**Table of contents**

## 1 Subject matter, objective, and purpose

This Robert Bosch (RB) directive describes the valid RB BBM standard for Vendor Managed Inventory (VMI) as well as the RB BBM procurement process for VMI in collaboration with external suppliers (*EZRS*) by means of EDI (Classic EDI and WebEDI).[1]

## 2 Scope

This central directive is binding for suppliers in accordance with section 3.4 of the Framework agreement on VMI.

## 3 Definitions of terms

| | |
|---|---|
| ASN | Advanced Shipping Notification (concerning in-transit goods) |
| Classic EDI | EDI process via an EDI infrastructure |
| CLP | Customer service and Logistics Planning |
| DELFORP | VMI EDI message "planned receipts" (Delivery Forecast Plan) – by supplier |
| DELFORV | VMI EDI message "gross demand" (Delivery Forecast) – RB internal |
| DESADV | EDI message "in-transit goods" = ASN – by supplier |
| DESADVV | VMI EDI message "in-transit goods" – RB internal |
| IDOC | Intermediate document – Electronic SAP outbound format |
| IMO-EDIFACT | classic EDI VMI message type, containing consignment stock, gross demand, and minimum and maximum inventory level information |
| EDI | Electronic Data Interchange |
| EWS | Early Warning System |
| EZRS | Direct and raw material |
| GR | Goods Received |
| INVRPT | EDI message "inventory report" for consignment |
| INVRPTV | EDI message "inventory report" – RB internal |

[1] This directive does not describe additional standards or concepts such as consignment or EDI rollout.

| | |
|---|---|
| LOG | Logistics |
| MRP | Material Requirements Planning |
| OTD | On Time Delivery |
| RB | Robert Bosch |
| SAP | Robert Bosch ERP system |
| SBI | Self-billing invoice |
| SupplyOn | Web based platform for supply chain collaboration: e.g for VMI and EDI |
| VMI | Vendor Managed Inventory |
| WebEDI | EDI based on an online platform (SupplyOn) |

# 4 Vendor Managed Inventory

## 4.1 Definition of Vendor Managed Inventory

Vendor managed inventory (VMI) is a logistics concept in which suppliers take over the full responsibility over customer inventory replenishment and its related decisions. So from this perspective the customer does **not** actively participate in this part of the supply chain.

The basic idea behind applying VMI is creating a more flexible and transparent supply chain by means of sharing information and the clear definition of responsibilities. In order to be able to do so, the customer has to share real-time information about inventory levels and demand with the supplier. This means the supplier has access to the same data as the customer.

The supplier monitors the customer's (consignment) inventory and gross demand, and makes decisions in regards to inventory replenishment. These decisions include determinations on how much will be supplied (e.g. quantities), when the goods will be supplied, and which means of transportation is used (only in case of DDP or DAP incoterms). Therefore, the supplier is dependent on real-time information about inventory levels and gross demand as well as on all variables determined within the mutually agreed VMI agreement.


Figure 1: VMI basics

It is the responsibility of the customer to share all the information that is necessary for the supplier to make the right decisions. In addition, the customer is responsible for creating a framework in which VMI can be applied. In this regard, it is of importance that both the customer and supplier agree on particular processes and levels of collaboration in order to enable a successful application of the VMI concept. Such a VMI and/or supplier agreement may include factors such as minimum and maximum levels of inventory, delivery timeslots or transport windows, what products are included in the process, the minimum delivery quantities, the means of communication (EDI), and the frequency of communication.

### 4.2 Benefits of VMI

The potential benefits of VMI cover benefits for the supplier, for the customer, and for the entire supply chain.

<u>More flexible and optimized processes</u>

- Daily availability of planning and forecast data
- Higher level of data transparency and details
- Optimization of production planning (e.g batch production)

Stock level cost optimization / reduction

- Reduction of warehouse space and buffer stocks
- Transfer from warehouse area to production area
- Reduction of handling costs

Transport cost optimization / consolidation

- Free decision of delivery dates within TMC1 transportation windows
- Flexibility in shipping quantity
- Reduction of bullwhip effect
- Reduction of special transports

Strengthening of strategic supply chain partnership

- Clear statement of appreciation and collaboration
- Supply chain planning empowerment of supplier
- Supplier evaluation criteria
- Customer loyalty and satisfaction

## 5 VMI standard for RB BBM

At RB, VMI is one of the preferred logistics (delivery) concepts for direct and raw material (EZRS). The objective of VMI at RB is to create a transparent and flexible supply chain in which both RB and the suppliers benefit.

Concerning VMI for EZRS it has been determined that this concept may only be applied in combination with consignment stock. This decision has been made whilst considering the (long) lead and replenishment times as well as the fluctuating customer demands. Finally, the RB VMI process supports an Early Warning System (EWS), which is based on the information that is shared between RB and its suppliers.

