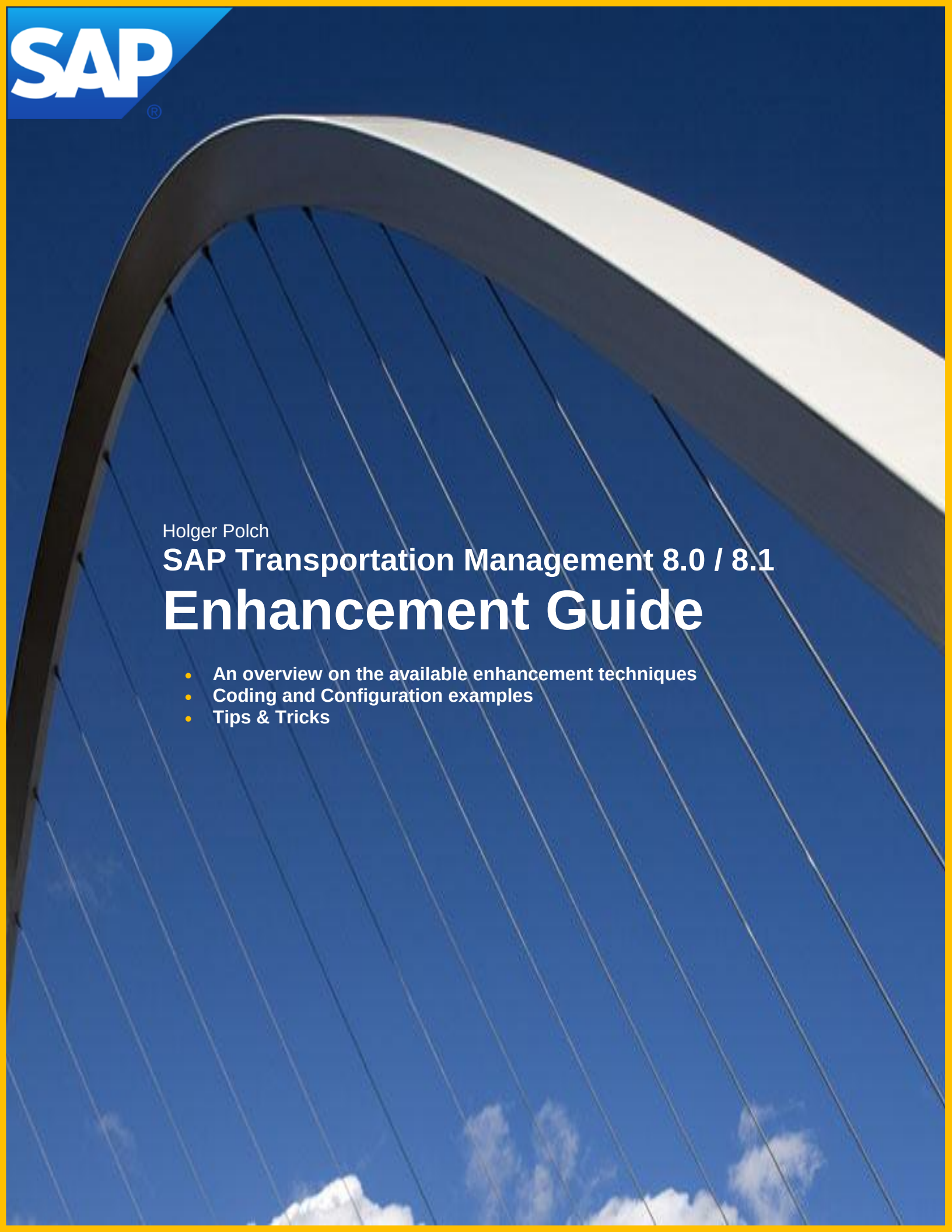

Holger Polch

SAP Transportation Management 8.0 / 8.1

Enhancement Guide

- **An overview on the available enhancement techniques**
- **Coding and Configuration examples**
- **Tips & Tricks**

Table of Content

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1 Introduction

The target of this document is to describe the possibilities and used technologies to enhance SAP Transportation Management 8.0™ / 8.1™. This document does not intend to provide a complete and detailed description of all possible enhancements.

Instead, it describes the usage of the available enhancement technologies based on some basic examples. These examples are chosen to be representative for similar enhancements in multiple areas of the application. In some cases, links to more detailed descriptions are provided.

