# Vendor Managed Inventory models in Sweden

## Industrial benchmarking experiences from autumn 2006

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Abstract

VTT and LUT carried out a joint excursion to Sweden in November 2006. The goal of the excursion was to benchmark Swedish companies and their Vendor Managed Inventory (VMI) models in practice. The excursion was part of the "Mobile technologies and VMI solutions in industrial inbound logistics" project (TEMO project). Our objective was to discover different industrial VMI collaboration models and to compare our findings to our experience from Finnish VMI cases. Sweden was chosen as the benchmark as it has a long tradition in manufacturing, along with similar logistics challenges due to its Northern location as we have also in Finland. This report includes three different industrial VMI cases, our findings and analysis.

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# Preface

The Technical Research Centre of Finland (VTT) and Lappeenranta University of Technology (LUT) is undertaking a "Mobile technologies and VMI solutions in industrial inbound logistics" project (TEMO-project) between 1.3.2006–30.5.2007. The TEMO project is being financed by nine Finnish companies, Tekes (the Finnish Funding Agency for Technology and Innovation) and VTT. We are creating an international benchmarking process as part of our project, which was the reason for our visit to Belgium during spring 2006 and now, our second international visit, to Sweden during autumn 2006. Our visit to Sweden was arranged for 22nd–23rd, November 2006. Attendees on the visit were Jukka Hemilä and Kim Jansson from VTT and Ari Happonen from LUT. The purpose of our trip was to find out Swedish best practices in industrial VMI partnerships. Mikael Ståhl Elvander from Lund University arranged all of our industrial visits. Therefore, we would like to thank Mikael for all of the arrangements, along with our hosts at Tetra Pak, Cepa Steeltech and Alfa Laval. Our trip was a success and we learned a lot!

Authors

# Contents

# 1. Introduction

This is a travel report concerning our industrial benchmarking visit to Lund, Sweden. We had three visits, which included the following companies: Tetra Pak, Vilas and Alfa Laval. Mikael Ståhl Elvander from Lund University selected the industrial companies to visit and interview.

We assumed that Swedish companies have similar thoughts about VMI as an operational model as do Finnish companies. Sweden is known for its long tradition in manufacturing, but Sweden also has similar logistical challenges as we have in Finland. These are the long distances inside the country and a Nordic position in Europe.

We wanted to compare our experiences from Finnish companies to Swedish companies: how they use VMI and information tools to support their operations. Our research has been focused on low-cost items' material flow, and we wanted to have a viewpoint on more expensive material VMI (A- and B-class materials). The Swedish companies we visited use VMI with their A- or B-class materials.

We had some common questions for our industrial visits:

- What are the present ideas and models, and future trends in the field of logistics in Sweden?
- How are VMI solutions seen in Sweden: for which kind of material flow is VMI used?
- What is the status of new ICT technology in the field of logistics? How can ICT be used for managing material flows in warehouses and at a management level in the supplier-customer relationship?
- Which kind of information should be collected, used and shared and how to use demand forecasting?
- Development actions: What is your vision for the future of VMI?

Chapter 2 is about Sweden as a country, Chapter 3 presents the industrial visits and our findings from these. Chapter 4 is conclusions and findings at a common level.

# 2. Information about Sweden

The following information in chapter 2 has been collected the from following sources: CIA World Factbook, Statistics Sweden and FinPro.

## 2.1 Country and people

- Area: 449 964 km² (174,000 sq. mi.), where forests 53%, mountains 11%, cultivated land 8% and lakes and rivers 9%. Sweden is the third largest country in Western Europe. Longest east-west distance: 499 km (310 mi.). Longest north-south distance: 1,574 km (978 mi.)

- Natural resources: iron ore, copper, lead, zinc, gold, silver, tungsten, uranium, arsenic, feldspar, timber, hydropower.

- Population: 9,103,551 (September 30, 2006).

- Languages: Swedish; recognised minority languages: Sami (Lapp), Finnish, Meänkieli (Tornedalen Finnish), Yiddish, Romani Chib (a Gypsy language).

- Religion: 80% belong to the Evangelical Lutheran Church of Sweden.

- Border countries: Finland 614 km, Norway 1,619 km.

- Biggest cities: Stockholm (1.87 million people), Gothenburg (481,410), Malmö (269,142), Uppsala (182,076), Linköping (136,912).

## 2.2 Infrastructure

Looking at the infrastructure, this high degree of development is reflected in everything from the road and highway network, the railroads and other transportation systems to IT, a field in which Sweden is sometimes classified as the most developed nation in the world.