### 5.1 Basics of the RB BBM VMI process

The particular RB plant is responsible for sharing up to date inventory and demand information with the particular supplier.

Based on the shared information from the RB plant, the supplier prepares and initiates shipments to replenish the consignment stock according to the mutual VMI agreement as well as considering the agreed minimum and maximum inventory levels. The preparation of shipments includes sharing information about planned deliveries (or planned receipts from RB's perspective). This information is also used for creating transport orders concerning TMC (only in case RB is responsible for transportation ↔ Incoterms dependent). When a shipment is dispatched, the supplier sends out in-transit information by means of an Advanced Shipment Notification (ASN).

After the goods are received by the RB plant, they are booked and the RB plant's consignment inventory information is adjusted accordingly.

The basics of the RB BBM VMI process are presented in figure 2.

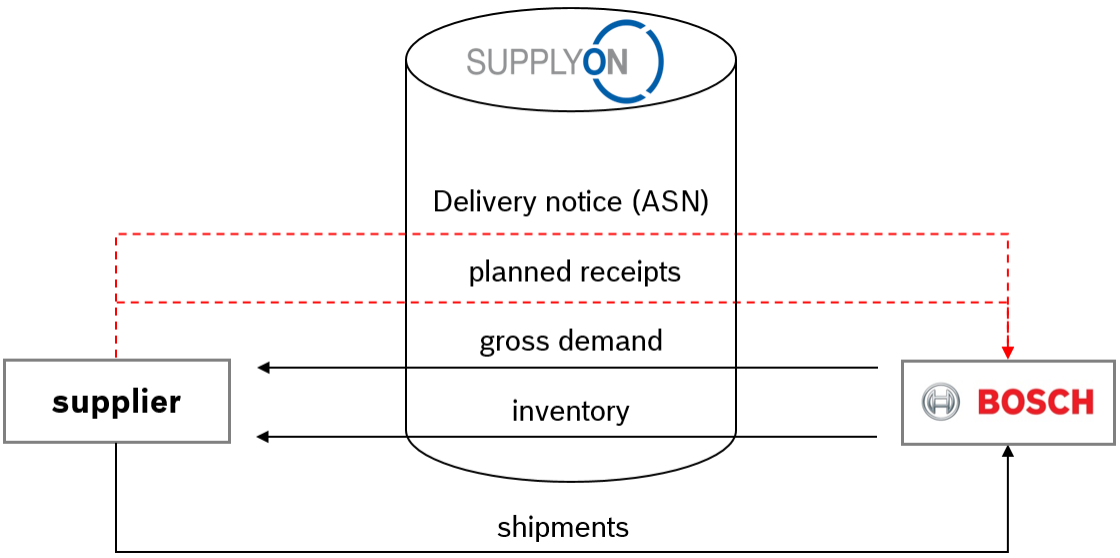


Figure 2: RB BBM VMI basics.

In accordance with the definition of VMI, RB strives for a transparent and collaborative supply chain. Therefore, RB expects that information is shared in a **two-way exchange** of information by means of **EDI**. The suppliers will be integrated into the electronic processes of VMI by using either traditional EDI (or classic EDI) or WebEDI (see chapter 6).

EDI enables the customer to share and automatically update information about inventory levels and demand. In addition, the supplier is able to inform the customer about planned deliveries as well as on when goods are actually being shipped.

In addition, figure 2 points out the role of the SupplyOn VMI-monitor within the RB BBM VMI process. The SupplyOn module VMI or VMI-monitor is the application used to visualize and monitor all RB VMI related processes. Thus, it provides a joint view for both RB and the supplier, enabling both parties to have access to the same relevant VMI information at all times. Therefore, both RB and the supplier have to ensure access to the SupplyOn VMI-monitor.

It is of importance to mention that the VMI-monitor is **not** a planning tool. This applies to both RB and the supplier. For RB, it is a tool in addition to SAP, which represents the SAP data in a joint overview and is able to monitor this data (supply chain transparency and EWS). If the supplier operates its own VMI application it may continue to use it. In this case, the supplier has to ensure that the data, content and functions of its VMI application correspond with the SupplyOn VMI-monitor. According to the VMI agreement, solely the data shown in the VMI-monitor are binding and authoritative.

A **two-way exchange** of **complete** information by means of EDI, in accordance with figure 1, as well as the availability of data within the VMI-monitor enables a successful application of the RB VMI EWS. By means of this systematic approach potential supply chain disruptions can be identified in an early stage, which gives the supplier the opportunity to react proactively in order to prevent those potential supply chain disruptions.