As the title of the document mentions, it is closely related to the SAP TM releases 8.0 and 8.1 based on SAP NetWeaver 7.02. The following release TM 9.0 is based on SAP NetWeaver 7.03. Most of the content & described concepts are independent of the TM release. A specific version for TM 9.0 and later releases will follow to especially reflect the changes e.g. in the FPM/FBI area for configuring the User Interface. In general these concepts are still the same as per TM 9.0 but might look different and provide some more comfortable handling. A follow-on version of this document will therefore contain adjusted screen shots as well as revised descriptions where required.

2 Glossary

The following abbreviations will be used in this document:

English Term	English Abbrev.	German Term (if applicable)	German Abbrev. (if applicable)	Definition
Business Object Processing Framework	BOPF		BOPF	
User Interface	UI		UI	
Business Object	BO		BO	
Business Object Repository	BOR		BOR	
Business Application Development Interface	BAdI		BAdI	
Transportation Management	TM		TM	
Floor Plan Manager	FPM		FPM	
Floor Plan Manager BOPF Integration	FBI		FBI	
Transportation Management	TM		TM	
Transportation Charges Management	TCM		TCM	
Process Controller Framework	PCF		PCF	
User Interface Building Block	UIBB		UIBB	
Generic Interface Building Block	GUIBB		GUIBB	
Post Processing Framework	PPF		PPF	
Enterprise Service Repository	ESR		ESR	
Software Component	SWC		SWC	
Software Component Version	SWCV		SWCV	
Enhancement Software Component Version	EnSWCV		EnSWCV	

3 BOPF - Overview and Architecture

SAP TM 8.0 is based on a set of Frameworks that help to realize different aspects of the application. The Business Objects are modeled and implemented with the **Business Object Processing Framework (BOPF)**. The User Interface is based on ABAP Web Dynpro and is realized with the **Floor Plan Manager (FPM)** which supports modeling, implementing and configuring the User Interfaces. The **Floor Plan Manager BOPF Integration (FBI)** is used to connect the Backend with the User Interface. It provides the connection between the Business Objects in the backend with the corresponding User Interface realized with the FPM.

To utilize the enhancement capabilities of SAP TM 8.0, some general knowledge on these Frameworks is required. Besides these Frameworks, general knowledge on the following implementation and configuration technologies are prerequisite for creating enhancements:

- **BAdIs** (Implementation)
- **Process Controller Strategies** (Configuration)
- **Conditions** (Configuration)
- **Implicit Enhancements** (Implementation)
- **BOPF Enhancement Workbench** (Configuration / Implementation, part of the BOPF Framework)

The mentioned frameworks and technologies shall be described in the following sections to provide a very basic insight on how they are involved in the SAP TM 8.0 application and how they are used for creating enhancements. This document can for sure not cover all aspects. Therefore links to more detailed information sources will be provided where appropriate.

3.1 BOPF - Business Object Processing Framework

Business Objects are the basis of the SAP TM 8.0 application. Each Business Object represents a type of a uniquely identifiable business entity, described by a structural model, an internal process model as well as one or more Service Interfaces. The business processes provided with SAP TM 8.0 operate on these Business Objects. Examples for TM Business Objects are the Forwarding Order or the Freight Order.

BOPF controls the application business logic as well as the data retrieval of the buffer and persistency layer. The main design principles are a clear separation of the business logic and the buffering of data as well as a clear structuring of the business logic into small parts with a clear separation of changing and checking business logic. The BOPF approach for implementing business objects breaks down business logic into the following four concepts (described in more detail on the next pages):

