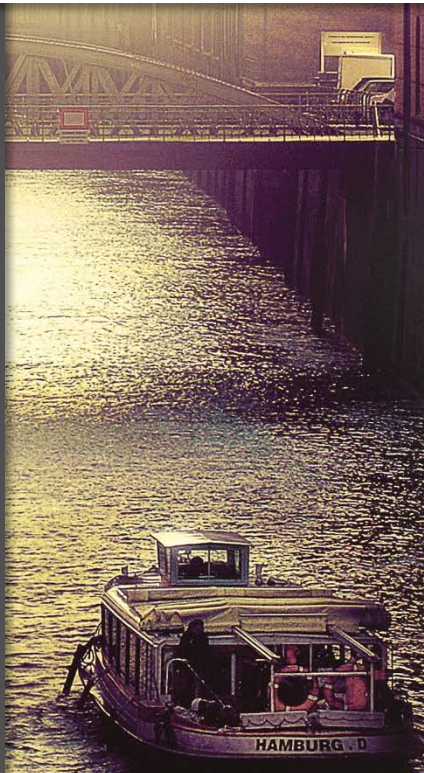


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Digitized VMI – Maturity Model for the FMCG Sector

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Optimized stocks and lean processes are prerequisites in order to keep up with the increasing consumption of goods and limited storage areas in cities due to urbanization. This paper, therefore, develops a maturity model to increase the dissemination rate of Digitized VMI to optimize supply chains in the FMCG sector. Firstly, criteria for successful VMI application are identified by literature research and expert interviews. Moreover, the respective target state descriptions are defined. Secondly, an assessment scheme is integrated. Finally, a procedure model to identify company-specific operational factors is developed. The research establishes requirements for successful VMI application in the FMCG sector within four generic categories and a specific one. It has been found that company-specific operational factors are particularly relevant in this context. Therefore, the specific fifth category is described by a procedure model to identify those factors. Current VMI models are generalistic and describe potential components of VMI, contract contents and relevant processes. However, a model addressing the barriers for VMI application ex ante and taking company-specific operational factors into account is pending. The VMI Maturity Model is practically applicable, since it has been tested at a company in the FMCG sector. It turned out, that assessing the VMI Maturity Level supports companies in identifying specific areas for improvements in advance of VMI implementation.

Keywords: FMCG; Vendor Managed Inventory

1 Digitized VMI in the FMCG sector

The megatrend of urbanization is driving consumption of goods in cities. Two-thirds of the world's population will live in cities in 2050 (United Nations, 2014), while in Germany, for example, it is already 75% (IW Köln, 2010). At the same time, storage areas in conurbations are limited and therefore it is expensive to increase stock capacities. Thus, optimized stock levels and lean processes are prerequisites in order to keep up with these developments.

Digitized Vendor Managed Inventory (VMI) is one effective solution to establish lean replenishment warehousing processes in a supply chain, while simultaneously increasing customer and vendor service levels. In VMI the customer is no longer responsible for inventory management and replenishment. Instead, the vendor becomes responsible for these processes. The customer has to offer current sales data and information regarding the inventory level continuously to the vendor (Schulte, 2013, p.506; Seeck, 2010, p.170). Especially in this case new digital technologies offer novel potentials regarding collecting, providing and analyzing data (Vogel-Heuser, 2014, p.36f). Therefore, the term "Digitized VMI" has been chosen to describe the subject matter. As a result of this reorganization of responsibilities, various improvements can be achieved (see table 1).

The table below has been developed based on the explanations of Draenert (2001), Schulte (2013), Werner (2008), Hellingrath et al. (2008) and Melzer-Ridinger (2007). It shows effects as well as examples that cause those effects and assigns them either to the vendor and/or to the customer, depending on which stakeholder rather benefits from the effect. This consideration makes the potential benefits of VMI obvious.

Particularly for companies in the Fast Moving Consumer Goods (FMCG) sector, which operate several stores in conurbations, VMI proves to be effective. However, VMI implementations are tentative in practice. Frequently, there is a lack of trust between supply chain partners and required data is not available. Thus, a model, which makes the success factors of VMI application transparent, could contribute to an increased dissemination rate of VMI.