### 5.2 RB responsibilities

As customer in the VMI process, RB is responsible for sharing inventory and demand information.

In this regard, both inventory and gross demand information is mandatory. This automatically implies that the VMI-monitor process key **IPR** has to be applied ↔ hence, RPM is not included in the RB VMI standard.

The RB information will be shared on plant level. Thus, in case of multiple plants the supplier receives the information of all respective plants. Information has to be shared and sent out on a **daily basis** in order to ensure the availability of up to date information. Even though there are no visible changes in either inventory levels or demand, the daily transmission of information to the SupplyOn VMI-monitor is mandatory. Altogether, this means that RB is responsible for daily

updates of both inventory and demand information in the VMI-monitor. In case of a Classic EDI connection between a RB plant and supplier (see chapter 6), the EDI outbound message flow towards the supplier has a minimum transmission frequency of once a week and daily transmission as maximum frequency (see section 6.1).

Besides sharing information and providing a VMI framework, the RB procurement planner is not actively involved in the inventory replenishment process. This means that the RB plant does **NOT** send out any scheduling lines (e.g. purchase or call off orders / LABs) to the suppliers. This automatically implies that FRC (Forecast) / MRP concerning scheduling lines has to be stopped.

### 5.2.1 Inventory

The RB inventory information that is forwarded to the SupplyOn VMI-monitor consists of the consignment stock for a particular component as well as the GR bookings regarding the particular consignment stock.

Please note that the shared inventory levels may not include the total stock levels (consignment + RB owned stock), but only the particular consignment stock available for RB. Only the latter is of relevance to the particular supplier.

INVRPTV is the (RB internal) EDI message that is to be used to transmit RB consignment stock information to the SupplyOn VMI-monitor.

### 5.2.2 Demand

The demand information comprises gross demand, hence the planned consumption from the particular consignment stock. This is information is equal to the actual planned consumption as planned in the plant's production planning ↔ actual production planning data.

The RB gross demand information has to cover a period of at least 12 months, but preferably longer.

DELFORV is the (RB internal) EDI message that is to be used to transmit RB gross demand information to the SupplyOn VMI-monitor.

### 5.2.3 Min/Max inventory levels

The minimum and maximum inventory levels ensure that RB meets the RB customer's requirements in regards to flexibility. In addition, it also ensures that the maximum storage space is not exceeded. From the supplier's perspective, the minimum and maximum inventory levels offer leeway and flexibility.

RB is responsible for configuring the minimum and maximum inventory levels for all VMI part numbers. The configuration is done within the VMI-monitor.

The standard RB approach is the determination and configuration of **dynamic** minimum and maximum levels. Dynamic may be explained as specified ranges of coverage of the inventories in days. Based on fluctuations in the gross demands the minimum and maximum inventory levels change dynamically.

Fixed or static levels should only be applied as exception.

The standard settings concerning inventory levels should represent a particular required minimum stock of production as well as a required maximum level of stock. It is planned to come up with standard settings for the minimum and maximum inventory levels per material group. These standard should be considered proposals.

Example: For particular material groups the standard settings for minimum inventory level represent a minimum inventory level of two weeks of production, and the maximum level of four weeks. ↔ a minimum inventory of two weeks and a maximum inventory of four weeks based on future average demand of production based.

Regarding the automatic calculation of the dynamic levels, the calculation period (or averaging period) should be set as 91 days (13 weeks or 3 months).

Any other configuration should only be applied as a justified exception, which has to be aligned with and approved by the divisional operational expert.

In case fixed levels are applied, the particular CLP planner has to review these levels on a frequent basis. The minimum frequency for this review is every three months. In the event of continuous fluctuations in demand, the particular CLP planner needs to inform the particular supplier in a timely manner, also considering lead times.

The initial agreed minimum and maximum inventory levels are documented in the Annex of the framework agreement on VMI. In accordance to the VMI framework agreement, changes to the maximum and minimum inventory levels with regard to ranges of coverage of the inventories may be agreed upon between the contracting parties in writing (including email).

When the supplier keeps the available inventory levels between the predefined minimum and maximum levels, the expected RB customer service level can be met. This is represented by the OTD measurement for VMI parts.

However, if the inventory levels do not remain between the predefined inventory levels a performance alert is generated by the VMI-monitor. Due to the fact that the VMI-monitor processes all VMI information to be able to visualize and monitor all VMI related data, this tool also generates the performance alerts based on the information available. The definition of performance alerts within the RB VMI process is based on the ODETTE basic alert definition (2004: 26), Appendix A.

RB measures the supplier's performance or service level based on the alerts that are generated on a daily basis by the VMI-monitor. Thus, the OTD for VMI parts is calculated by the VMI-monitor and not in SAP. PICOS withdraws the particular OTD ratings from the VMI-monitor.