- Dialling code: +46 (Biggest cities: Stockholm 08, Gothenburg 031, Malmö 040, Uppsala 018, Linköping 013)

- Mobile phone networks: GSM 900/1800

- Electric network: 230V, 50 Hz (same as in Finland)
- Phone lines: 63% (31.12.2005)
- Mobile phone density: 108.5% (31.12.2004)
- Internet connections density: 68% of households (2004)
- Roads: 213,237 km, (where 1,542 km are highways)
- Railroads: 11,481 km
- Airports: 154; 18 important airports

## 2.3 Politics and government

- Country name: conventional long form: Kingdom of Sweden. Conventional short form: Sweden.
- Parliament: The Riksdag, with 349 members in one chamber.
- Form of government: Constitutional monarchy, parliamentary democracy.
- Capital: name: Stockholm
- Administrative divisions: 21 counties; Blekinge, Dalarnas, Gavleborgs, Gotlands, Hallands, Jamtlands, Jonkopings, Kalmar, Kronobergs, Norrbottens, Orebro, Ostergotlands, Skane, Sodermanlands, Stockholms, Uppsala, Varmlands, Vasterbottens, Vasternorrlands, Vastmanlands, Vastra Gotalands
- Independence: 6 June 1523 (Gustav VASA elected king). National holiday: Flag Day, 6 June.
- Chief of state: King CARL XVI GUSTAF (since 19 September 1973); Heir Apparent Princess VICTORIA Ingrid Alice Desiree, daughter of the monarch (born 14 July 1977).
- Head of government: Prime Minister Fredrik REINFELDT (since 5 October 2006).

- Cabinet: Cabinet appointed by the prime minister.

- Elections: the monarchy is hereditary; following legislative elections, the prime minister is elected by the parliament; election last held 17 September 2006 (next to be held in September 2010).

## 2.4 Economical details and Swedish industries

Today Sweden has an extremely large number of multinational corporations and brands for its modest population. Volvo (part of Ford Motor Group), Saab (part of General Motors Group), Ericsson, ABB, AstraZeneca, Electrolux, IKEA, H&M, Hasselblad and Absolut are only a few of these Swedish-rooted companies and brands. About 70% of industrial workplaces belong to big companies.

Aside from these, a third of Swedish industry of the future is increasingly referred to today as the "experience industry." This concept is a new, comprehensive label for such inter- related creative sectors such as design, music, fashion, the art industry, gastronomy, media, advertising and tourism, in which Sweden has experienced a creative revolution over the past decade that has attracted worldwide attention and given the country substantial new export income.

- Most important export goods: Electrical and telecom equipment, machinery, passenger cars, paper, pharmaceuticals, iron and steel.

- Most important imported goods: Electrical and telecom equipment, machinery, foodstuffs, crude oil, textile products, footwear, passenger cars.

- Unemployment 4.6% (October 2006)

- GDP +1.3% (Q2 2006 compared with Q1 2006)

- Currency: SEK, 1 krona = 100 öre (USD = 7.347 SEK; 1 EUR = 9.138 SEK, in year 2004).

- Most important trading partners: Germany, UK, Norway, US, Denmark, Finland.

# 3. Industrial visits

We made three industrial visits during our two day visit to Sweden. Our purpose for the visits was to benchmark Swedish VMI operational models in industry. On the first day, we visited Tetra Pak and Vilas/Cepa. On the second day, we visited Alfa Laval and, in the afternoon, a researcher workshop was held with Lund University.

The information in the following chapters was collected from companies' public websites, and partly from presentations during our visits, and then our own interpretations (Tetra Pak, 2006a; 2006b; Alfa Laval, 2006; Vilas / Cepa, 2006).

## 3.1 Tetra Pak

Tetra Pak is committed to making food safe and available, everywhere. Tetra Pak operates in more than 165 countries with over 20,000 employees. The company believes in responsible industry leadership, creating profitable growth in harmony with environmental sustainability and good corporate citizenship. Today Tetra Pak supplies hundreds of different types of carton packaging formats. Tetra Pak packages fulfil the main purposes of packaging, namely to: maintain product quality, minimise waste and reduce distribution costs. Tetra Pak has developed its own state-of-the-art processing solutions and designs and it serves complete plants as customers.

Tetra Pak is one of three independent industry groups that belong to the Tetra Laval Group. The other two are DeLaval and Sidel. Tetra Laval is a private industrial group of Swedish origin, headquartered in Switzerland. Figure 1 is about Tetra Laval group structure.


