

Version 5.9

Functionality of Adapter for SAP

Manual

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1 FORCAM Adapter Overview

1.1 General

The FORCAM Adapter is an SAP certified add-on, developed in SAP standard programming environment **ABAP**, to integrate an ERP system (SAP) and the Shop Floor based system (FORCAM FORCE™).

The FORCAM Adapter facilitates the integration of FORCAM FORCE™ data into an environment running SAP applications with SAP's Net Weaver 7.01 and vice versa. IDocs are used as communication media for data exchange between the connected systems. FORCAM specific BASIC types have been implemented.

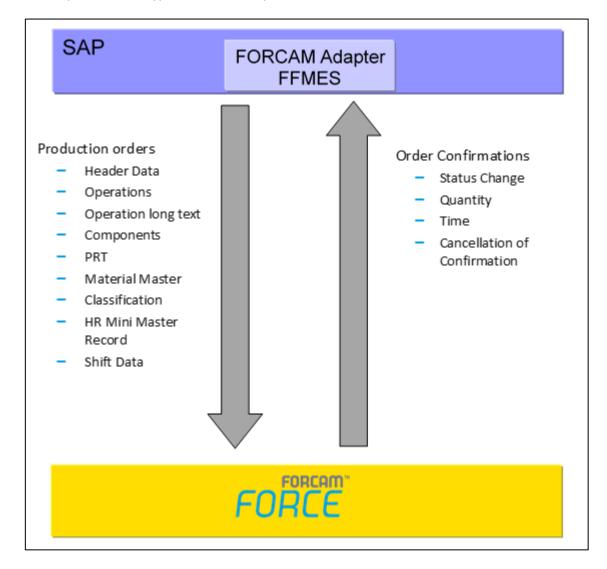


Fig. 1: The key functionality is the exchange of Production Order information



1.2 Communication Concept

FORCAM FORCE™ provides a download service for communication and data transfer to the connected ERP system. This ERP system provides an appropriate upload service for information transfer back to the ERP system in form of a confirmation process. The Rule Engine can add calculated key values to the events (e.g. actual processing time of production order). Fig. 2 shows this scenario.

Actual download and upload implementations are optimized for use with the ERP system SAP. Adaptation to other ERP systems is possible through a specification process.

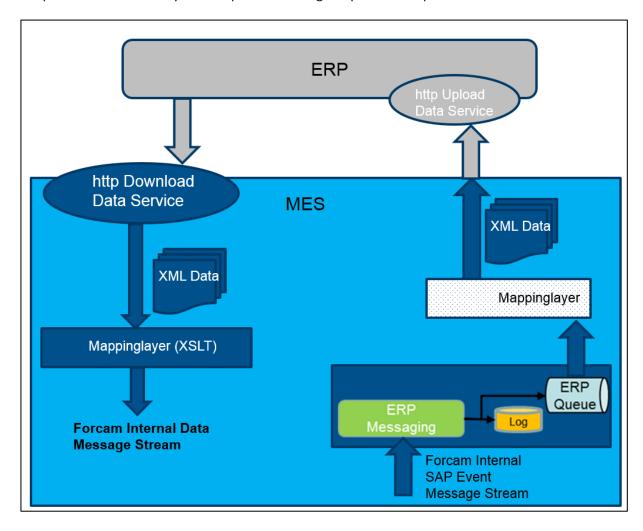


Fig. 2: Upload and Download structure between ERP and FORCAM FORCE™



2 Core Functionality

2.1 Data Download from Sap to FORCAM FORCE™

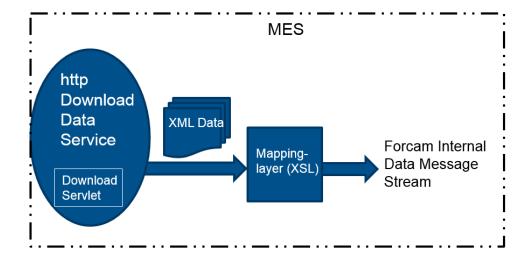


Fig. 3: Overview of data download from ERP to FORCAM FORCE™

All data defined and required for download is mapped in the ERP system into a defined structure. Data download to FORCAM FORCE™ is triggered by events in the ERP system and performed by the FORCAM download service.