- Actions
- Determinations
- Validations
- Queries

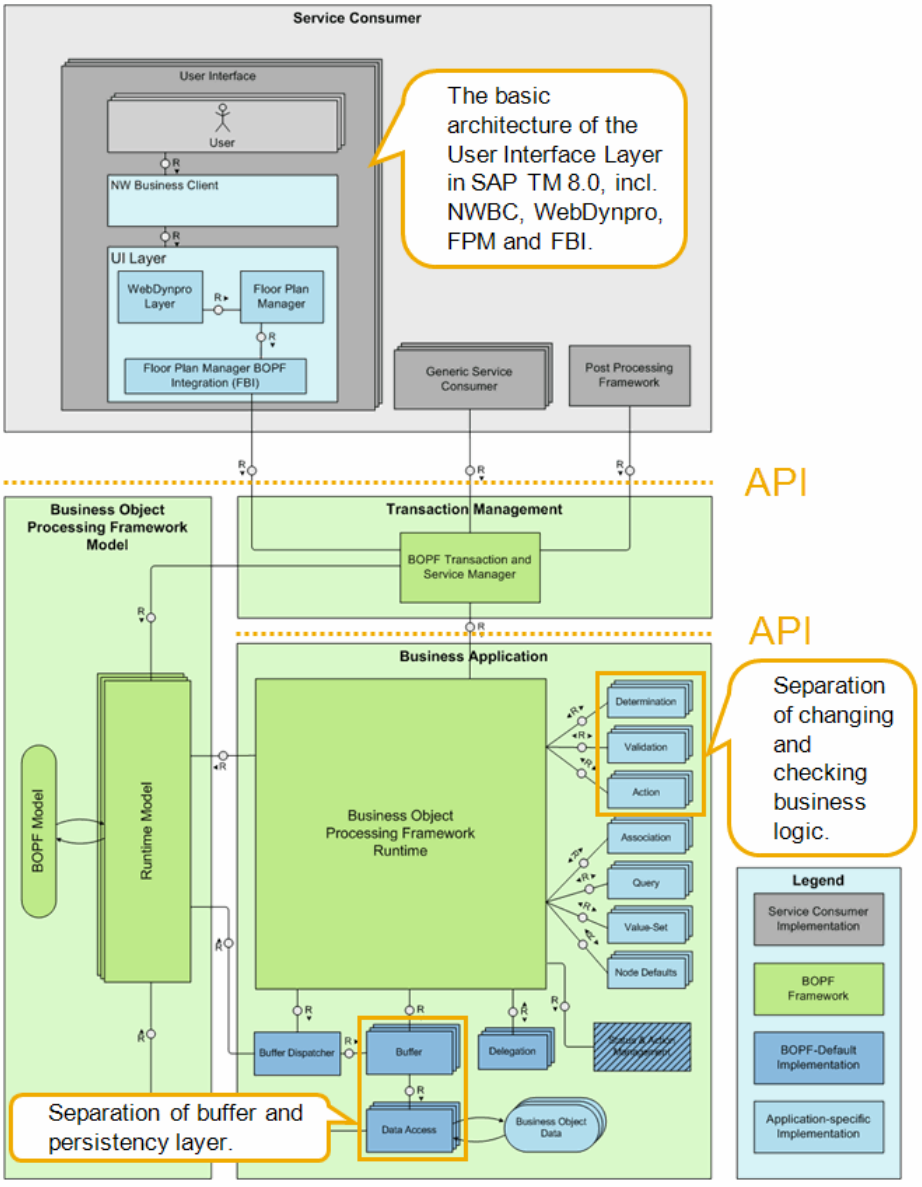
The reason for this breakdown is to avoid the mixing of the four types of functionality into one single entity. This improves the potential for reusing implementations and simplifies maintenance by reducing the complexity and dependencies, and thereby reducing the development effort.

3.1.1 Architecture

The architecture of BOPF comprises two principal areas:

- **Business Application**, which is the heart of the application and provides an interface between the business data, the business logic and the end user
- **BOPF Model**, where the runtime configuration parameters for each of the implemented business objects are located.

The Business Application includes specific entities that support the configuration and runtime operation of each business object, and offers access to the business object's data via Buffer Classes and Data Access Classes. Furthermore, the Business Application includes specific determinations, validations, actions and associations that dictate the specific behavior for each and every implemented business object.



Picture: The basic BOPF Architecture.

The Business Objects are accessed only via a defined API (Service Manager). Changing and checking Business Logic of a BOPF Business Object is clearly separated. There is no mixture of methods that change the business object with methods that have the purpose to check the business objects consistency.

Moreover, business logic and data buffering are clearly separated. The business logic is built on top of the Business Object and the buffer to behave independent of the way how data is buffered and where data is buffered. BOPF allows replacing buffer and data access classes for Business Objects. Both do not contain business Logic.

Data buffer and persistency are also clearly separated from each other as well as from the business logic. This allows establish individual buffer and persistency implementations, i.e. both are exchangeable (e.g. to achieve specific performance requirements).

Besides the basic BOPF architecture, the picture above also depicts the basic architecture of the Transportation Management User Interface.

3.1.2 Business Object Model

A Business Object is a representation of a type of uniquely identifiable business entities described by a structural model and an internal process model. Implemented business processes operate on business objects. Most important for the context of this document: A Business Object and its characteristics as well as its configuration settings can be enhanced. We'll later see how this is done. First, let's take a brief look at the parts a BOPF Business Object consists of. A BOPF Business Object model consists of the following entities:

Nodes:

A Node is a semantically related set of attributes of a business object. Nodes can be used to define and structure your business object. The attributes of a business object node are defined by dictionary data types.