*Figure 1. Tetra Laval Group structure. (Tetra Pak, 2006a)*

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The industry groups´ activities focus on systems for processing, packaging and distributing food and accessories for dairy production and animal husbandry. The three industry groups are leaders within their respective areas of business. They operate independently, but are able to cooperate when this can bring benefits to the customers.

We visited on Tetra Pak, which have two main business functions: Packaging Solutions and Processing Solutions. Figure 2 presents Tetra Pak organisational structure.

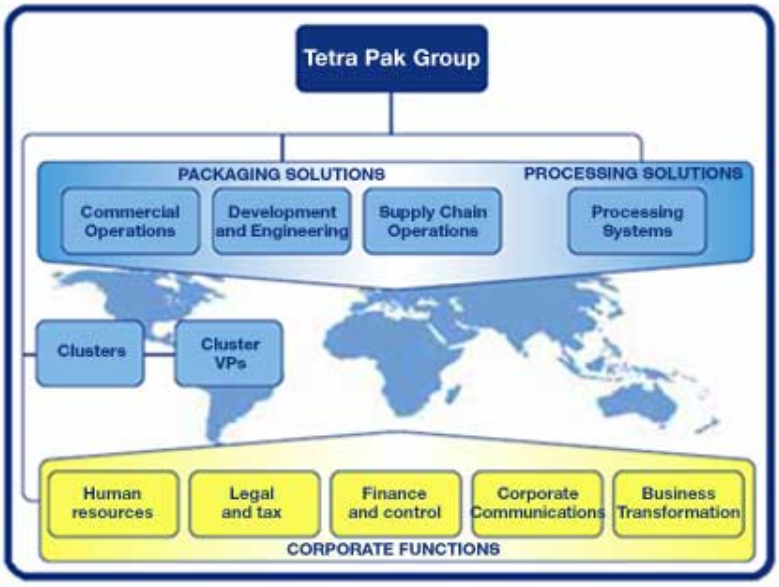


*Figure 2. Tetra Pak organisational structure. (Tetra Pak, 2006a)*

### 3.1.1 VMI at Tetra Pak

Tetra Pak is a packaging material supplier and they provide VMI for their packaging material customers. In addition, they have started upstream VMI for their suppliers as well, but we focused on the VMI provided by Tetra Pak. The overall purpose of Tetra Pak VMI is to optimise service at a minimum total supply chain cost, including the features presented in Table 1.

*Table 1. Tetra Pak VMI optimises customer service at minimum supply chain cost.*

| **Customer service** | **Supply chain cost** |
|---|---|
| Availability | Production cost |
| Reliability | Transport cost |
| Flexibility | Inventory cost |
| Visibility | Process workload |

According to Tetra Pak, VMI addresses and involves three supply chain best practices: **Segmentation** (By customers and products), **Synchronisation** (Aligning supply to demand), and **Collaboration** (Total supply chain view and shared process).

First, **Segmentation** from Tetra Pak's viewpoint. Products suitable for VMI should be: Predictable, Stable, High volume, Co-printable, and have Design validity. The first three features were common for VMI, but the last two were more connected to Tetra Pak's own business and not common for other kinds of business than the packaging solution business.

Secondly, **Synchronisation** means that production is synchronised with demand, whose benefits are:

1) Stable and simplified production schedule

2) Lower supply chain inventory

3) Reduced effective lead-time and increased responsiveness.

Tetra Pak has analysed the following prerequisites that should be addressed for synchronisation:

1) Regular supply chain planning cycles

2) Removal of demand distortions

3) Understanding of capacity constraints and synchronisation capability.

The third supply chain best practice was **Collaboration.** Collaboration means a close and open relationship between the supplier and the customer. Collaboration is in

practice, for example, the agreement of responsibilities and planning parameters, or the customer and the supplier having shared stock and demand information. Table 2 presents the potential benefits of collaboration in the VMI approach.