Communication connection between the ERP system (SAP) and FORCAM FORCE™ is established by using a RFC connection.

XML http port is created in SAP (content type = text/xml).

RFC connection in SAP uses the following parameters:

- http connection to external server
- target machine (FORCAM FORCE™ server)
- path prefix
- service number = communication port (e.g. 10080)

Created IDocs are sent on operation system level in form of an xml file over xml port. FORCAM FORCE™ service waits for a transfer and passes the IDocs to further processing.



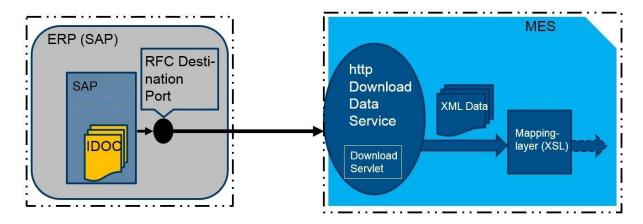


Fig. 4: Download connection between SAP and FORCAM FORCE™ using RFC

Production orders make the biggest part of the exchanged data between the connected systems. IDocs are created by a specific function module in an implementation of SAP standard BADI **WORKORDER_UPDATE**.

The FORCAM FORCE™ function Order Management (order pool) allows a general view over all (released) orders and operations for all work places. Here also the occupational status, job status and production progress is visible.

In the SAP IDoc inbox, IDocs can be monitored easily and effectively by using special reports and graphic display.

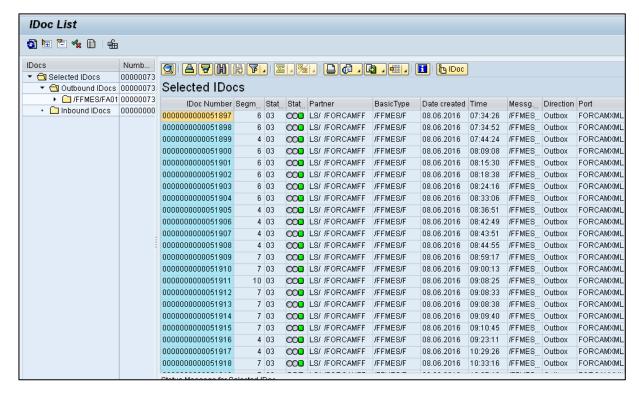


Fig. 5: SAP IDoc list



2.2 Data Upload from FORCAM FORCE™ to SAP

Confirmation events (event sequences) and assigned structured data from FORCAM FORCE™ are reported to the ERP system by using an upload scenario. Events are triggered from the MES system. Appropriate web services for communication and data transfer must be provided and utilized in the FORCAM system.

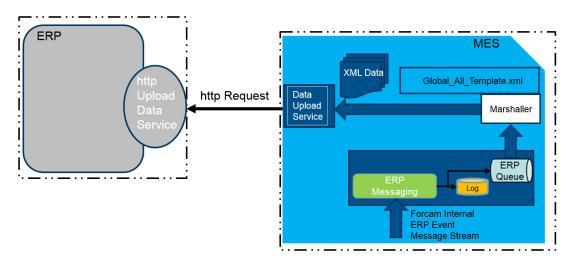


Fig. 6: Common data upload structure to ERP

In the MES itself, a "FORCAM internal ERP message stream" is created by trigger events (like operation start, operation end, setup start, setup end, corrections) and is amended with corresponding event data. Events can be also amended with customer specific calculation data or characteristic values via Rule Engine options. The single events from the "FORCAM internal ERP message stream" are transformed by a XSLT mapping layer into respective XML telegrams with the help of a XSL scheme file. These XML telegrams are sent to the ERP by using an ERP upload service. In this case, the ERP upload service in FORCAM FORCE™ uses the data service provided in the ERP system.

The communication connection between SAP (ERP) and FORCAM FORCE™ (MES) is always executed in the current implementation and specification by using an explicit RFC communication. The data upload process for it is shown in Fig. 7.