The VMI models which currently exist are generalistic and describe potential components of VMI, contract contents and relevant VMI processes. Beckmann and Schmitz (2008) describe an extensive VMI model including components as strategy, processes, systems, benefits and costs cooperation controlling and contract design. In addition, Werner (2013) explains operational constraints. However,

Table 1: Potential VMI Benefits in the FMCG Sector

| Potential Benefits | Effect | Cause (examples) | Stakeholder |
|-----------------------------------|---|--|---------------------|
| Reduction of inventory costs | Reduced inventory levels | No double safety stocks | Vendor and Customer |
| | Reduced days inventory held | Lower safety stocks | Vendor and Customer |
| Reduction of production costs | Improved utilization of production capacity | Lower demand fluctuations | Vendor |
| Reduction of transport costs | Improved utilization of transport capacity | Optimized lot sizes | Vendor |
| Reduction of administrative costs | Reduced effort to satisfy volatile customer demands | Less ad-hoc customer requests | Vendor |
| | No effort for requirements planning and ordering | No demand planning and ordering processes | Customer |
| Reduction of Process costs | Reduced process lead time | Less feedback loops | Vendor and Customer |
| Sales growth | Improved goods availability | Less dependence on customer's processes | Vendor |
| | | Less stock-outs | Customer |
| Improvement of service level | Improved customer retention | Responsibility for the customer's process | Vendor |
| | Improved end customer retention | Less stock-outs | Vendor and Customer |
| | Improved response speed | Transparent end customer demand in real time | Vendor and Customer |
| Improvement of supply reliability | Reduction of bottlenecks in supply | Continuous demand transparency | Customer |

Werner (2013) further points out that social factors are often disregarded - even if, for instance, the experience and know-how of employees are critical for the success of VMI - and recommends to supplement VMI models with qualitative investigation in the company. The experts research has strengthened the fact, that considering social factors in terms of VMI is important, because traditionally evolved responsibilities are shifted from the customer's side to the vendor's side

A model that addresses the barriers of a VMI implementation in advance, takes company-specific and social factors into account and actively supports companies in determining targets and actions for a VMI collaboration does not exist yet. Therefore, this paper follows the scientific question: Which tool effectively supports companies in the planning process of VMI?

In order to answer this scientific question, a model which supports companies in defining concrete measures and corresponding goals to improve the organization is recommendable. In this context, maturity models are commonly applied (Feld, 2012, p.41ff). For this purpose, a VMI Maturity Model based on literature and experts research was developed. The research establishes requirements for successful VMI application in the FMCG sector. Furthermore, the model contains a procedure model to identify operational company-specific success factors and supports companies in identifying specific areas for improvements during a VMI planning process by assessing a Maturity Level.

2 Methodology of Model Creation

According to the example of two famous maturity models, the European Foundation for Quality Management (EFQM) model and the Process and Enterprise Maturity Model (PEMM) developed by Hammer (2007), two key aspects have been derived and adopted to develop the VMI Maturity Model:

1. Categories and criteria define the model's nature.
2. An Assessment Scheme objectifies the evaluation process including a Maturity Level for each criterion and a rating scale.

2.1 Categories and Criteria

The VMI Maturity Model aims at identifying VMI success factors to offer companies indications of the factors that have to be met in order to realize VMI opportunities optimally. Consequently, every success factor which is identified sets up a criterion for the VMI Maturity Model. This research has identified 24 factors by literature research. In order to facilitate the model's usability, the criteria have been logically clustered within the four categories Stakeholders, VMI Potential Utilization, Infrastructure and Planning System and complemented by the Procedure Model (chapter 4).

2.2 Assessment Scheme

The assessment scheme is composed of the Maturity Level and the Rating Scale. Regarding the Maturity Level, the model's approach is based on the PEMM. The reasons are the practical applicability and the transferability of its methodology. For this purpose, VMI target states have been derived in order to define the highest Maturity Level for each criterion. This highest Maturity Level is defined as the target state that is recommended to be achieved in the context of VMI. In order to determine an assessment scheme subsequently, statements have been formulated that can be checked by the assessing company.