The RB OTD calculation for VMI parts is included as Appendix B.

The calculation is embedded in a so-called Rating Profile. The particular rating profile is *VMI_SPT_7-3-1* (projected stock). This rating profile does consider RB initial demand (backlogs). Overdue production demands of a BOSCH plant (VMI monitor "initial demand") are due for delivery. Therefore, initial demand is to be fulfilled at all times, except where the BOSCH plant waives full or partial delivery of the overdue BOSCH production demands in writing (including email). This is not only critical for RB production and stock, but also regarding the actual OTD ratings. In such case, when calculating the dynamic maximum and minimum inventory levels, the VMI monitor does not take such overdue production demands into account. Hence, when initial demand is not delivered, it will result in negative OTD ratings. Please note, that this approach may differ per BBM division. Therefore, alignment between the RB plant and the particular supplier is required.

The transparency that is created by the VMI-monitor as well as the generation of performance alerts, enable the VMI-monitor to function as the **RB standard EWS for VMI components**. RB has the responsibility to instruct the supplier about mutual settings regarding early warnings as well as expected approach regarding early warning response (time fence, settings, etc.).

### 5.2.4 Framework

All involved RB plants ensure at least one VMI key user and expert within their CLP organization.

According to the RB VMI standard, VMI can only be applied successfully when the VMI-monitor is integrated in the process. The VMI-Monitor has been identified as standard tool for the RB VMI process. It provides a joint view for both RB and the supplier at any time. The application is used to visualize and monitor all RB VMI related processes. The information within the VMI monitor is binding regarding decisions within the VMI process.

Therefore, all plants have to ensure the compatibility of SAP with the VMI-monitor by means of the correct settings in SAP, their particular SMI manager as well as within the EDI manager.

In addition, all involved CLP planners need to ensure access to the tool.

All involved RB plants have to ensure the correct configuration of SAP master data according to the configuration guideline described in this standard, also considering divisional or plant specific configurations.

Such a configuration will ensure that VMI is applied according to the correct definition of the VMI concept, and that the right information is shared within the VMI process. Amongst others, the former means that VMI will be applied **without** sending additional schedule lines (purchase orders or LABs) to a supplier.

Similar to SAP, the material master data within the VMI-monitor have to be configured according to the configuration guideline described in this standard.

The configuration is usually done by either the responsible CLP planner or the particular VMI key user.

### 5.3 Supplier responsibilities

The supplier is fully responsible for keeping the RB consignment stock between the predefined minimum and maximum inventory levels. This automatically implies the following:

- The supplier monitors the RB consignment stock continuously either based on the information provided by RB by means of EDI or via the information retrieved from the VMI-monitor. RB ensures that the information in the VMI-monitor is updated on a daily basis.
- The supplier ensures the configuration of early warning settings according to the mutual agreement with RB.
- The supplier continuously monitors the established EWS and has the responsibility to respond proactively to any occurring early warnings.

Based on the shared information from RB, the supplier prepares and initiates shipments to replenish the RB consignment stock according to the mutual VMI agreement as well as considering the agreed minimum and maximum inventory levels. This is expected to be done in a proactive and anticipatory manner and taking transport times and delivery windows into account. If it becomes apparent to the supplier that there will be deviations from the agreed minimum and/or maximum inventory levels, the supplier has to inform RB thereof within two working days. The supplier has to

present proposals for rectifying the deviations. If a shortfall below 50% of the minimum inventory level is to be anticipated, the supplier has to inform RB without undue delay.

The preparation of shipments includes sharing information about planned deliveries (or planned receipts from RB's perspective). This information is also you used for creating transport orders concerning TMC (only in case RB is responsible for transportation ↔ Incoterms dependent). When a shipment is dispatched, the supplier sends in-transit information by means of an Advanced Shipment Notification (ASN). From RB's perspective, the planned deliveries and the in-transit information comprise the inbound information flow.

### 5.3.1 Planned deliveries

The planned deliveries comprise all deliveries the supplier is planning to dispatch over a minimum period of six months.

The supplier has to update information on planned deliveries on a frequent basis. The standard frequency is determined on at least once a week, even if there are no apparent changes in the planning[2]. However, the more frequent the updates the more up to date the information in the VMI-monitor is.

DELFORP is the EDI message that is to be used for the supplier's planned deliveries within the RB VMI process. This EDI message is also you used for creating transport orders concerning TMC (only in case RB is responsible for transportation ↔ Incoterms dependent).

Please note that planned deliveries can only be applied in case in-transit data is shared. Hence, DELFORP can and may only be implemented after DESADV (ASN) has been implemented.