*Table 2. Potential benefits of collaboration in the VMI approach. (Tetra Pak, 2006b)*

| **Production cost opportunities** |
|---|
| Capacity levelling<br>• Increased capability – overall throughput<br>• Reduced overtime<br>• Reduced expediting and order changes<br>Stable schedule – quantities and timings<br>• Increased throughput<br>• Reduced expediting and order changes<br>Optimal order quantities<br>• Optimised set ups<br>• Co-printing optimisation |
| **Transport cost opportunities** |
| Transport utilisation<br>• Optimise full truck loads<br>• Trade off of utilisation and stock and service<br>Lowest cost transport options<br>• Direct deliveries and reduced warehousing – pipeline stock<br>• Visibility to avoid high cost transportation |
| **Inventory cost opportunities** |
| Customer inventory<br>• Optimal stock level – safety and cycle stock<br>• Reduced obsolescence<br>• Profit and cash flow benefits<br>Supplier inventory<br>• Optimal stock level – cycle stock and safety lead time<br>• Profit and cash flow benefits<br>Total supply chain inventory<br>• Flexibility vs. design change lead time |

Key Performance Indicators (KPIs) and performance management are essential in the VMI process. Tetra Pak has defined a performance management process, which is presented in Figure 3.

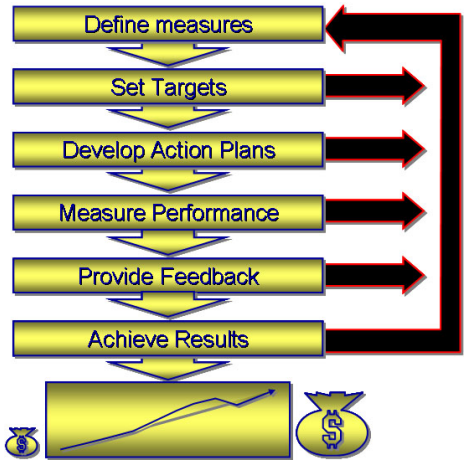


*Figure 3. VMI performance management according Tetra Pak's definition. (Tetra Pak, 2006b)*

Process defines and measures the service provided by Tetra Pak to its customers; it also targets and measures the delivery of business benefits to Tetra Pak and its customers. The process itself has been developed to provide the basis for a continuous improvement process.

Tetra Pak uses SAP in their operation, and its APO (Advanced Planner and Optimizer) module for managing the supply chain. SAP Advanced Planning & Optimization (SAP APO) is a software solution that enables dynamic supply chain management. It includes applications for detailed planning, optimisation and scheduling, allowing the supply chain to be accurately and globally monitored, even beyond enterprise boundaries. SAP APO is a component of mySAP Supply Chain Management. (SAP, 2006). According to Tetra Pak, APO helps VMI operations as follows:

- Automation of data handling and calculations
    - Automated data transfer and upload
    - Automated calculations: netting, time-based, multiple levels and locations simultaneously
    - Automated and real-time updates: stock, production, deliveries
    - Automated order creation in R/3
- Visibility and exception management
    - Clear planning results that can be shared, e.g. between MC and CF
    - Exception management using predefined alerts

- Planning logic and parameters
  - Statistical forecasting toolbox
  - Lot sizing, safety stock rules, truck load planning, etc.
  - 'What if' tests and simulations

Figure 4 presents SAP APO modules. Its main modules, from a VMI operational point of view, have been circled in red.