The Rating Scale of the model is based on a qualitative assessment method, a ten-scale benefit-analysis, because the benefit-analysis is useful in making a decision if several non-monetary criteria are assessed. In order to assess the maturity of a company regarding the VMI criteria, the current overlap of the target state with the desired VMI business case is assessed. Therefore, zero means that the criterion does not apply to the underlying business case and ten means that the criterion does entirely apply. Thereby, the assessor has the possibility to assess that the criterion does not apply to the company at all (value 0), that the criterion does partly apply to the company (values 1 to 9) – hence, the assessor has nine gradations to self-evaluate to which extent the criterion is already implemented – and assesses that the criterion does entirely apply (value 10).

3 VMI Maturity Model

The above mentioned categories Stakeholders, VMI Potential Utilization, Infrastructure and Planning System of the VMI Maturity Model and related criteria are described sequentially in the following. At first the basic criterion is always described. The target state is defined at the end of each paragraph within square brackets.

3.1 Stakeholders

The category Stakeholders includes criteria, which build the basis for the collaboration of two stakeholders following a joint SCM interest through VMI. Aspects which regulate the collaboration legally and structurally and express the stakeholders' competences and attitudes in terms of VMI are mapped.

3.1.1 Inventory Responsibility

The inventory responsibility has to be transferred from the customer to the vendor (Arndt, 2010, p.162; Zsifkovits, 2013, p.88f). The vendor is responsible for replenishment processes and the inventory levels of the customer. Consequently, this includes corresponding requirements planning processes. However, it has to be noted that not all products are suited to be managed by VMI. Therefore, the appropriate product range has to be identified and determined (Beckmann and Schmitz, 2008, p.274; Werner, 2008, p.107f).

The vendor is responsible for replenishment processes and consequently for the inventory levels of a specific pre-defined product range at the customer.

3.1.2 Know-how

In VMI, the vendor has to perform logistics activities significantly better and more cost-efficient than the customer. The customer, on the other hand, needs the know-how to influence the efficiency of the VMI processes in order to decrease transaction costs (Rajiv, 2009, p.20).

The vendor who is responsible for the replenishment processes has comprehensive expertise in the field of logistics. The customer is aware of possibilities to influence VMI processes.

3.1.3 Awareness & Commitment

The criterion Awareness has been taken from the PEMM and extended by Commitment. Awareness of the potential VMI benefits has to be created to convince the stakeholders to collaborate in an open and reliable way for self-interest reasons (Gudehus, 2010, p.974f). Committing the stakeholders to the agreed-upon goals is essential for collaborations (Arndt, 2010, p.187). Commitment makes the stakeholders acting goal-oriented and counter the threat of resistance against the impending changes (Pfetzing and Rohde, 2009, p.147; Neumann, 2012, p.253).

All stakeholders are, firstly, aware of the potential VMI benefits for the supply chain. Secondly, they are committed to the VMI implementation.

3.1.4 Behavior

This criterion has been borrowed from the PEMM, because even if stakeholders are aware of the VMI potentials and committed to the goals set, they may not behave in this way.

All stakeholders collaborate in the VMI process in order to fulfil defined and communicated VMI goals.

3.1.5 Contractual Agreements (SLAs)

Firstly, performance targets have to be determined for the vendor. Secondly, both stakeholders have to agree on the consequences if those targets are not met (delays in delivery, stock-outs...), since both the vendor (e.g. bad handling of products) and the customer (e.g. transfer of inconsistent data) may be the cause for errors. Those agreements are documented in Service Level Agreements "SLAs" (Darwish and Odah, 2010, p.474; Beckmann and Schmitz, 2008, p.272ff). ECR Austria for instance published a model agreement for VMI within the results of a CPFIR workgroup (ECR Austria, 2015).

