

## A PROCESS FRAMEWORK FOR IMPLEMENTING VMI ON THE DEMAND SIDE

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**Abstract** Constantly, increasing customer requirements and changing market conditions require companies to collaborate with supply chain partners. Therefore, supply chain concepts like *Vendor Managed Inventory* (VMI) are now applied in various industries. Although VMI has become well-known in recent years, only a few companies plan, optimize, coordinate and implement processes with partners of the supply chain. Especially *small and medium enterprises* (SMEs) do not coordinate business processes with their suppliers, because it is very difficult for SMEs to estimate the effects of the implementation of VMI on their business processes. This paper focuses on a framework for integrating such a supply chain concept into the business processes on the demand side. To support the VMI implementation a process reference model with best practice processes is needed. Therefore, an extended process reference model LogWIN-P\_VMI was developed, which helps companies to estimate the effects of VMI on their business processes.

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## 1. INTRODUCTION

As customer needs are increasing constantly and market conditions are changing continuously, companies need to collaborate with supply chain partners to fulfil and satisfy their customer's requirements (Wildemann, 2011). Therefore, the use of supply chain concepts like *Vendor Managed Inventory* (VMI) has grown over time (Yao, Evers & Dresner, 2007, pp. 663-666) and VMI is now applied in various industries (Dong & Xu, 2002, pp. 75-95). Although VMI has become well-known over the last years (Waller, Johnson & Davis, 1999, pp. 183-198), a longitudinal study by the Upper Austrian University of Applied Sciences and the Upper Austrian Chamber of Commerce in 2009 showed that only one fifth of the 168 surveyed companies from various sectors (e.g. trade and commerce, industry, information and consulting, transportation) plan, optimize, coordinate and implement processes with their suppliers (Humpl & Starkl, 2009). Especially *small and medium enterprises* (SMEs) do not coordinate business processes with their supply chain partners, because it is very difficult for SMEs to estimate the effects of the implementation of VMI on their business processes. (Niranjan, Wagner & Thakur-Weigodl, 2011, pp. 39-44) Therefore, this paper focuses on how to integrate such a supply chain concept into a company's business processes. To help companies, especially SMEs, to implement VMI successfully, a process reference model, that provides best practice processes, is needed. Therefore, based on the existing reference model LogWIN-P, an extended model LogWIN-P\_VMI was developed. This reference model is realized as a framework with three phases, shows the necessary modifications of business processes and organizational structures and supports companies in estimating the effects of VMI on their business processes (Ortner, Rothböck, Stüger, Unterbrunner & Wallner, 2005).

### 1.1. Methodology

LogWIN-P\_VMI was developed based on a multi-staged approach including a literature review and an empirical study. To evaluate process variations of VMI and critical success factors the literature review was based on five data bases (EBSCO, Science Direct, Emerald Management Xtra, IEEE Explore, WISO) with the focus on the topics Vendor Managed Inventory, Supply Chain Management, Cooperation, Logistics, Process Reference Modeling and Process Optimization. Overall 58 journals from these data bases were reviewed and 28 papers were used to develop the extended reference model. Additionally, 21 bibliographies were reviewed. The empirical study was conducted in two steps using half-standardized questionnaires to evaluate the practical relevance of VMI. In the first step five experts were surveyed. The results provided an overview of VMI variations in different industries. The second step consisted of a survey of eight companies, which showed the application of VMI in the area of supply chain management.

## 1.2. Key Findings

Vendor Managed Inventory is a collaboration concept which authorizes suppliers to manage the buyer's inventory (Waller, Johnson & Davis, 1999, pp. 183-198) to improve multi-firm supply chain efficiency (Yu, Huang, Liang, 2009, pp. 368-382). VMI is part of the collaboration concept *Efficient Consumer Response* (ECR) (Arnold, Kuhn & Furmans, 2008), which focuses on satisfying customer needs. Consequently, processes are restructured or sourced out to the supply chain partner (Yao, Evers, Dresner, 2007, pp. 663-666). In the case of VMI the supplier is responsible for the inventory replenishment at the buyer's warehouse. This is based on electronically transferred information (e.g. inventory level, sales data) (Southard & Swenseth, 2008, pp. 275-287). Therefore information technologies such as *Electronic Data Interchange* (EDI) (Yao, Evers & Dresner, 2007, pp. 663-666) or web-based platforms are used (Hieber, 2002). Beside the VMI three other forms of ECR exist (Arnold, Kuhn & Furmans, 2008), which are shown in Figure 1. This paper focuses on the term VMI.