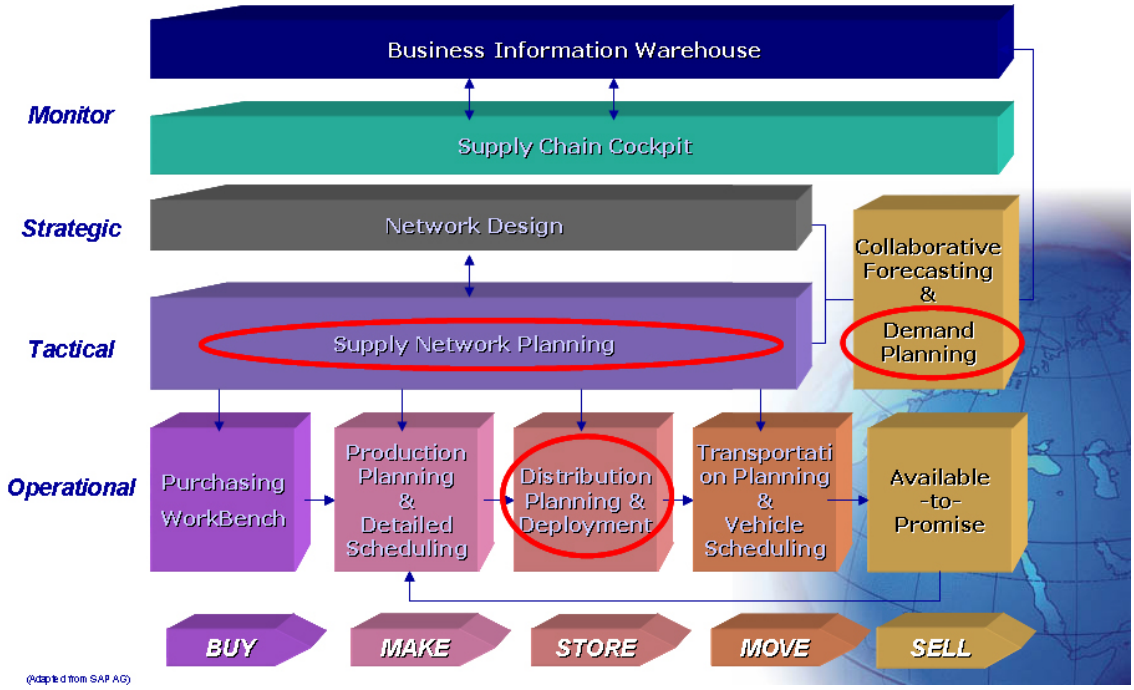


*Figure 4. SAP APO modules related to VMI operation. (Tetra Pak, 2006b)*

### 3.1.2 Findings from Tetra Pak

Tetra Pak has really analysed how they could be more competitive. VMI is one operation model, and it has been clearly defined, created and monitored. The main difference between our viewpoint and Tetra Pak's view about VMI was the meaning of collaboration in VMI. As we have our project with C-class material flows, where VMI is usually used more like a replenishment tool rather than as a collaboration model. The reason for this might be the value of the products. Tetra Pak is an important partner for customer (packages are A-class material for the customers), and in that way, both supplier and customer are interested in developing the operation.

Another interesting point was the usage of the APO module in VMI. It makes it possible to have data from forecasts for deliveries and follow-up every part of the supply chain.

Forecasting is a challenge for our C-class material flows, because there is no clear view about the consumption of the items in the near future (or even today). In addition, Tetra Pak mentioned “Stability” as one feature of Synchronisation, and that the production schedule should be stable for a “good” VMI case basis. This is an interesting viewpoint, because in our C-class item cases, the demand is usually everything else but stable. For this reason, warehouse levels are set quite high in cases of low-value items to ensure availability in an environment with unstable demands.

When planning a VMI implementation, it is essential to have a service-level-agreement, SLA (supplier – customer and market department – production department). After SLA, it is important to measure, analyse and receive feedback on the process.

According to Tetra Pak’s idea of VMI, the materials should always been owned by the customer, otherwise it is not Vendor Managed Inventory. In many cases, the supplier actually owns the items in stock and the customer pays after using items from stock. However, the customer might be forced to buy all of the items in stock. It is not as simple as just saying “the customer owns all of the items in stock”, because the supplier might have paid for many days (even 40–60 days) after the usage. So, is it then “owned by customer”? Anyhow, this is the aspect that is not clear when the definition of VMI is not clear, or when VMI can be interpreted in many different ways.

The Service Level Agreement is a contract between the supplier and the customer for ensuring the common understanding of operation, for example, stock levels, delivery accuracy, etc. In this case, the supplier knows their own stock, in transit and customer warehouses, so in this way they can manage their operations and ensure availability.

We heard about the GUSI (Global Upstream Supply Initiative) project, in which Tetra Pak is involved. GUSI creates standards for supply chain management and one part of the project is defining VMI. Interesting parts of GUSI are forecasting, delivery planning and the creation of sales/production orders. Tetra Pak has implemented these GUSI processes in their operation. More about the GUSI project and its definitions are available on the web (GUSI, 2006).

## 3.2 CEPA Steeltech AB

CEPA is a sub-contract manufacturer that focuses on long-term customer relationships and repeat business. CEPA makes sheet metal components for industry; using an advanced laser technology -based welding process. CEPA customers include ABB, Alfa Laval and Hasselblad.

Production is based on flexibility and the absence of fixed tools. The production process is suitable for manufacturing small- and medium-sized production runs. Table 3 shows the main CEPA industrial services.