Nodes can be hierarchically defined and related. Each business object has only one Root Node. Nodes are defined via compositions in a tree, but nodes can also be related in an arbitrary structure via associations that can be separate from the tree structure.

Business Object Representation nodes are placeholders for other business objects and the associations to these. They are only for visualization of the association to other business objects.

Associations:

An association is a direct, unidirectional, binary relationship between two business object nodes.

Associations can be used to relate two nodes in a well-defined direction. The association can be used to navigate from one node (source node) to the related node (target node). The associated nodes can be nodes within one business object or in different business objects (cross business object association).

Associations can have parameters to filter the result of the related nodes. They can only be defined between two nodes and in one defined direction. Moreover, they have a defined cardinality which gives information about the existence of an association and the number of associated nodes.

Actions:

An action is an element of a business object node that describes an operation performed on that node.

An action can be used to allow the external triggering of business logic (in contrast to a determination). When the action is performed, you must specify the key for the instances on which it is to be performed (if it is not a static action) and any input parameters that the action requires.

An action can only be performed with the number of instances that is configured in the cardinality of the action. It is performed for all instances if an error in the action validation has not occurred. If errors occur, then the behavior depends on the action settings.

Determinations:

An element of a business object node that describes internal changing business logic on the business object. It can be used to trigger business logic based on internal changes (in contrast to an action). There are two types of determinations: Transient and Persistent. This categorization indicates whether a determination will alter persistent or only transient data. A determination is mostly used to compute data that can be derived from the values of other attributes. Examples:

- Products (for example, item amount = quantity × list price) and ratios
- Totals of items (for example, invoice amount = Σ item amounts)
- Statuses

The determined attribute and the determining attributes can belong to the same node (example 1) or to different nodes (example 2). There are also values that do not depend on any other value but still have to be determined automatically upon creation or modification of a node instance, for example, IDs, UUIDs, and GUIDs.

For each determination, it is necessary to specify which changes (such as create, update, delete or load) on which nodes will trigger the determination at a specific time. A determination is called at different points in time (determination time), depending on the model. The following determination times exist:

Execution Time	Use Case
After Loading	Dependent fields that are not saved (redundant) have to be recalculated.
Before Retrieve	Before Retrieve Determining contents of transient nodes before their first retrieval. After the first retrieval of a node instance determinations for this determination-time are not executed, as changes to data during retrieval are not allowed.
After Modify	Recalculation of fields that depend on changed fields. This is especially useful for derived fields that are of interest to the “outside world” and need to be updated immediately.
After Validation	This point in time can be used to modify data based on the outcome of consistency validations in the Determination & Validation cycle. A typical use case is to perform some follow-up actions depending on whether there were error messages in the consistency validations.
Before Save (Finalize)	Determine data that must not be determined prior to saving or for data that is not visible to the “outside world” (so it’s determination can be postponed until saving for performance reasons).
Before Save (Draw Numbers)	Determine data that must not be determined unless the transaction succeeds but may be used by other Business Objects. A typical use case for such very late changes is drawing numbers to assure gapless numbering.
During Save	Determine data that must not be determined unless the transaction succeeds. Determinations for this determination-time will be executed at most once in a LUW.
After Commit	Determine data after a transaction was successfully committed. A typical use case for this determination-time is starting asynchronous processes.

After Failed Save Attempt	Do cleanups after a try to save a transaction was rejected during the Finalize or Check before Save stages. A determination is only triggered if request nodes are assigned to it and instances of these request nodes are changed.

Validations:

A validation is an element of a business object node that describes some internal checking business logic on the business object.

A validation can be used to check if an action is allowed. Action validations can be assigned to object-specific actions and to the framework actions create, update, delete and save. They can be used to check if an action can be carried out. An action validation is carried out when an action is called before it is performed. If some validations fail, the action is not performed for the instances where the validation failed. Depending on the action settings, the action is also not performed.

A validation can be used to check the consistency of a business object. Consistency validations can be used to check the consistency of a business object. They can be assigned to the framework actions check of each node. Consistency validations are carried out when this action is called or automatically after a change is made if they are triggered via trigger nodes based on the changes. It is only triggered if some of the trigger nodes are assigned and instances of these trigger nodes are changed.