The customer and vendor agree on VMI performance goals. Furthermore, they agree on the consequences in case these goals are not met. Those agreements are documented in SLAs.

3.1.6 Communication

Communication channels have to be defined to ensure the information flow between the customer and the vendor (Beckmann and Schmitz, 2008, p. 272f). Communication cannot merely be seen from a technical perspective. In SCM, face-to-face communication becomes more and more important whether digitally supported or not (Liebhart, Mödritscher and Blecker, 2007, p.173). Furthermore, knowledge-based uncertainties lead to deviations from standardized processes (Wildner, 2011, p.215ff). Therefore, for instance, process instructions have to be clear and mutually understandable.

The customer and vendor define clear communication channels. Furthermore, applied concepts and terms are clearly defined and known by the stakeholders.

3.2 VMI Potential Utilization

The category VMI Potential Utilization includes criteria which reveal the situation, whether stakeholders are willing to fully or partially exploit the potential of VMI. In order to create awareness for the full VMI potential and investigate the criteria where opportunities remain, this category maps the goal dimensions time, costs and quality.

3.2.1 Order Time

One of the most important VMI benefits is to eliminate double-work. Therefore, the customer does no longer invest time on ordering and requirements planning as the vendor becomes responsible for the corresponding operational activities (Darwish and Odah, 2010, p.473; Schulte 2013, p.506).

The customer does no longer spend time on requirements planning and ordering.

3.2.2 Order Process Lead Time

Neither the requirements planning nor the ordering process are eliminated, only the double-work is. Therefore, unless the customer and vendor are not able to reduce the total process lead time, no improvements are achieved for the supply chain (Alicke, 2005, p.175). Consequently, administrative effort has to be reduced via automation.

The administrative process lead time is reduced by process automation.

3.2.3 Inventory Costs

Inventory costs can be decreased due to the elimination of double efforts too. The customer, for instance, does no longer need safety stocks (Schulte, 2013, p.506; Seeck, 2010, p.170).

Inventory costs are decreased by reducing inventory levels.

3.2.4 Process Costs

The vendor has the opportunity to cut costs particularly in the procurement process, because requirements can be pooled based on a real time customer demand. Furthermore, improvements in the handling and order picking process may be realized, if ad-hoc requests are eliminated and a continuous replenishment process is implemented. Finally, transport capacities can be optimally utilized and tours to the stores can be improved, too (Alicke, 2005, p.147f; Hellingrath et al., 2008, p.468ff; Beckmann and Schmitz, 2008, p.271f).

The vendor reduces process costs based on better planning information.

3.2.5 Saleability

Reducing stock-outs and improving the saleability are main goals of VMI and, consequently, key success factors (Zsifkovits, 2013, p.89).

The customer's saleability is increased and stock-outs are decreased.

3.2.6 Bullwhip-Effect

Due to the variety of other factors which are affected by the Bullwhip-Effect, it is included as a distinct criterion. Companies should evaluate if they have managed to eliminate distortions in the planning process (Melzer-Ridinger, 2007, p.141f; Yao, Evers and Dresner, 2007, p.664). Hence, it can be concluded that first successes have been achieved through VMI.

Distortions in the planning process through demand fluctuations of end customers are eliminated.

3.3 Infrastructure

This category depicts the resources which are required in order to run the VMI collaboration efficiently. Beckmann and Schmitz (2008) highlighted the importance of ICT technology and sensors to make data available and exchange it between functional units. Furthermore, Hammer (2007) has incorporated the dimension Infrastructure in his model in order to reflect information and management systems that support the process. These considerations and Hammers' wording have been adopted and expanded by adding additional criteria. The information processes, the ICT system and the use of technology are described.

3.3.1 Information Collection

In order to realize better planning information, the right information has to be collected in the process. Firstly, the automated collection of sales data at the POS is one key criterion in order to gain a better understanding of the end customer and future demands (Hellingrath et al., 2008, p.468f; Alicke, 2005, p.174). Secondly, information about the inventory levels has to be collected in order to determine net requirements. In the FMCG sector it is necessary that both sales data and inventory data are collected to check the true consumption of operational units (Zsifkovits, 2013, p.89). Therefore, the inventory process is important to check whether the inventory levels depicted in the system correspond to the true inventory levels on stock (Lux, 2012, p.179).