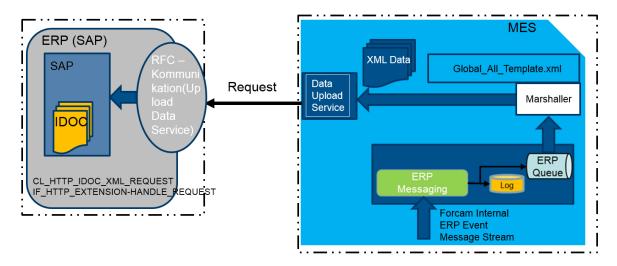




Fig. 7: Upload connection von FORCAM FORCE™TM and SAP

The upload data service in SAP uses the IDoc Communication Framework by utilizing ALIAS definitions of the IDoc_XML service.

The system user for communication logs on to the SAP gateway and delivers an IDoc in INBOX. Each logic message (IDoc basic type) is assigned to a confirmation code via the partner profile (transaction **WE20**).

The confirmation code is maintained in SAP customizing and connected to an inbound function module that processes the incoming IDocs.

The inbound function module **/FFMES/IDoc_INPUT_MESSAGE** processes the incoming IDocs sequentially and calls the function module **/FFMES/BAPI_PROCESS_MESSSAGE**. FORCAM Reports are available for the following topics:

- Quality
- Setup time
- Machine up-time



3 Key Features of the FORCAM Adapter

Easy Installation

Simple installation with SAP standards

Requires no additional SAP licenses

Flexible Integration

Easy and coherent integration of new functions, programs and tables in SAP standard

Configurable

SAP connection is configurable without modification.

Communication

Prompt and easy data transfer with Remote Function Call, HTTP-XML communication and Web Services (IDoc communication framework)

Consistent

Avoids the maintenance of duplicate data in FORCAM and ERP systems due to an integrated correction module.



4 Key Business Process

The actions described below trigger actions in SAP automatically as IDocs are received. The process flow starts with confirmations in FORCAM.

4.1 Confirmation

The confirmation process for finished or semi-finished goods is started in the MES and reported to SAP by sending IDocs. A subroutine in the FORCAM Adapter processes the incoming messages and books all the quantities in SAP.

Processing programs are assigned to all record types in a FORCAM specific customizing table.

Along with the quantities, different activity types are also booked in SAP when IDocs received from the MES are processed. Various control parameters are provided in the FORCAM Adapter which allow the booking of different confirmation scenarios.

Actual times can be confirmed as well as planned times along with quantity bookings. Booking of component quantity is customizable, as to be done along with leading product booking or at some later event.

Alternative standard values of workplaces can be handled by specific customizing tables. Customer specific messages can be created and included into processing without modification.

Types of messages received from FORCAM FORCE™ to ERP:

- Status message
- Quantity message
- Time confirmation
- Correction

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Table 1: Confirmation messages and their descriptions

Confirmation Messages	Type of Message	Description
	STATUS	Message when operation starts in MES. Two IDocs are received from MES with this status:
OPSTR		AUSTA = 48: Setup starts in MES
OI 31K		 AUSTA = 50: Production starts in MES Operation status in SAP changes to PCNF as the production starts in MES
OPINT	STATUS	Message when operation is interrupted in MES. This leads to operation status change in SAP.
OPEND	STATUS	Message when operation ends in MES. This changes operation status to CNF (finally confirmed) in SAP.
QTYMG	QUANTITY	Reports quantity from MES to SAP (confirmed quantity). This can be yield, rework or scrap quantity. This is reflected in the production order as the IDoc is processed. For partial quantity, the operation status changes to PCNF, and if full quantity has been confirmed, it changes to CNF.
DURAT	TIME CONFIRMATIONS	This message contains the time base sent by the MES. SAP takes the sent duration from the message and converts and determines time unit from the order. Duration is sent for all the activities like SETUP/MACHINE/PERSONNEL. IDoc contains LSTAR field which identifies the activity to be booked.
REVMG	CORRECTION	This message contains correction information (QUANTITY or ACTIVITY TIME)

4.2 Cancellation of Confirmation

The FORCAM Adapter provides an integrated correction functionality. All previously booked confirmations in the MES can be cancelled or corrected automatically.