### 5.3.2 In-transit data

The in-transit information contains shipment information and is sent by means of an ASN. Whenever a shipment is initiated and dispatched by the supplier, an ASN needs to be transmitted at all times.

Concerning the ASN, the following information is mandatory and the minimum RB requirement: 9-digit supplier number; order number; material number; RB plant number; RB plant unloading point; expected time of arrival (only in case the agreed Incoterms are DAP or DDP).

[2] If the replenishment times (incl. additional deliveries and transportation) allow this. If not, the frequency needs to be increased.

DESADV is the EDI message that is to be used for the supplier's in-transit information.

By means of the ASN message, the projected stock levels within the VMI-monitor are automatically updated.

Please note that the implementation of planned deliveries DESADV (ASN) is mandatory in order to be able to share information concerning planned deliveries (DELFORP).

### 5.3.3 Framework

A supplier has to assign one central point of contact for VMI and related topics.

According to the RB VMI standard, VMI can only be applied successfully when the VMI-monitor is integrated in the process.

Therefore, the supplier has to be connected to the VMI-monitor. This is defined within the RB VMI agreement.

The supplier will use its own ERP or planning system for planning and transmission of particular data. However, to ensure a collaborative supply chain and a functional EWS, the supplier needs to ensure the complete availability and visibility of information within the VMI-monitor according to the RB VMI standard.

The second supplier requirement is an EDI connection, either classic EDI or WebEDI. This requirement is also defined within the RB VMI agreement.

Within the VMI-monitor, the supplier ensures the same early warning settings as agreed on with the particular RB plant. These early warning notifications are leading concerning the **RB standard EWS for VMI components.** Hence, within the RB VMI process the supplier's own EWS is not binding. Therefore, it cannot be used as reference or tool towards RB (supplier internal use only). But if the supplier operates its own VMI application it may continue to use it. In this case, the supplier has to ensure that the data, content and functions of its VMI application correspond with the SupplyOn VMI-monitor. According to the VMI agreement, solely the data shown in the VMI-monitor are binding and authoritative.

## 6 EDI requirements

The RB VMI process includes the following EDI messages:

- IMO-EDIFACT: classic EDI message type, send by SupplyOn VMI-monitor to supplier, routed via RB EDI manager. The message contains consignment stock, gross demand, and minimum and maximum inventory level information.
- INVRPTV: send by particular RB plant to SupplyOn VMI-monitor, and contains RB consignment stock and GR information.
- DELFORV: send by particular RB plant to SupplyOn VMI-monitor, and contains RB gross demand information.
- DESADV: send by particular supplier, shipment information for in-transit goods (ASN).
- DESADVV: adjusted format of DESADV forwarded by RB EDI manager to SupplyOn VMI-monitor, containing shipment information for VMI related in-transit goods (ASN).
- DELFORP: send by particular supplier, the supplier's planned deliveries over a period of twelve months.

As aforementioned messages already imply, the RB VMI process requires that all information is shared in a **two-way exchange** of information by means of **EDI**. The suppliers can be integrated into the electronic processes of VMI by using either classic EDI or WebEDI (see figure 3). The following sections and figures give an overview of the different VMI EDI options at RB. The overviews also include the particular EDI messages that are involved in the RB VMI process.