<b>BMI</b>	Buyer Managed Inventory...a cooperation between the supplier and the (end) customer.
<b>CMI</b>	Co-Managed Inventory...a cooperative separation of process activities. The supplier manages the inventory together with the buyer
<b>SMI</b>	Supplier Managed Inventory...a cooperation between the pre-supplier and a manufacturer.
<b>VMI</b>	Vendor Managed Inventory...a cooperation between manufacturer (supplier) and retailer (buyer)

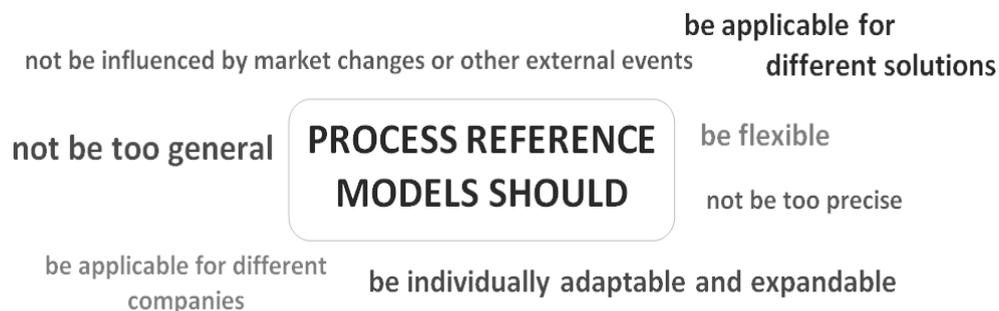
**Fig. 1** Four forms of ECR; based on: (Reitner, Wetzlinger & Ortner, 2011, p. 139)

All ECR concepts and especially VMI aim at creating benefits for all cooperation partners. Some benefits are shown in Table 1 (Arnold, Kuhn & Furmans, 2008), (Mentzer, 2001), (Locker & Kreisel, 2010, pp. 12-15), (Southard & Swenseth, 2008, pp. 275-287), (Almehdawe & Mantini, 2010, pp. 292-302).

**Table 1** Benefits of ECR concepts

Benefits	
optimized and integrated inventory management	reduced inventories
reduced uncertainties concerning customer requirements	enabled expeditious and flexible reaction to occurring demand modifications
efficient, value added and lean processes	competitive capability
reduced transport, inventory and transaction costs	increased delivery service rate

Furthermore, for modelling the VMI processes and to point out procurement processes affected by VMI, theoretical knowledge of Process Reference Models is essential. Process Reference Models provide best practice processes based on theoretical and practical knowledge. They are guidelines for companies for modelling business processes and organizational structures (Becker & Delfmann, 2004). In general they have to fulfil different certain requirements (Fig. 2).



**Fig. 2** Requirements of Process Reference Models (Schulte, 2009)

Additionally, these models have to be applicable for companies operating in different markets. To be able to point out the effects of VMI on the procurement process in addition to the requirements of Schulte (Fig. 2) a high level of detail was defined as an additional criterion to select a process reference model for modelling the processes of VMI. The Supply Chain Management process reference model LogWIN-P fulfilled these mentioned requirements best. LogWIN-P was developed at the Upper Austrian University of Applied Sciences in Steyr/Austria and is applicable for any industry. It formed the basis for developing a new reference model which includes all processes of VMI on all levels of detail (Tab. 2) (Ortner, Rothböck, Stüger, Unterbrunner & Wallner, 2005).

**Table 2** Four detailed levels of LogWIN-P; based on: (Reitner, Wetzlinger & Ortner, 2011, p. 141)

Levels	Level Description
Level 1	Overview of six Business Processes (Order Management, Planning, Production, Distribution Research & Development)
Level 2	Separation of each of the six business processes into management processes, core processes and support processes.
Level 3	Overview of content of management, core and support processes.
Level 4	Description of processes of Level 3 (= highest level of detail)

As it extends LogWIN-P with VMI processes, the new model is called LogWIN-P\_VMI. It supports companies planning to implement VMI and shows the

affected processes. Additionally, it provides a guideline that points out which process activities need to be adapted. Based on the above described comprehensive literature review and the findings of the empirical study, the extended process reference model LogWIN-P\_VMI was developed. This paper focuses on the processes affected by VMI on the demand side as the buyer has to make essential process modifications. The affected processes on the demand side are described in the following section.

## 2. AFFECTED PROCESSES ON THE DEMAND SIDE

Implementing VMI affects processes of the supplier (supply side) and the buyer (demand side) (Reitner, 2010). From the buyer's point of view VMI influences mainly the procurement process (Dong & Xu, 2002, pp. 75-95).