*Table 3. CEPA industrial services.*

| | |
|---|---|
| Laser welding and cutting | Laser welding is a fast and precise technology with many advantages over TIG/MIG. The low heat level minimises deformation and creates very precise dimensions. Little after-treatment is required, if at all. Laser welding technology is a solution that provides better quality at the same cost or more cheaply. |
| Powder coating | Our completely automated conveyor plant with 5-stage iron-phosphate treatment has a high capacity, creating short lead times. The short colour-change times give us the flexibility that is a prerequisite for painting products on time. |
| Pressing | Hydraulic pressing: hydraulic presses equipped with the latest technology and with a force of up to 500 tonnes.<br><br>Eccentric pressing: Automated eccentric pressing for large volumes from coils with workbenches measuring up to 2 x 1 m. We also have manual pressing for small- and medium-sized series. |
| Other production | Information services: with the MPS system, everything from offer through to invoice can be handled. Other production services: high capacity in the field of laser cutting, handling plates at up to 6000 x 2000, riveting, stud welding. |

Today CEPA has about 60 employees in two production plants, which are located on the same industrial estate. CEPA also has a production plant in Poland with about 20 employees. There are quite many competitors in the metal industry. CEPA has chosen, as their philosophy, to be smarter not faster compared to its competition. In the metal industry, the main challenge today is to get good employees. Today the metal industry is a fast growing business with more orders than providers to fulfil those orders. CEPA has modern and quite expensive production machines (laser welding/cutting machines), which is their main competitive edge. This modern equipment and know how differs them from, e.g. Chinese manufacturers. Today all products from CEPA are customer specific, mainly pressed and laser manufactured products.

### 3.2.1 VMI at CEPA

We focused our case research on CEPA to the case in which CEPA supplies Alfa Laval with VMI. Today there are about 40 items in the VMI, but the number of items should expand to 60 items shortly. Typically, CEPA has approximately 100 different items in production every week.

With Alfa Laval, they have the customer's ICT tool in use. CEPA can review order, delivery and forecast information from a web-based solution. This data has to be manually added to CEPA's own system, which is one of the things that takes time and which is under development in this VMI case. We enquired about the main positive and negative things in VMI operations and we found out that, in this case, these are:

- VMI pros
    - No need to ask Alfa-Laval about changes in deliveries
    - Possibility to plan production better
    - Know what the customer needs, work with the right details
    - Degree of utilisation of the sheet material (less waste)
    - Alfa-Laval owns the stock and takes all of the risks
- VMI cons
    - Duplicate everything in the IT systems (own system and the customer's system), also when delivering
    - VILAS is not paid until the customer takes out the details from stock. Payments are summarised monthly and credit time is longer than before (average 45 days)
    - Forecasts are still not as good as they should be.

CEPA has agreed minimum and maximum warehouse levels together with the customer, but in some cases, they could deliver more or less. The main thing is that there are enough items for the customer at all times.

### 3.2.2 Findings from CEPA

VMI is a long-term collaboration model, where it is important that both the customer and the supplier have benefits. The customer has benefits when they do not have to make orders, but they have a delivery contract (VMI contract) and the supplier is responsible for fulfilling according to the delivery contract. In addition, the customer receives economic benefits, because they pay only after usage of the items from stock. The customer takes the risk of the material, because they have to buy all of the items in stock, which is of course a benefit for the supplier. The supplier has optimisation benefits as they can optimise the manufacturing process and fulfilment arrangements.

VMI in the metal industry is good for the supplier when competition is hard, because VMI partnership ensures long-term co-operation with the customer. When products are specific according customer design (non-standard items), the customer also wants to have long-term relationships. It is always hard and it takes a long time to get a new supplier for special items. The total profit might be lower for the supplier in VMI operation, but long-term co-operation is better in many cases than short-term income from individual orders. Our case companies in the TEMO project are mainly standard item suppliers, and in those cases, customers have been persuaded for long-term co-operation with a large choice option of items. The CEPA case is an example where a quite small company could be an effective VMI partner with a large-scale company.

## 3.3 Alfa Laval

Alfa Laval is a leading global provider of specialised products and engineered solutions. Alfa Laval's equipment, systems and services are dedicated to helping customers optimise the performance of their processes. Alfa Laval's worldwide organisation works closely with customers in almost 100 countries to help them stay ahead. Alfa Laval's core competences remain the same as in beginning of their business: heat transfer, separation and fluid handling. Alfa Laval helps customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals.

Alfa Laval has led the development of separation technology since the company was formed in 1883 to exploit Gustaf de Laval's revolutionary invention, the cream separator. Since then, they have continually developed new separation products, solutions and applications that have formed important milestones for many industries. Alfa Laval is the world's largest supplier of separation solutions, holding large market shares in numerous industries.

Heating and cooling are essential parts of most industrial processes. These functions have to be performed in an energy-efficient way based on highly efficient heat transfer solutions. Alfa Laval's expertise in thermal technology is respected all over the world. Alfa Laval supplies a broad range of heat exchangers for heating, cooling, evaporation and condensation. They have achieved world leadership in plate and spiral heat exchangers and offer the market's most extensive range of refrigeration equipment.