Sales data are collected at the POS and saved automatically. Inventory levels are measured by defined inventory processes.

3.3.2 Information Update

The vendor is only able to realize benefits through an improved information basis if the (correct) data is current data. For this purpose, data has to be transferred frequently - e.g. on a daily basis or much better in real time - and error-free - as inconsistent data distort the vendor's planning processes and may require reworks - from the customer to the vendor (Alicke, 2005, p.174; Hellingrath et al., 2008, p.468f).

The customer transfers current and correct data (sales and inventory information) daily and error-free to the vendor.

3.3.3 System Integration

The automated information exchange is one key criterion of VMI. For this purpose, the customer and vendor have to be connected by an electronic interface. Furthermore, standards for exchanging and identifying information unequivocally have to be defined (Beckmann and Schmitz, 2008, p.273; Draenert, 2001, p.51).

The IT systems of the customer and vendor are connected electronically and the data is transferred in a standardized way in order to enable an automated information exchange.

3.3.4 ICT Support

It is necessary that processes are carried out automatically to reduce manual work. These processes include determining net requirements, generating orders and sending the required information to the customer. The automation of those processes is supported by software systems (Draenert, 2001, p.81f).

The vendor's inventory management system determines the customer's net requirements and generates sales orders automatically.

3.3.5 Identification Technology

Identification technology should be implemented to streamline the process of identifying information and process the data automatically. In the context of VMI, mainly Barcode and RFID have proven to be effective (Hellingrath et al, 2008, p.471).

Identification technology supports the collection and processing of data.

3.3.6 Technical Equipment

In practice, inventory processes to identify inventory levels require manual work and are time-consuming (Lux, 2012, p.179). Therefore, technical equipment has to be used to make this process efficient (Beckmann and Schmitz, 2008, p.272f). If barcode or RFID technology has been implemented, technical equipment (e.g. scanners) has to be used anyway. In order to improve the process reliability of the picking process – which directly affects the inventory process – pick-by concepts can be deployed (Gudehus, 2010, p.693). Furthermore, several types of sensors can be used in order to automatically determine inventory levels (Schulte, 2013, p.506; Beckmann and Schmitz, 2008, p.272f).

Technical equipment supports the identification process of current inventory levels.

3.4 Planning System

High-quality planning processes are important in VMI (Beckmann and Schmitz, 2008, p.272). Therefore, aspects assigned to the VMI planning system as constraints, forecasting and control mechanisms have been summarized within this category.

3.4.1 Inventory Range

Firstly, a minimum inventory range at the customer has to be determined to ensure the saleability of the customer. In order to determine the right minimum inventory range, sales and required consumption quantities are considered. Furthermore, the lead time for the transport process has to be taken into account.

Additionally, potential lot size restrictions influence the minimum inventory range and safety stocks are considered. Usually the lead time for the production process is important too, however for FMCG usually a continuous demand in the market enables the suppliers to run the production continuously. Secondly, a maximum inventory range has to be determined in order to take the storage capacity at the store of the customer and warehousing cost aspects into account (Hellingrath et al., 2008, p.469f; Werner, 2008, p.108).

The customer and vendor agree on a minimum and a maximum inventory range.

3.4.2 Order Policy

If the delivery date is variable, the reorder point method is applicable (Schulte, 2013, p.412f). In case of a continuous customer demand, it is recommended that the vendor determines the delivery cycle in order to reduce process costs (Werner, 2008, p.109f; Draenert, 2001, p.89 and 93). This approach is in line with the order cycle method (Schulte, 2013, p.412f).

As FMCG are mainly handled continuously, determining order cycles is attractive. However, depending on the number of stores or on the products involved, the reorder point method can also be effective. Therefore, both order policy approaches are covered and the reference to take the cost/benefit ratio into account is explicitly given.