A correction IDoc with record type **REVMG** is created and sent to the SAP Inbox.

The old confirmation will be reversed and a new confirmation is processed.

The correction module handles the processing of incoming correction IDocs with message type **REVMG**. Additional information is included in the correction IDoc to find the booking to be corrected.



4.3 Correction/Cancellation Through Adapter

The cancellation of confirmation through IDocs sent by FORCAM FORCE™ is executed by means of IDocs and there are different processing modules. This is a two-step process in the adapter. Two IDocs are received from the MES with a correction record type. Both quantity and duration can be corrected or cancelled.

- One IDoc deletes the old booking which is required to be corrected. This step is equivalent of reversal/cancellation of the old confirmation. A field KORTY with value D indicates the deletion of the old booking.
- Second IDoc with insertion indicator. Field KORTY with value I indicates the insertion of a new booking. The processing of this IDoc executes a new booking in place of the cancelled one.

The operation and order header status is also updated by the adapter processing while executing the correction process.

4.4 Goods Issue

Goods Issue is a movement of goods where the materials issued or drawn to customers are posted. Goods Issue is the physical issue of goods or materials from the warehouse. Goods Issue posting results in a decrease in stock in the warehouse.

This is movement type **261** which is customizable as per the customer's requirement. Possible customizations include the following:

- To be performed with the quantity confirmation received from the MES. Actual quantity of the component is sent from the MES by means of IDoc. Batch number can also be picked from the MES or may be from the production order itself.
- To be performed automatically at SAP when confirmed quantity is received through IDocs from the MES. This is called "Backflush". Configuration is required at the SAP system for automatic Goods Issue (Backflush indicator to be checked).
- To be performed with a separate customized message from the MES (customer specific customization).
- Material documents are generated at SAP with each posting done.
- With cancellation of the confirmation (time ticket), if posting has been done too, this is also reversed and so the material and accounting documents are as well.
- Withdrawn quantity is reflected in production order display with each confirmation performed.

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4.5 Goods Receipt

Goods Receipt is a goods movement that is used to post goods received from external vendors or from in-plant production. Goods Receipts will result in an increase of stock in the warehouse. This is movement type **101** which is customizable as per the customer's requirement. Possible customizations include the following:

- To be performed with the quantity confirmation or/and Goods Issue when received from the MES.
- To be performed automatically at SAP when confirmed quantity is received through IDocs from the MES. This is called Automatic Goods Receipt. Configuration is required at the SAP system for Automatic Goods Receipt (control key or production scheduler profile).
- To be performed with a separate customized message from the MES (customer specific customization).
- Material documents are generated at SAP with each posting done.
- With cancellation of the confirmation (time ticket), if posting has been done too, this is also reversed and so the material and accounting documents are as well.

The amount of quantity received is reflected in production order display.