Buildings are heated and ventilated by Alfa Laval's heat exchangers. The chemical and process industries are the major users of heat exchangers, as are refrigeration plants and the mechanical engineering industries. Alfa Laval builds large heat exchangers for the

offshore, steel and power-generation industries. On board ships, heat exchangers are used for everything from the cooling of diesel engines to air conditioning.

Alfa Laval is the world leader in hygienic fluid handling equipment, as they manufacture a comprehensive range of pumps, valves and fittings. Pumps are suitable for liquids with differing viscosities and particle sizes, and valves and fittings meet high demands on hygiene and precision, whether the product is a beverage, viscous foodstuff, lotion, cough mixture, plasma, protein solution or tablet.

The organisation of the company was previously based on three key technologies, Separation, Heat Transfer and Fluid Handling, all of which continue to form the stable base for the business.

Alfa Laval's organisation today is a result of an extensive change programme launched during 1998. The concept is based on both centralisation and decentralisation. All activities with a critical mass, excluding sales and marketing, have been centralised. This is valid for functions like Finance & Legal, IT/IS, Human Resources, Corporate Communications and Operations. Today there are about 10,000 employees working for Alfa Laval. Figure 5 is about Alfa Laval organisation structure.


*Figure 5. Alfa Laval organisational structure. (Alfa Laval, 2006)*

### 3.3.1 VMI at Alfa Laval

The purpose of VMI in Alfa Laval is to bring the real end-customers need, further back into the supply chain, and lower the variation in demand. Alfa Laval's vision is that tomorrow competition will be between supply chains, not between individual companies. This is probably the reason why many companies are developing and focusing on supply chain management. VMI is one of the many competitive tools for managing the supply chain.

Alfa Laval is the market leader in its business. It is a big company with a large research and development department. Alfa Laval has developed their way for VMI. They are mainly a customer for VMI suppliers, but in some cases they do provide VMI for their customers. Initially, it looked like Alfa Laval's case was similar to our case examples in our project: a big company requiring VMI from its suppliers. However, this was not a typical case of VMI as we know the VMI model. For Alfa Laval, VMI is a co-operation model with its suppliers. They do not force suppliers to operate with the VMI model, rather Alfa Laval markets VMI as a long-term co-operation model in which both the supplier and the customer wins. Alfa Laval's main idea in their VMI concept is to bring the end-customers needs further back into the supply chain and lower the variation in demand. We noticed the following main advantages in VMI for the customer and for the supplier in this case, which is been presented in Table 4.

*Table 4. Advantages for the customer and the supplier.*

| **Customer point of view** | **Supplier point of view** |
|---|---|
| No purchasing/buying operation needed | Long-term co-operation instead of individual sales |
| Purchasers can focus on demand forecasting | Possibility to better manage own production capacity |
| No invested capital in warehouse, payment after usage (juridical customer owns the warehouse) | Less inventory |
| Better availability of stock | Less day to day communication |

One important aspect of Alfa Laval's VMI was measurement (as in Tetra Pak too). Alfa Laval uses five Key Performance Indicators (KPIs) for evaluating its VMI operation: 1) forecast accuracy, 2) availability, 3) maximum available-to-promise, 4) quality, and 5) stock days. As those are measured, an agreement between the supplier and the customer on forecast accuracy, availability, price and maximum ATP level has been reached.

The following figures present the main idea of the movement from a "traditional model" to a VMI operational model.