Within LogWIN-P, procurement process modifications due to the implementation of VMI are divided into five categories (Reitner, 2010):

- new: new processes required by VMI implementation,
- significantly affected: a lot of process modifications are necessary,
- partly affected: only a few and less important modifications are necessary,
- unaffected: no process modifications are necessary,
- outsourcing to partner: the process is relocated to the VMI-partner.

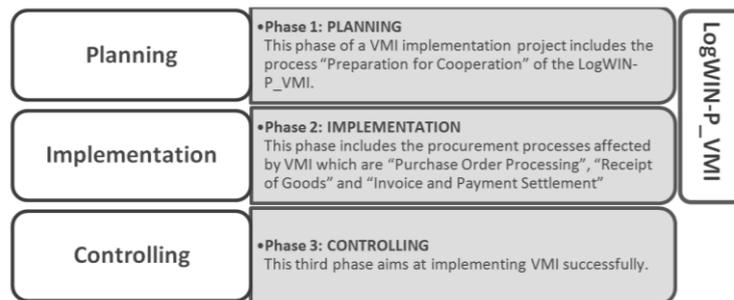
**Table 3** Impacts on Demand Side of LogWIN-P\_VMI (Reitner, 2010)

Procurement Process		Affected				
		New	Significantly	Partly	Not Affected	Outsourcing to partner
Demand Side	Procurement Marketing					
	Definition of Procurement Transport Strategy					
	Definition of Material Stock Strategy					
	Supplier Management					
	Definition of Packaging Strategy					
	Determination of Requirements					
	Purchase Order Processing					
	Transportation Procurement by Supplier					
	Receipt of Goods					
	Invoice Processing and Payment Settlement					
	Procurement Market Research					
	Evaluation of Suppliers					
	Qualification of Supplier					
	Logistics Control of Materials					
	Management of Material Stock					
	Allocation of Goods					
	Preparation for Cooperation					

Due to VMI three processes are affected significantly and four are affected partly. Only one process which did not exist in the standard LogWIN-P model was integrated in LogWIN-P\_VMI. Table 3, below shows the process modifications with the corresponding categories.

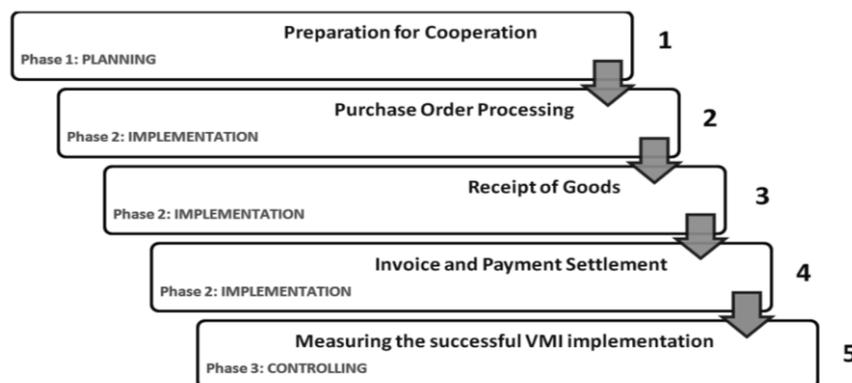
Due to the implementation of VMI a lot of processes are sourced out to the partner (supplier). Therefore, the supplier assumes responsibility for more process activities. The supplier has to replenish the buyer's inventory stock based on transmitted inventory and sales data. As a result the supplier gains more flexibility concerning planning and production. In the following section the three significantly affected processes (Purchase Order Processing, Receipt of Goods, Invoice Processing and Payment Settlement) are described as they represent the core process activities of VMI.

The implementation of VMI can be set up as a project using the LogWIN-P\_VMI model. Within this project a framework with three main phases (Planning, Implementation, Controlling) is defined (Fig. 3).



**Fig. 3** VMI-Framework with three phases (Reitner, 2010)

Figure 4 shows the relevant VMI processes of LogWIN-P\_VMI for each phase.



**Fig. 4** Affected LogWIN-P\_VMI Processes of the three phases (Reitner, 2010)

In the following subsections these three phases of implementing VMI (Fig. 4) based on LogWIN-P\_VMI are described.