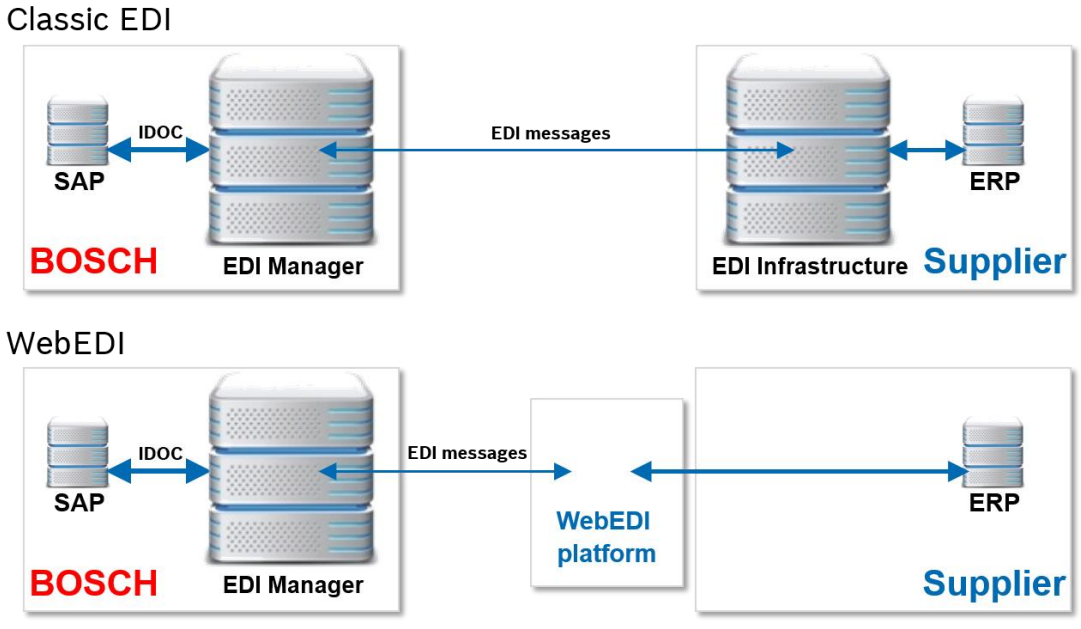


Figure 3: classic EDI versus webEDI.

### 6.1 Classic EDI

The classic EDI connection has been designed for machine to machine communication. This means that no human interference is required in order for the EDI messages to be readable for the receiver. This configuration is characterized by an available EDI infrastructure, e.g. server, etc.

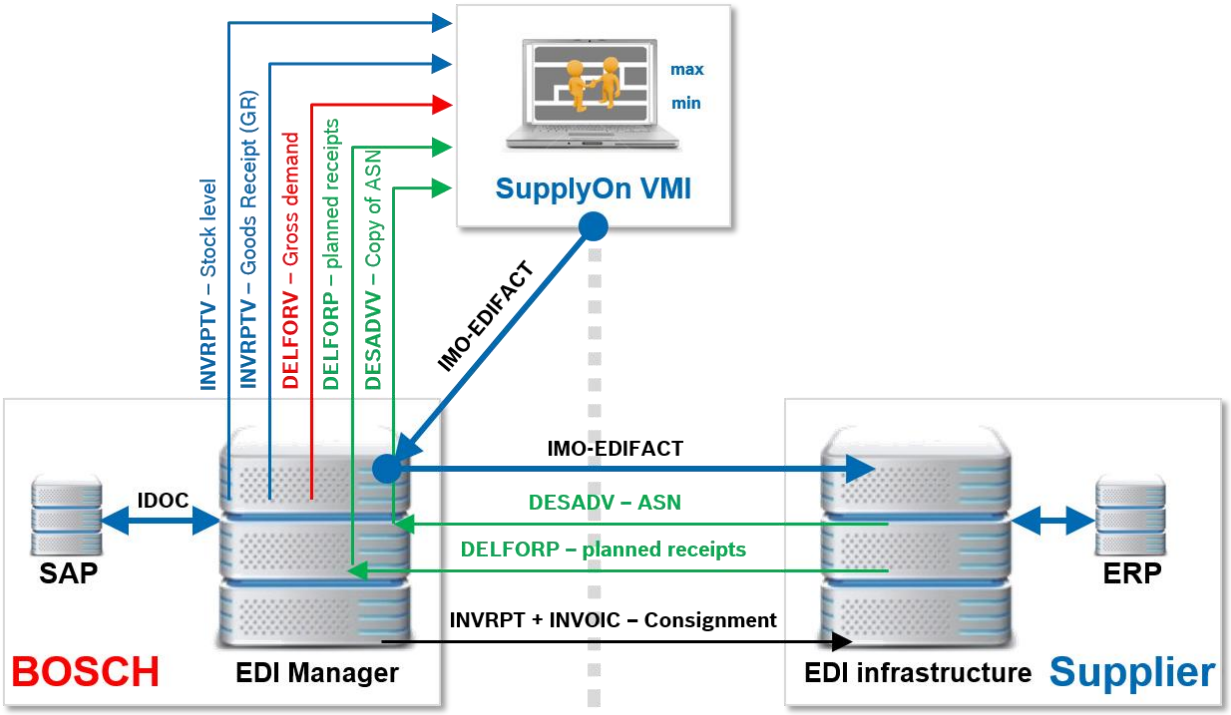


Figure 4: VMI message flow by means of classic EDI with IMO-EDIFACT.

The RB VMI classic EDI connection includes the IMO-EDIFACT outbound message type. Within the RB VMI process this is the only supported alternative of VMI outbound information flow.

The plant's EDI manager system uses VMI EDI messages to transmit all the data from the particular RB plant's SAP system to the VMI-monitor. This is done on a daily basis. The time of transmission depends on the settings of the plant's UC4 job, but is usually scheduled at night.

In contrary to a traditional classic EDI connection, the shared information is not shared and sent to the particular supplier by means of separate EDI messages. The IMO-EDIFACT outbound message type implies that all information available in the VMI-monitor (inventory, demand, current min/max levels) is consolidated into one message: the IMO-EDIFACT message.