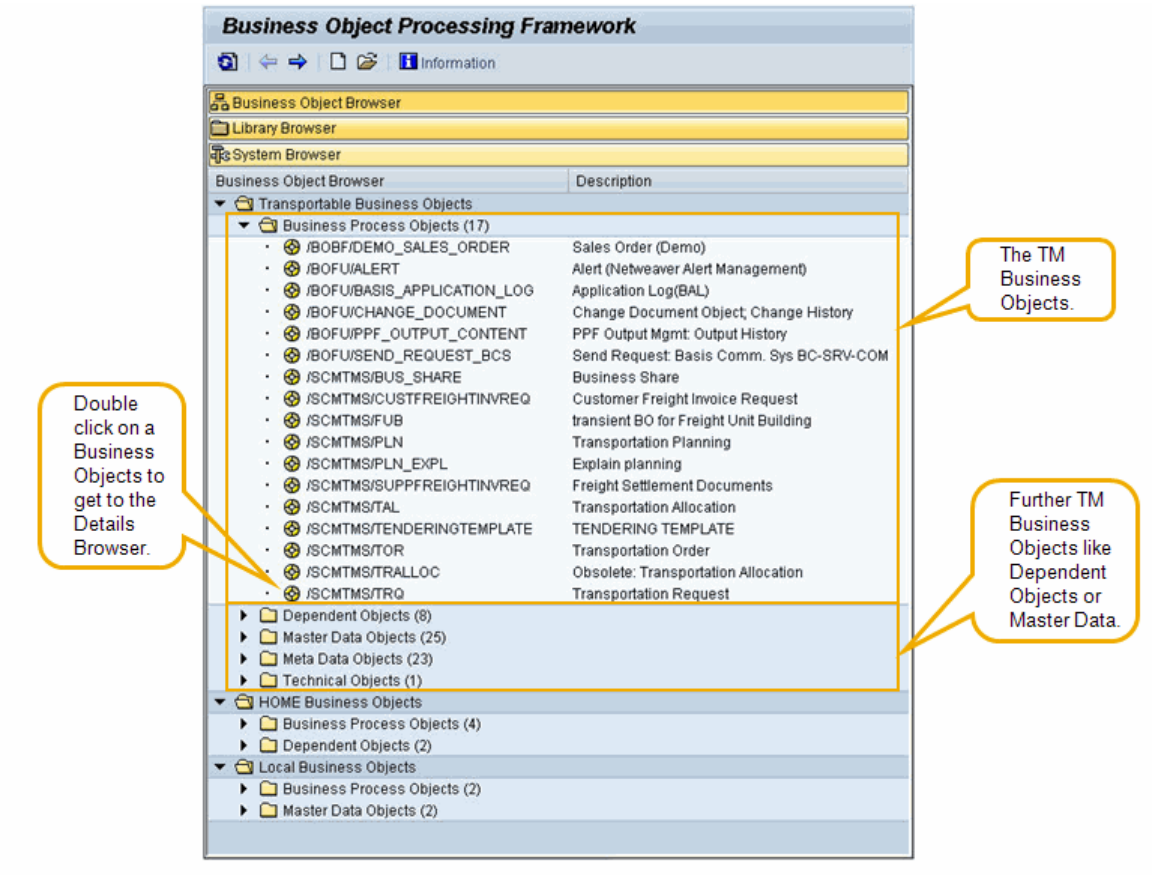
Queries:

Queries represent a defined set of attributes, such as search parameters, that return the queried IDs of the business object node instances.

A query allows you to perform searches on a business object. They provide the initial point of access to business objects. Each query has an associated parameter structure. The result of the query is a set of all the record IDs in a business object that match the query criteria.