The customer and vendor decide on the ideal order policy by taking the respective cost/benefit ratio into account.

3.4.3 Forecasting Method

Traditional manual replenishment methods do not fulfil the contemporary requirements in terms of cost efficiency and service levels. In order to check the customer's inventory level, generate the forecast, determine the order quantity and submit it to the customer automatically, automated replenishment systems are implemented in the FMCG sector. In this context the forecasting system plays a vital role to forecast sales quantities of an operational unit for any desired time period. For this purpose, statistical methods are applied which, nowadays, deliver paramount predictive accuracy. Furthermore, those methods consider delivery

times, minimum inventory levels and seasonal factors in the calculation (Draenert, 2001, p.48). Not least, Beckmann and Schmitz (2008) also highlighted the importance of forecasting.

Future requirements are determined objectively by means of a statistical forecasting method.

3.4.4 Planning Accuracy

FMCG companies usually run several stores in conurbations. Consequently, a variety of different factors individually influences the VMI collaboration and different persons manage different stores. This leads to a stronger heterogeneity in the system and increases complexity (Strunz and Dorsch, 2009, p.297). For example, if employees do not fully comply with standard processes, the process output may vary from store to store. Furthermore, the headquarters usually conduct promotions by means of voucher campaigns, which affect parts of the product range. Those voucher campaigns usually boost the sales of the advertised products (Jahn, 2003, p.147). Consequently, the sales vary considerably across the market since the consumers will react differently to a centrally organized campaign. The planning system has to deal with this complexity and take those customer (store) individual factors into account (Hellingrath et al., 2008, p.470f; Werner, 2008, p.109f).

The planning process considers defined customer individual influence factors as well as sales policy measures (promotions) across the market.

3.4.5 KPIs

It is difficult, but important to track the VMI performance (Zsifkovits, 2013, p.89; Gudehus 2010, p.976). For example, the delivery quality is applicable as a quantitative KPI by tracking the amount of additional deliveries due to impending stock outs (Beckmann and Schmitz, 2008, p.273). In terms of qualitative KPIs we propose to monitor the customer satisfaction as an integral part of the VMI collaboration (Wannenwetsch, 2004, p.217). As VMI is about collaboration in order to generate mutual benefits, the customer's as well as the vendor's cost/benefit ratio has to be critically and continuously assessed and deviations should cause tangible measures (Beckmann and Schmitz, 2008, p.272).

KPIs measure quantitatively and qualitatively if agreed VMI goals are achieved. Deviations in terms of the aimed win-win situation between the customer and vendor are analyzed and lead to tangible measures.

3.4.6 Plausibility Check

The Plausibility Check is explicitly incorporated into the model due to the enormous importance of the stakeholders' acceptance towards VMI. This insight was achieved during the expert interviews. Therefore, the plausibility of the quantity of each order position has to be checked automatically.

The plausibility of the planned replenishment requirements is checked automatically.

4 Procedure and Maturity Model

In order to create the VMI Maturity Model, the four categories are combined with the Procedure Model (see figure 1). The model is embedded into the Assessment Scheme in order to identify potential areas of improvement within the four generic categories and the fifth company-specific one, which is described by the Procedure Model. The four generic categories have been described above, therefore, before presenting the final results the integrated Procedure Model is described in the following.

4.1 Procedure Model

The aim of the integrated Procedure Model is to provide an approach to identify operational company-specific VMI factors. For this purpose, guided interviews with employees who have particular and specific know-how are recommended (Gläser and Laudel, 2006, p.36-41 and 140). Three steps are required to be carried out:

1. Preparation of the expert interviews
2. Implementation of the expert interviews
3. Analysis of the expert interviews

4.1.1 Preparation

Before the interview is conducted, the number of interviews and the right interviewees have to be defined. It is recommended to conduct several interviews, because firstly many people possess the required knowledge and secondly sources of error exist, which might lead to a loss of information. Furthermore, in terms of triangulation it is important to gather information from several points of view (Stake, 2010, p.123f). This model has been applied in practice by interviewing eleven managers. Six persons were operatively and two strategically engaged at the customer. In the case of the operational managers, care was taken that the persons manage stores with different requirements in terms of customer structure. Furthermore, three strategically involved persons of the vendor have been interviewed, whereby one has already maintained a VMI project in a different market and, therefore, was able to give insights in the learnings of a similar project.