This message is transmitted to the supplier according to the frequency that is configured in the VMI-monitor. Thus, whereas the frequency of information transmission is usually dependent on the plant's EDI manager configuration, it can easily and independently be configured within the VMI-monitor in case of IMO-EDIFACT. The minimum frequency is weekly and the maximum is daily.

The inbound message flow, DESADV and DELFORP, is received by the plant's EDI manager. At the same time as when the RB plant's SAP information is transmitted to the, the EDI manager also transmits the particular DELFORP information to the VMI-monitor. DESADV information is instantly forwarded to the VMI-monitor.

Please note that in case of classic EDI the supplier does not transmit the inbound messages directly into the VMI-monitor.

The EDI manager also shares the ASN (by means of the DESADVV format) information with SAP by means of an IDoc. This is done upon receipt of the message.

### 6.2 WebEDI

The second possible EDI connection is internet or web based: WebEDI. This connection is subject to human interference and requires manual input. In this case, the EDI infrastructure is not mandatory. This type of EDI connection is very suitable for smaller companies for which a complete EDI infrastructure is not economically feasible. The SupplyOn internet platform provides WebEDI services to RB suppliers. From a RB VMI perspective, WebEDI is the less preferred type of connection, because it requires manual input and is therefore potentially subject to human errors.

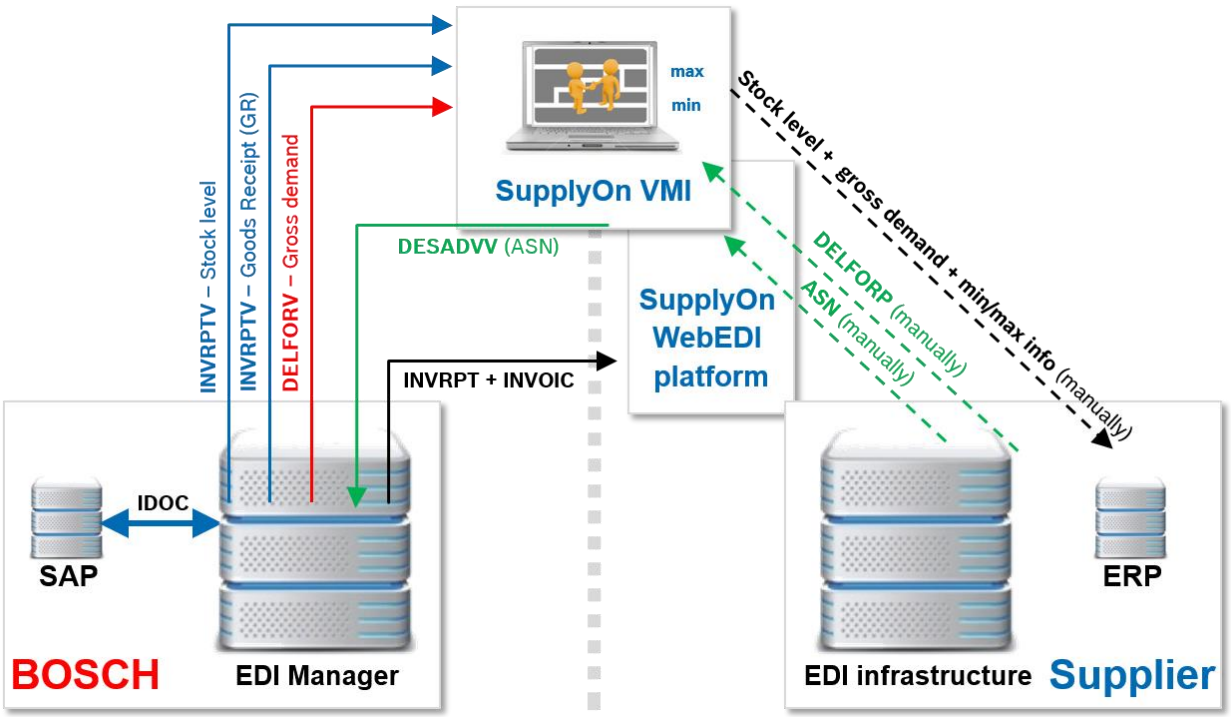


Figure 5: VMI message flow by means of WebEDI.

The plant's EDI manager system uses VMI EDI messages to transmit all the data from the particular RB plant's SAP system to the VMI-monitor. This is done on a daily basis. The time of transmission depends on the settings of the plant's UC4 job, but is usually scheduled at night.

Due to the WebEDI connection this information cannot automatically be shared with and directly transmitted to the supplier's ERP or planning system. In order to be able to process the data, the supplier needs to manually withdraw the particular information from the VMI-monitor. This can be done by means of a download (.csv or .xls file).