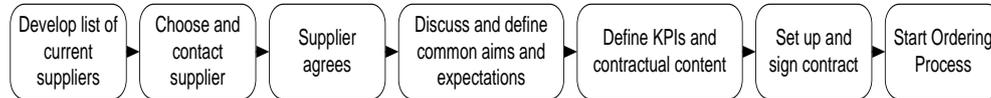
## 2.1. Phase 1: Planning

A successful implementation of VMI requires intensive planning and preparation. The new process ‘Preparation for Cooperation’ in LogWIN-P\_VMI offers a best practice process to prepare the implementation carefully. If the buyer initiates the implementation of VMI, the first step is to develop a list of current suppliers to find potential partners. Afterwards, suppliers are chosen by defined criteria (e.g. long-term suppliers, certain products, delivery reliability) and contacted. If the supplier agrees to cooperate, common goals and expectations have to be discussed and defined. In most cases, this is part of a cooperation contract or of a framework agreement. Several authors have mentioned different contractual content that can form part of a VMI agreement or contract as shown in Table 4 (Arnold, Kuhn & Furmans, 2008), (Schulte, 2009), (Völker & Neu, 2008), (Senger, 2004), (Locker & Kreisel, 2010, pp. 12-15), (Wildemann, 2011).

**Table 4** Contractual Content

<ul style="list-style-type: none"> <li>• duration of VMI cooperation,</li> <li>• extent of cooperation,</li> <li>• involved parties and their roles within the cooperation,</li> <li>• applied products (e.g. products with a high capacity, constant requirements),</li> <li>• employees and their VMI trainings (e.g. employees of the supplier, trainings by customer),</li> <li>• delivery dates (e.g. defined time slots),</li> <li>• minimum and maximum level of inventory and days of inventory,</li> <li>• point of transfer of ownership,</li> <li>• reliability and shared risk,</li> <li>• confidentiality, price, invoice and payment agreements,</li> </ul>	<ul style="list-style-type: none"> <li>• transfer of services to a third party provider (e.g. transportation by a logistics service provider),</li> <li>• required data and information (e.g. inventory, sales or consumption data, demand forecast, planned major orders),</li> <li>• communication and exchange of information and data,</li> <li>• the case of not fulfilling points agreed in the contract (e.g. poor quality, delay of delivery),</li> <li>• used IT and communication systems,</li> <li>• test run and</li> <li>• measurement of success and Key Performance Indicators.</li> </ul>
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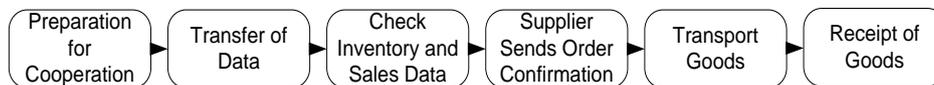
Additionally, interviewed experts and companies see trust between the partners as a prerequisite for a successful collaboration. After agreeing on these listed contractual subjects the implementation of VMI can start. Afterwards a test run can be conducted to identify inefficient processes or occurring difficulties. Subsequently, these difficulties are eliminated and the first order can be initiated. Figure 5 shows this process illustrated as EPC (event-driven process chain).



**Fig. 5** Process ‘Preparation for Cooperation’ (Reitner, Wetzlinger & Ortner, 2011, p. 145)

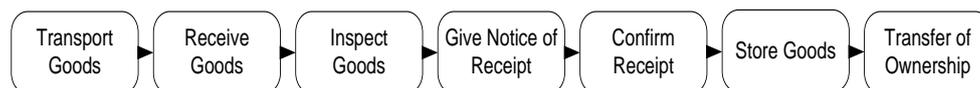
## 2.2. Phase 2: Implementation

After the first phase (Planning) the execution of VMI can start. One process affected by VMI is ‘Purchase Order Processing’, which includes operational process activities like ordering and delivering. Without VMI (as shown in the standard model LogWIN-P) the supplier does not have access to the buyer’s data and information (e.g. inventory data or sales data) thus the buyer checks the inventory levels and orders the required goods. Then the supplier delivers the ordered products and generates the invoice. In LogWIN-P\_VMI the supplier is responsible for all inventory management. In most cases the exchange of information and data happens via *Electronic Data Interchange* (EDI) or web-based platforms (Völker & Neu, 2008). If defined inventory levels are undercut, the supplier has to replenish the customer’s stock. This implies that the whole ordering process is sourced out to the VMI partner as well. Then the supplier has to deliver the goods to the buyer’s warehouse. In some cases the supplier commissions a third party provider (e.g. logistics service provider) to conduct the transport (Fig. 6).