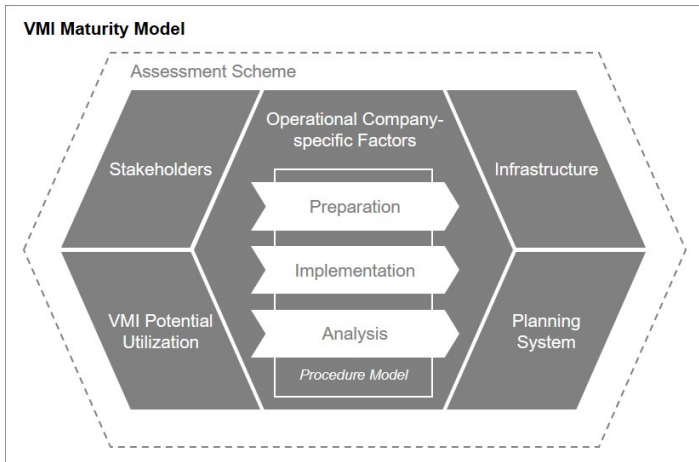


Figure 1: VMI Maturity Model for the FMCG Sector

As guideline interviews are the appropriate interview form for expert interviews, 8 to 15 questions including an introduction have to be prepared in advance. Binding rules do not exist for the development of an interview guide, however, the formulated questions should be open, neutral, simple and clear (Hopf, 1973, p.99ff; Gläser and Laudel, 2006, p.36-41, 140 and 111; Patton, 1990, p.295). As in the model's test, we recommend to check the guiding questions with the stakeholders and apply the company-specific wording.

Before the interview is conducted the initial contact with the interviewees has to be established. We ensured that the management level explains the background of the expert interviews to the respective experts.

4.1.2 Implementation

At the beginning, we recommend to obtain the approval for recording the interview after the greeting. Then give the introduction about your background and explain the research goal as well as the contribution of the interview in achieving that goal to create a pleasant atmosphere. Further explain the anonymization process to protect the interviewee's privacy and make the interviewee aware of information which might have been gathered in advance. Finally, inform the interviewee that any questions may be skipped and the whole interview may be aborted anytime (Gläser and Laudel, 2006, p.153-161). After that start asking the questions prepared and be open to unforeseen topics as well.

After the interview the parts which are related to the research subject have to be transcribed (Meuser and Nagel, 2005, p.83). The texts created represent the raw data and are then further analyzed.

4.1.3 Analysis

The analysis of expert interviews follows the approach of the qualitative data analysis and aims at identifying the aspects the statements of the experts have in common (Meuser and Nagel, 2005, p.80-83). For this purpose, several different methods exist in theory. However, a standardized approach does not exist (Saunders, Lewis and Thornhill, 2012, p.556). In practice, hybrid forms between free interpretation and strict methods are commonly applied (Mayring, 2010, p.602; Gläser and Laudel, 2006, p.41f). We recommend to identify the characteristics in the raw data by using a category system, following a basic approach in qualitative

analysis according to Mayring called “Structuring” (Diekmann, 2004; Gläser and Laudel, 2006).

In the first step, summarize the raw data in tabular form regarding the questions of the interview guide to present them clearly. In the second step, assign codes to the text passages and, thereby, structure the raw data. We recommend to derive the codes during the analysis. Assign a code to the first similarities identified in the content and create a category. The next text passage which is related to this code, is then assigned to this category as well. Whenever new definable text passages are identified, a new category is created.

4.2 Results and Outcome of the Application

The model has been applied in practice. In the following an example of a VMI Maturity Level evaluation is shown (see table 2).

After scoring the target states behind the criteria by applying the assessment scheme, the Maturity Level of each category is calculated in percent. Thereby, the assessing companies are able to define certain areas for improvements via radar chart (see figure 2). The continuous line shows the maximum value of 100% and the dashed line shows the current state.