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5 Scope of the Adapter

- Production order data is transferred to the sub-system in the form of IDoc segments of an own basic type (/FFMES/F). This IDoc contains different optional segments.
- The Shift data for a workplace with n breaks is transferred with the program /FFMES/TRANSFER_SHIFT_DATA to the connected MES. The available capacity of the workplaces is selected by this report and the IDoc is created. It is also possible to transfer shift capacities that are not as per the factory calendar.
- The data from the MES is processed in the form of incoming IDocs in the SAP system. The SAP standard IDoc-XML service of the IDoc communication framework is used for the communication. SAP internal standard data base tables are updated as confirmations are received from the MES.
- Different messages can be received from the MES during the execution of the production order. All successfully booked messages by the function module
 BAPI_PRODORD_CREATE_TT will be logged in the control table /FFMES/RUECKTAB. The processing of the confirmations can also be done with a customer specific function. For that, the enhancement method CUST_SPEC_CONF can be implemented.
- Serialization of the incoming IDocs is a standard feature of the FORCAM Adapter. FORCAM has developed a specific serialization by production order number and operation. FORCAM FORCE™ is sending each IDoc with a serialization information in IDoc control record. This serialization is required for providing a correct system status in production order operations. The IDoc serialization is only activated during IDoc Input. All entries on the recipient side are processed exactly in the order that was defined on the sender side.
- The FORCAM Adapter has an integrated correction module that enables a direct trigger of corrective entries from the MES, which are then sent to the SAP system. The corrections are a special form of messages from MES to SAP. Corrections can be triggered automatically from the MES for all messages to SAP with the record type REVMG. These records contain the addition record type (KORSA) and the internal GUID (KORID) of the message to be corrected. Corrections are lodged in the table /FFMES/KORR_CUST. A customized processing for the corrections is adjusted through table /FFMES/KORR_CUST. Method CUST_SPEC_CANC_CONF must be implemented if the flag CUST_CONF in the table /FFMES/GLOBAL is set. The correction IDocs are received in the SAP standard inbox with the basic type /FFMES/R.
- Customer specific enhancements can be implemented if the standard FORCAM scope of operation is not sufficient. Several enhancement spots can be used to transfer and receive data. No modification of the SAP standard is required.

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6 Adapter Tools

Various tools and reports are also provided in the adapter for support and analysis of MES/ERP communication. To start these special programs, separate authorization is needed: **/FFMES/T** with the activity **BTCSUBMIT**

/FFMES/CHECK LOG

This tool is to check log entries during error analysis. It allows to find out which user created what objects on what date, what method was used to create those objects etc. In specific error situations, the FORCAM Adapter programs write Method LOG entries.

- /FFMES/DELETE TAB

This tool is provided to reduce the size of main FORCAM protocol tables. The tables /FFMES/RUECKTAB and /FFMES/OBJ can grow strongly over time and accessing these tables can get slower. To enable the deletion of entries that are not needed anymore, the report /FFMES/DELETE_TAB was created. With this, an increase of the processing speed can be achieved.

- /FFMES/IDoc_DELETE

If it becomes necessary to delete specific IDocs, the report **/FFMES/IDoc_DELETE** can be used besides the existing SAP standard tools. There are two alternatives to delete:

- o Delete completely:
 - The IDocs are removed completely from all data bases.
- Delete logically
 Changes the status of IDocs to 68, i.e. no further processing required.

- /FFMES/IDoc_MON

This tool is provided to monitor IDocs at a single console. IDocs can be displayed, processed and reprocessed directly from here. The tool can be used for convenient IDoc monitoring of IDocs in IDoc inbox.

/FFMES/IDoc_STATUS_NOTIF

This Report could be used to notify daily IDoc status to specified email accounts. The authorized person can get daily status updates about the IDocs processed or failed. This helps to rectify and analyze the factors affecting the daily business process.

/FFMES/RBDAGAIN HTTP

This program can be helpful to redirect the IDoc (resend outbound IDoc). If the IDoc gets stuck in status **02**, program will analyze the changes meanwhile made in production order and then resend the IDoc to the MES again.

Main advantage is here that all order changes are considered and only one IDoc with correct data is sent out.

/FFMES/AUFNR_IN_IDocs

This report will create a list of production order numbers contained in selected IDoc worklists.

- /FFMES/TRANSFER_ORDER_SPEC

This report is used for selective transmission of production order data. If it is necessary to transfer specific orders again, even without any order change done, the report /FFMES/TRANSFER_ORDER_SPEC can be used. This report creates standard FORCAM order IDocs with the base type /FFMES/F (respectively with an existing customer add-on to this base type).



i Note:

- All developments are available for SAP release 4.6C and above.
- The data exchange is based on IDocs (incoming and outgoing).
- The IDoc monitoring and processing is done by SAP standard features.
- All development comes in a certified package with own registered name space.
- Customer specific enhancements can be implemented.
- SAP standard tables will not be modified.
- Updates of the FORCAM Adapter can be provided.
- No data is transferred if the connection interrupts.
- The MES system has functionality which keeps IDocs in a sent queue to send them later.