to receiving dock with the help of a fleet of dedicated transportation. Home Depot, Wal-Mart, Cosco, Fed Ex and all major Indian retailers use this technique for their operations.

Sodhi & Son (2009) conducted a study in South Korea at the stores of major retailers like Carrefour, Tesco, Wal-Mart and their suppliers Coca-Cola, Kimberley-Clarke and Nestle to understand the organizational dynamics of supply chain partnerships. 74 supplier-retailer partnerships were analysed and a model developed on the basis of five factors – 1) Information Exchange 2) Trust 3) Joint partnership management 4) relationship-specific assets and 5) Partner Asymmetry. They had an interesting finding that the factors that best model a strategic performance are different from the factors that best model an operational performance.

4.4 Studies on reduction in Bullwhip effect due to VMI implementation

The bullwhip effect has been studied by Wikner et al. (1992), van Ackere et al. (1993), and Towill (1997). These methods work in the real world, as demonstrated by Towill and McCullen (1999). The study was on a global mechanical precision product supply chain in which they studied that the bullwhip was reduced by 50%, and stock turn improvements of 2:1 were observed after a Business Process Reengineering on the inventory system was done. Wharburton (2004) also had conducted a detailed analytical investigation into the Bullwhip effect using differential equations.
Disney and Towill (2003) compared the properties of a VMI supply chain and the traditional supply chain vis-à-vis the Bullwhip effect. The study showed that two sources of bullwhip effect, specifically Houlihan effect and Burbridge effect could be completely eliminated. Houlihan effect is also called rationing or gaming effect. As shortages or missed deliveries happen in the traditional supply chain, customers overload their orders, leading to bullwhip effect. Similarly, batch ordering is called Burbridge effect. It is done to achieve economies of scale up the supply chain but can lead to bullwhip effect.

Disney and Towill (2003) in their study at Cardiff Business School compared the expected performance of a VMI supply chain and a traditional “serially linked” supply chain. They tried to understand the effect of both these systems on the well known Bullwhip effect in a supply chain, using a simulation ordering model. VMI was shown to be significantly better at responding to changes in the demand that are very volatile, like discounted orders & variations in prices. The study focussed on one supplier one customer relationship and the manufacturer’s production scheduling activities was also taken into account as it has been found to be the biggest source of the bullwhip effect or the Forrester Effect.

Disney et al (2003) conducted a simulation study to understand the effect of a VMI supply chain on the savings achieved in the transportation operations of a supply chain. Though not fully conclusive, it was established that transport cost savings are achievable in VMI supply chains both in the short run and long run, irrespective of whether escapable costs exist or not.
4.5 Studies on RFID Technology in VMI Implementations

Rahman (2004) had mentioned that state of the art technologies like EDI, RFID and other tracking & tracing devices used by 3PL providers helped them become more responsive and render better services to customers.

Gao et al of IBM China Research Labs (2004) touched upon the security and privacy issues dealing with RFID implementations in a supply chain. Lee et al. (2004) used simulations to study a three-stage supply chain and found that with RFID, average inventory decreased by 16%, and total back orders by 22%.

The impact of the usage of RFID technology in grocery retail was researched upon by Prater, Frazier & Reyes (2005) to understand the different issues that crop up during its implementation. The study focused on the impact of operational issues like shoplifting, forward buying, sudden demand changes, and modified packing methods on RFID implementation leading to inaccurate forecasts.

Michael & McCathie (2005) conducted a study on the pros and cons of RFID implementations in supply chain management. Mitra (2005) in a working paper of IIM Kolkata has mentioned about the role of RFID in improving the operations of logistics service providers who work for big manufacturers like Arvind Mills, Gillette and Barista.

Kang & Gershwin (2005) used simulations to study shrinkages in physical inventory which increased the losses in sales due to the sudden out of stock condition. They found that, with an error rate of theft as small as 1% of the average demand, the disturbance led to 17% of demand lost.
The most cutting edge technology for supply chain integrity and traceability is the Radio Frequency Identification (RFID) system as mentioned by Kumar and Budin (2006). Doerr et al. (2006) combined a multi-criteria tool for the valuation of qualitative factors with a Monte–Carlo simulation of anticipated financial factors to analyze the costs and benefits of RFID investment.

Delanuay et al. (2007) classified the errors that create inventory mismatches in supply chains into four categories: Permanent shrinkage in physical stock due to theft, obsolescence, or breakage; misplacement or temporary shrinkage in physical stock that can be replaced; random yield of the supplier or permanent changes in the physical inventory due to supplier errors & transaction type errors.

Wang et al. (2007) in a simulation study to evaluate the impact of an RFID system on a TFT-LCD supply chain in Taiwan found that the RFID-enabled pull-based supply chain was able to achieve a 6.19% decrease in the total inventory cost and a 7.60% increase in the inventory turnover rate.

Bottani and Rizzi (2008) quantitatively examined the impact of RFID systems on the Fast Moving Consumer Goods (FMCG) supply chain. Results showed that RFID implementation was still not profitable at all examined stages. RFID adoption with pallet level tagging provided positive revenues for all supply chain players, while case level tagging produced negative results.

Rekik et al. (2008) simulated an inventory model of a single period newsvendor with inaccuracies in the inventory through three approaches. The first approach where the retailer is unaware of errors in the store, the second where the
retailer is aware of the errors & the third approach where the retailer deploys RFID to eliminate errors.

Kok et al. (2008) compared cases with and without RFID in terms of costs in his analytical model which was built to calculate the break-even prices of an RFID tag. It was found that the break-even prices were closely related to the value of the lost items, the shrinkage fraction, and the remaining shrinkage after implementation.

Ustundag & Tanyas (2009) conducted a study to investigate how product value, lead time, and demand uncertainty affects the cost performances of an integrated RFID supply chain using a simulation model. An increase in the product value resulted in an increase in the total supply chain cost savings, and the increased demand uncertainty decreased it.

The study also found that each member of the supply chain did not benefit equally from RFID implementation. The retailer had the highest cost savings. The increase in the cost savings for the distributor and manufacturer were almost equal to the increase in the product value. Increasing lead time was found to decrease the total supply chain cost savings of the retailer. The decrease in the cost savings for the retailer, distributor and manufacturer are almost equal to the increase in demand uncertainty.

This chapter provided an overview of the studies conducted globally on VMI and RFID implementations in several sectors. This builds a strong foundation for the researcher to embark on his research on VMI/RFID implementations in Indian retail sector.