According to this example, the assessing company will at first have to go deeper into the categories Infrastructure and VMI Potential Utilization. Within the category Infrastructure, especially the reasons for the low rating of System Integration and Technical Equipment have to be analyzed in a second step. In dependence of the results, it is above all necessary to take further measures in order to be able to implement VMI successfully. If, for instance, the topic of System Integration was left unsolved, this could lead to considerable efficiency losses in case of VMI application. Following this method, all potentials regarding VMI can be analyzed successively.

Table 2: Example of a VMI Maturity Level Rating

| Category | Criteria | Score | Maturity Level [%] |
|---------------------------|-------------------------------|-------|--------------------|
| Stakeholders | Inventory Responsibility | 10 | 80 |
| | Know-how | 8 | |
| | Awareness and Commitment | 6 | |
| | Behavior | 10 | |
| | Contractual Agreements (SLAs) | 8 | |
| | Communication | 6 | |
| VMI Potential Utilization | Σ | 48 | 53 |
| | Order Time | 10 | |
| | Order Process Lead Time | 4 | |
| | Inventory Costs | 2 | |
| | Process Costs | 10 | |
| | Saleability | 4 | |
| Infrastructure | Bullwhip-Effect | 2 | 40 |
| | Σ | 32 | |
| | Information Collection | 6 | |
| | Information Update | 4 | |
| | System Integration | 2 | |
| | ICT Support | 6 | |
| Planning System | Identification Technology | 4 | 60 |
| | Technical Equipment | 2 | |
| | Σ | 24 | |
| | Inventory Range | 9 | |
| | Order Policy | 3 | |
| | Forecasting Method | 6 | |
| Planning System | Planning Accuracy | 9 | 60 |
| | KPIs | 3 | |
| | Plausibility Check | 6 | |
| | Σ | 36 | |

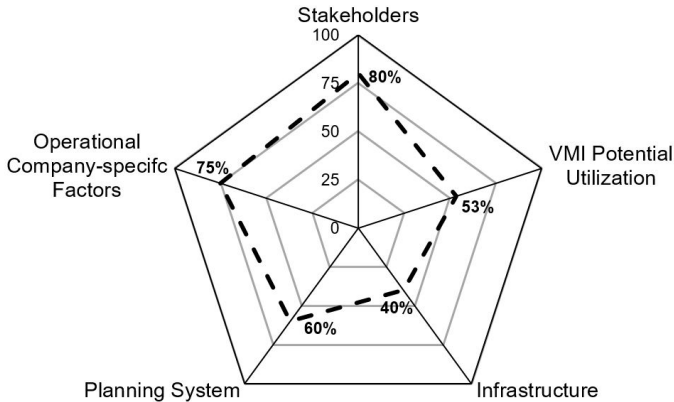


Figure 2: VMI Maturity Level - Areas of Improvements

5 Concluding Remarks

The VMI Maturity Model was applied to a company in the FMCG sector and supported the company in identifying weaknesses regarding VMI. Thereby, the company was able to solve the main problems, before finally daring to a test run. As a result, the functionality and applicability of the model could be reviewed and confirmed. Furthermore, the application of the model strengthened the point of view of Werner (2013), that social aspects should be considered in terms of VMI. Concluding, we recommend the VMI Maturity Model in three different states of a VMI implementation. During a VMI Feasibility Study, the model can be used as a checklist in order to make sure that relevant aspects are covered. If "Digitized VMI" is implemented, companies are able to check to which extent the potentials are exploited by comparing actual values and target figures within the Monitoring Process. The monitoring process will become more and more real time with fully information out of the supply chain. This leads to improved data and as a consequence to better VMI processes in the supply chain. The benefits could only be realized with new and digital technologies.

However, the main benefit is in the Implementation Decision Process itself: Companies become able to check which aspects are covered by the desired VMI business case to which extent by comparing plan and target figures and, thus, defining concrete actions to optimize their intentions.

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