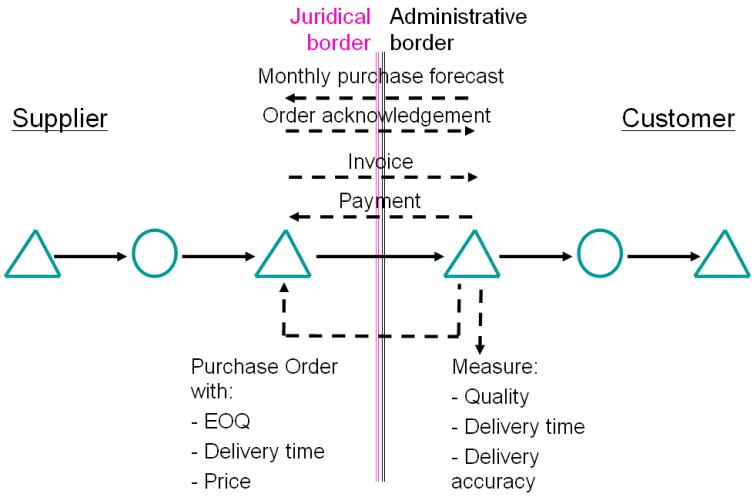


*Figure 6. Old supply chain model.*

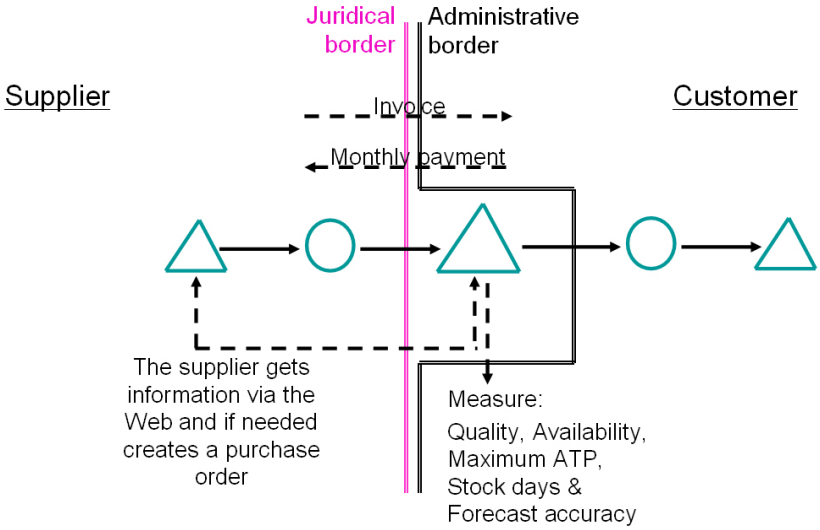


*Figure 7. New VMI operation model.*

Alfa Laval had an ICT tool for managing its VMI operation. They have opened an extranet site for every VMI supplier and all transactions should be made through that system.

### 3.3.2 Findings from Alfa Laval

One learning from Alfa Laval was the customer's view in VMI. We were familiar with the idea of a big company requiring VMI from its suppliers. However, in cases of standard items (like C-class materials), the supplier is not a strategic partner for the customer. A standard item supplier might "easily" be changed to some other supplier providing similar settings. However, in the case of Alfa Laval, the situation was different. In this case, a big customer wants to partner with suppliers and provides an opportunity to use the VMI operational model. Alfa Laval is marketing VMI towards suppliers and in that way it is aiming to get closer and longer relationships with its suppliers. Both the supplier and the customer can achieve the advantages. Again, we noticed the operation measurements. As in many of the low-cost item cases that we have researched, the main measurement is delivery accuracy. In this case, measurements were more performance-oriented. In addition, it is not only the measurements that are important – there is also discussion between the supplier and the customer and how they might be more competitive in the future according to the performance measurement.

# 4. Conclusions and discussion

As we again found out, the definition for VMI is not clear for all researchers and practitioners. For the same operational model, the process was named as a VMI model or something else. Our case studies on low-cost items and the VMI service model seem to be just an item replenishment process for parties operating VMI in A- or B-class materials. There are many articles and academic papers about different replenishment models (e.g. Elvander, 2005), and based on those research results and academic papers, it is not clear how to correctly define a term for all warehouse replenishment processes. Suppliers will discuss VMI in cases of providing replenishment for a customer, in those cases, VMI is merely a "sales gimmick". One argument was that "Vendor Managed" really means that the customer only pays for the items that it uses and the rest is left as the concern of the supplier. It could be asked if it is "Vendor Managed" if the customer does something (for example, collect and send data, give forecast, etc.) in a VMI operation? Yes, it is hard to say exactly which kind operation is VMI and which is not. The common idea is that VMI should somehow rationalise operations and the supply chain process, and then both the supplier and the customer benefits (win-win situation).

Measurement in business is important. Operation parameters should be agreed somehow, for example, with a Service Level Agreement between the supplier and the customer, before anything else is agreed upon. Then indicators for measuring operational efficiency has to be set, and a way of learning something new from these measurements has to be discovered. Measurement is the key issue in A- and B-class material flows, but it should not be forgotten in C-class materials either.

ICT utilisation in VMI is not common in low-cost item flows, but it was discovered to be an effective tool within more valuable item flows in VMI operations. Of course, companies are using their own ERP or other tools to manage materials and operations in cases of low-cost items, but the information is not shared with partners. We have noticed that automated information collecting, analysing and sharing would provide competitiveness in all VMI operational models. That is also one of the reasons why we are developing our mobile VMI concept in our TEMO project.

Our further research will focus on A- and B-class material flows and VMI partnerships.

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