3.1.3 BOPF Modeling Tool

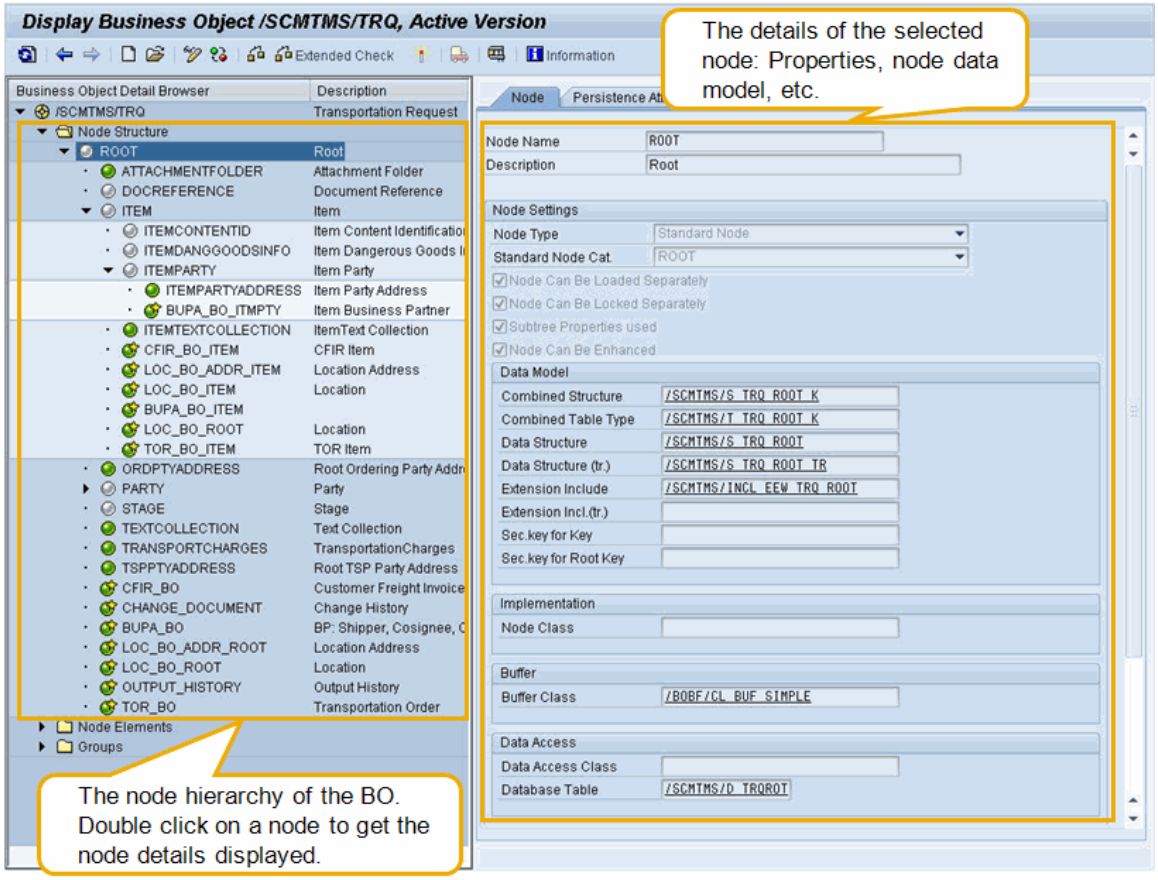
The models of the TM business objects can be displayed with the BOPF Modeling Tool. It can be started via transaction **/BOBF/CONF_UI**. It allows browsing through the list of the business objects of the application. From here, you can navigate to the details of each business object to display its node structure and hierarchy, the configuration, the DDIC structures for each node, the node elements (e.g. Associations, Actions, Determinations, Validations and Queries), etc. Moreover, it allows navigating to the implementing ABAP classes of the business object.



Picture: The Business Object Browser.

On the initial screen (Picture 2) the user can browse through the available TM business objects as well as four other object categories which are used in the context of TM. These are:

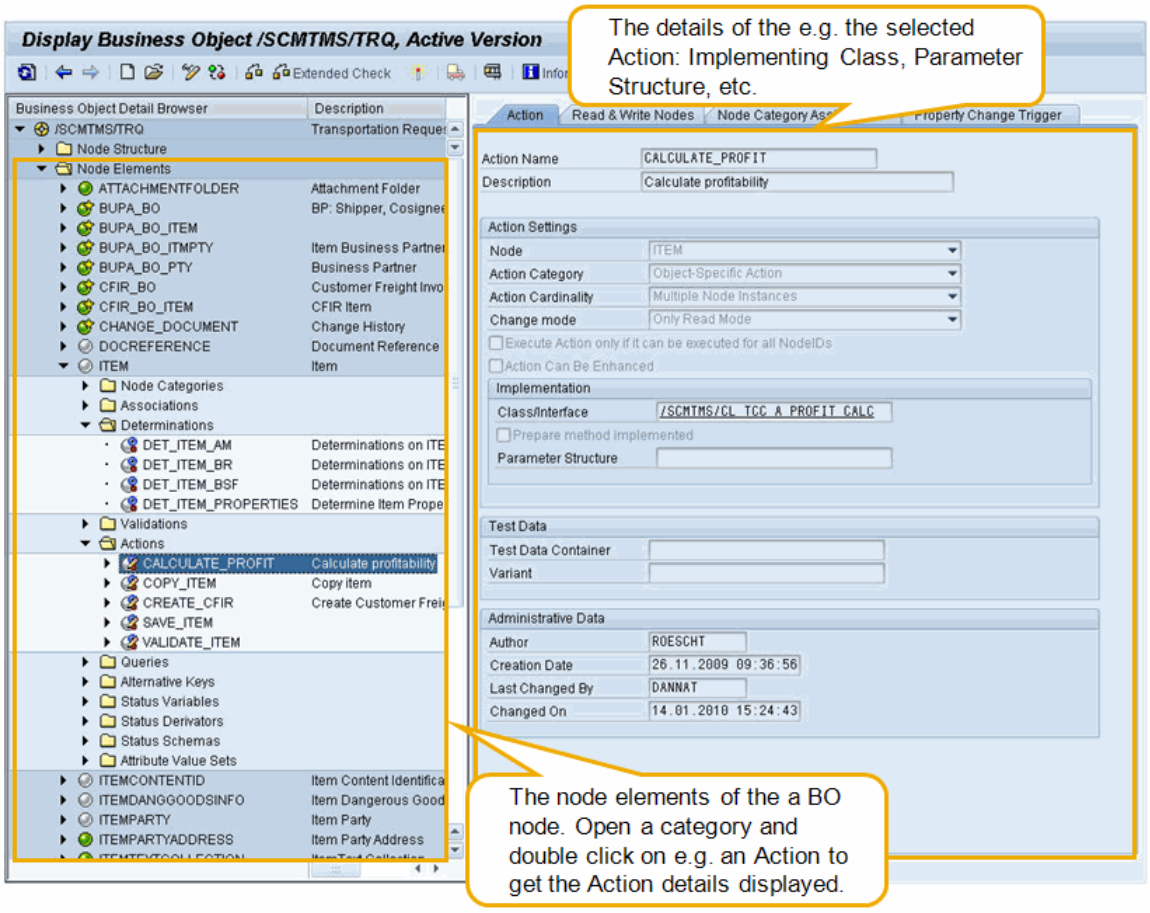
- **Dependent Objects**:
  Used in SAP TM for reusable parts of business objects that are not objects on their own, i.e. they only exist in the context of a business objects (the hosting object). Examples are address, attachment folder, text collection, and transportation charges.
- **Master Data Objects**:
  Most master data BOs call the SCM Basis Master Data Layer (MDL) via an adapter in a read-only way. The content of these master data objects is maintained via the standard transactions in SCM Basis. The master data distribution between SAP ERP and SAP TM follows the standard SCM middleware architecture of the SCM Core Interface (CIF). Within SAP TM, access to master data occurs via master data BOs only. Examples are Location, Business Partner, Material, etc.
- **Meta Data Objects**:
  Examples are Freight Unit Building Rule, Planning Profile, etc.



Picture: The Business Object Detail Browser - Node Structure.

In the Business Object Detail Browser, you can navigate through the node hierarchy of the business object and display the node details. Besides other information, the node details show the data model of the node.

- **Combined Structure**:
  This DDIC structure includes the data structure of a nod. In addition it includes a fixed BOPF DDIC structure which contains the node instance key (KEY), the key of the direct parent node instance (PARENT_KEY) as well as the key of the related business object instance (ROOT_KEY).
- **Data Structure**:
  This DDIC structure contains the attributes of the node, representing the node data.
- **Data Structure (tr.)**:
  Contains the transient attributes of a node, i.e. attributes which do not get persisted but are only filled and used during runtime.
- **Extension Include & Extension Include (tr.)**:
  Important for field extensions on a node is the Extension Include. With this include, all extension fields are added (via Append Structures) which are to be persisted. Extension fields which are only relevant at runtime and not relevant to be persisted are placed in the corresponding transient Extension Include.
- **Database Table**:
  Shows the database table where the persistent node information gets stored.



Picture: The Business Object Detail Browser - Node Elements.

When expanding the Node Elements, you can further navigate to a node and the elements assigned to it (e.g. Associations, Determinations, Validations, Actions and Queries as described in the previous sections). Moreover, the details for each of these elements can be displayed from here. For example the details of an Action include a link to the implementing class of this Action and - if the Action has parameters - the corresponding parameter structure.

The details of the node elements like Actions, Validations, Determinations, etc. are the starting point to identify places in the coding where a specific functionality of interest is implemented. Within the implementing classes of the node elements, of course further classes and their methods are used to realize its functionality.