In case of WebEDI, the supplier is not able to directly send its inbound message flow, DESADV and DELFORP, to the RB plant's EDI manager. The supplier needs to key in or upload the data manually into the VMI-monitor. The latter is usually done by means of a download (.csv or .xls file).

At the same time as when the RB SAP information is transmitted to the VMI-monitor, the EDI manager also withdraws the inbound message information from the VMI-monitor and shares this with RB plant's SAP system by means of an IDoc.

The DESADV related information is instantly forwarded to RB SAP right after the data has been entered in into the VMI-monitor. This is done via the EDI manager by means of an IDoc.

**Document History**

| Issue | Date | Editor | Description of amendment |
|---|---|---|---|
| 1.0 | 30.03.2016 | AE/LOG-E<br>CP/LOG-S<br>Benschop | First release – preliminary version – of RB BBM VMI Manual |
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**List of Appendices**

## APPENDIX A: ODETTE BASIC ALERT DEFINITION

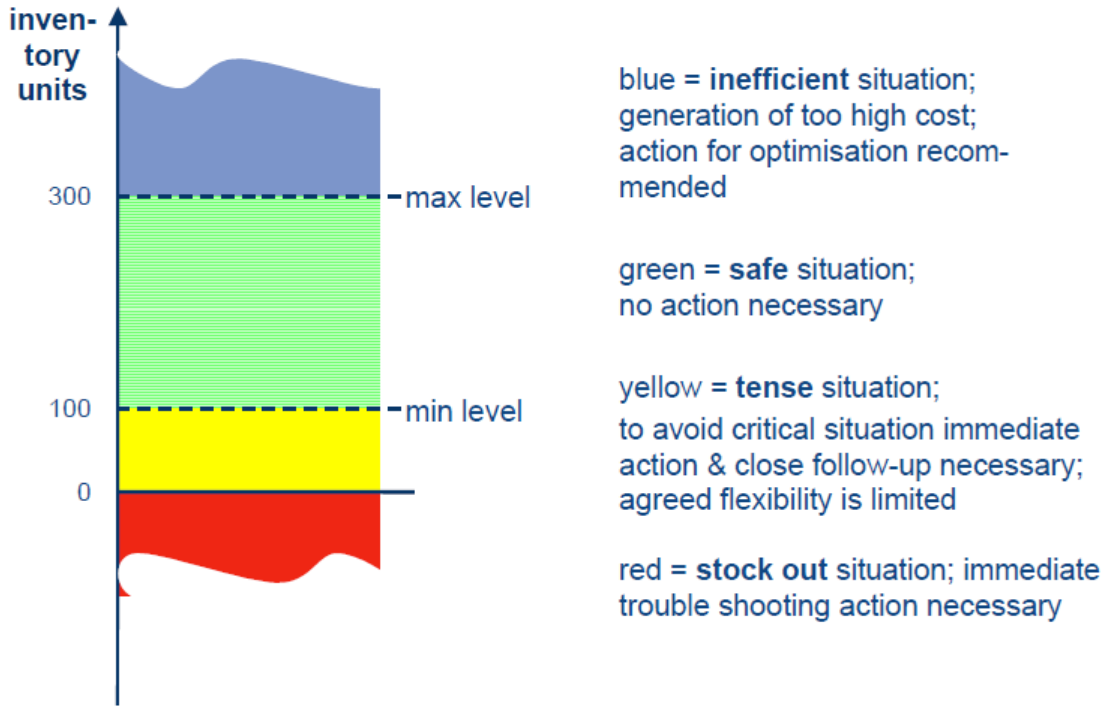


Figure A1: ODETTE basic alert definition (ODETTE, 2004: 26).

## APPENDIX B: RB VMI OTD CALCULATION

RB VMI penalty definition

- 7 = Stock out (below zero)
- 3 = Below min
- 0 = Between min and max
- 1 = Above max

Example of calculation:

$$OTD = \frac{\sum(200x1x100) + (15x1x1) + (10x3x1) + (10x7x1)}{(200 + 15 + (10x3) + (10x7))}$$

$$OTD = 63{,}8\%$$

| | Delivery Performance | Weight | Amount of Alerts / Time Span (Example) |
|---|---|---|---|
| **Weighted Assessment:** | | | |
| Inventory between agreed limits | 100 % | 1 | 200 |
| Inventory above agreed limits | 1 % | 1 | 15 |
| Inventory below agreed limits | 1 % | 3 | 10 |
| 0 Inventory (stock out) | 1 % | 7 | 10 |

Figure B1: Logic of RB VMI OTD calculation - weighted (Robert Bosch GmbH).