**Fig. 6** Process ‘Purchase Order Processing’ (Reitner, Wetzlinger & Ortner, 2011, p. 146)

The next process affected by VMI is ‘Receipt of Goods’. It includes receiving and inspecting the ordered goods and giving the notice of receipt. After delivery of the goods by the supplier or a logistics service provider the buyer receives the dispatch note and the delivered goods are checked at the buyer’s ramp. This takes place on a random basis or in the form of a complete examination. If the delivery and the ordered products are correct the receipt of goods is confirmed and the wares are stored in the buyer’s warehouse. Unless otherwise agreed, at this point the buyer becomes owner of the goods (Fig. 7).



**Fig. 7** Process ‘Receipt of Goods’ (Reitner, Wetzlinger & Ortner, 2011, p. 146)

After this transfer of ownership of the goods, the invoice is generated by the supplier. This is part of the process ‘Invoice Processing and Payment Settlement’ which is also affected significantly by VMI. In contrast to the process without VMI in LogWIN-P\_VMI the buyer does not get the invoice directly after receiving the goods. Mostly the invoice and the payment are initiated on a monthly basis. The buyer compares the collective invoice with the received dispatch notes of each delivery and – if the invoice is correct – the payment is made. If the invoice is not correct the buyer files a complaint. Subsequently, the buyer pays for the goods, mostly on a monthly basis as a collective invoice in contrary to the original process of LogWIN-P (Fig. 8).



**Fig. 8** Process ‘Invoice Processing and Payment Settlement’ (Reitner, Wetzlinger & Ortner, 2011, p. 146)

After implementing VMI the correct execution and the success of the concept have to be measured. This is part of the third phase Controlling (Engelhardt, 2002).

### 2.3. Phase 3: Controlling

Measuring the processes and the success of VMI requires the use of *key performance indicators* (KPI). KPIs are measures used to regulate and control business processes. In the planning phase they are defined together with the VMI partner (see process step ‘Define KPIs’ in Fig. 5). KPIs have to measure aspects that can be influenced by VMI. In most cases controlling of processes is part of process management or the controlling department (Engelhardt, 2002). Examples for key performance indicators concerning VMI (Senger, 2004) on the demand side are shown in the Tab. 3 (Klaus & Krieger, 2000). The listed KPIs are separated into three categories. These KPIs measure the success concerning

- VMI process: KPIs measure the process and the success of VMI
- Cooperation: KPIs measure the cooperation between the partners
- End Consumer: KPIs measure the satisfaction of end users.

Some key performance indicators measure the success of two or more categories, for example ‘Number of out-of-stock situations’ or ‘Product Quality’.

The usage of key performance indicators enables the VMI partners to control and estimate the effects of VMI on the processes of the demand side. Furthermore, in our survey, experts and representatives of companies alike stated, that a continuous (e.g. annual) dialog with the VMI-supplier is essential and supports a good relationship between all VMI-partners.

**Table 5** KPIs for measuring VMI on demand side based on three categories (Reitner, Wetzlinger & Ortner, 2011, p. 147)

Categories	Key Performance Indicator
VMI process	Delivery quality, Product quality, Transportation costs, Process costs, Inventory costs and costs of capital commitment, (Process) Lead time, Duration of storage/Days of inventory, Rate of stock turnover, Inventory level, Number of out-of-stock situations, Errors
Cooperation	Reliability, Ability to respond, Number of out-of-stock situations, Duration of delivery, Delivery service level, Delivery quality, Product quality
End consumer	Number of complaints, Number of out-of-stock situations, Customer satisfaction, Product quality

### 3. CONCLUSION

Implementing Vendor Managed Inventory requires internal and external process modifications. From the buyer's point of view the procurement process is most affected by VMI. A lot of processes are sourced out to the supplier (e.g. Management of Inventories, Storage, Ordering Goods) in order to optimize the supply chain and eliminate inefficient process activities. The supplier becomes more flexible concerning forecasting of demands and planning the production. The presented reference model LogWIN-P\_VMI supports companies by providing best practice processes on a very high level of detail and by reducing the effort of adapting the procurement processes. This extended process reference model offers companies, especially *small and medium enterprises* (SME) valuable support for modifying and adopting business processes to VMI. Additionally, companies are able to estimate the impact of this supply chain concept on the procurement processes (from the point of view of the demand side) and get support for the successful implementation of Vendor Managed Inventory.

The focus of this paper lies on processes of the demand side. The impact of VMI on distribution processes (supply side) is identified in additional work. Furthermore, in our on-going research project ILog we want to develop process reference models of the supply chain concepts Just-in-time, Quick Response and Cross Docking.

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