3.2 BOPF Consumer Implementation Basics

In this section, we give examples on how to implement BOPF consumers, i.e. how to use core services that allow creating, accessing and modifying business object instances. In section 2.3 we take a look at how to implement BOPF entities such as actions, determinations and validations (this can be also done with the BOPF Enhancement Workbench which is described in section 3.4 of this document).

3.2.1 Service Manager

A business object can be accessed via a so called Service Manager. The following coding shows how to get an instance of the service manager for e.g. the business object Forwarding Order:

```
*&---------------------------------------------------------------------*
*& Report  ZREP_SRV_MGR
*&---------------------------------------------------------------------*
*& How to get a service manager instance and use it to access BOPF
*&---------------------------------------------------------------------*
REPORT  zrep_srv_mgr.

DATA: lo_srv_mgr TYPE REF TO /bobf/if_tra_service_manager.

* Get an instance of a service manager for e.g. BO TRQ
lo_srv_mgr = /bobf/cl_tra_serv_mgr_factory=>
             get_service_manager( /scmtms/if_trq_c=>sc_bo_key ).
```

Besides others, the service manager provides the following methods that can be used to access the corresponding business object that it was instantiated for:

Method	Description
QUERY	Search, execute a BO query.
RETRIEVE	Read data for a given set of node instance keys.
RETRIEVE_BY_ASSOCIATION	Read data via association.
DO_ACTION	Execute a given action of a BO node.
CONVERT_ALTERN_KEY	Convert an alternative key to the technical key.
MODIFY	Create, change and delete BO node instances.

The following coding examples and descriptions of the semantics of the corresponding method parameters illustrate the usage of the service manager methods to access BOPF business objects. We will add corresponding examples in a small demo report ZREP_BOPF_DEMO_1 step by step.

3.2.2 Query

The coding example shows how to call a BOPF query. To start a query, method QUERY of the service manager instance is used:

```
*&---------------------------------------------------------------------*
*& Report  ZREP_BOPF_DEMO_1
*&---------------------------------------------------------------------*
*& How to get a service manager instance and use it to access BOPF
*&---------------------------------------------------------------------
REPORT  zrep_bopf_demo_1.

FIELD-SYMBOLS: <ls_root> TYPE /scmtms/s_trq_root_k,
               <ls_item> TYPE /scmtms/s_trq_item_k,
```

```
                <ls_link> TYPE /bobf/s_frw_key_link,
                <ls_loc>  TYPE /scmtms/s_bo_loc_root_k,
                <ls_txc>  TYPE /bobf/s_txc_con_k,
                <ls_msg>  TYPE /bobf/s_frw_message_k.

DATA: lo_srv_trq           TYPE REF TO /bobf/if_tra_service_manager,
      ls_selpar            TYPE /bobf/s_frw_query_selparam,
      lt_selpar            TYPE /bobf/t_frw_query_selparam,
      lo_message           TYPE REF TO /bobf/if_frw_message,
      ls_query_inf         TYPE /bobf/s_frw_query_info,
      lt_key               TYPE /bobf/t_frw_key,
      lt_root              TYPE /scmtms/t_trq_root_k,
      lt_failed_key        TYPE /bobf/t_frw_key,
      lt_item              TYPE /scmtms/t_trq_item_k,
      lt_link              TYPE /bobf/t_frw_key_link,
      lt_item_key          TYPE /bobf/t_frw_key,
      lt_target_key        TYPE /bobf/t_frw_key,
      lt_loc_root          TYPE /scmtms/t_bo_loc_root_k,
      lv_text_assoc_key    TYPE /bobf/conf_key,
      lt_link_txctext      TYPE /bobf/t_frw_key_link,
      lt_txc_text_key      TYPE /bobf/t_frw_key,
      lv_text_node_key     TYPE /bobf/conf_key,
      lv_content_node_key  TYPE /bobf/conf_key,
      lv_content_assoc_key TYPE /bobf/conf_key,
      lt_txc_content       TYPE /bobf/t_txc_con_k,
      lo_change            TYPE REF TO /bobf/if_tra_change,
      lr_action_param      TYPE REF TO /scmtms/s_trq_a_confirm,
      lt_msg               TYPE /bobf/t_frw_message_k,
      lv_str               TYPE string,
      lo_msg               TYPE REF TO /bobf/cm_frw,
      lt_trq_id            TYPE /scmtms/t_trq_id,
      lt_trq_root_key      TYPE /bobf/t_frw_key.

* Get an instance of a service manager for e.g. BO TRQ
lo_srv_trq = /bobf/cl_tra_serv_mgr_factory=>get_service_manager(
                /scmtms/if_trq_c=>sc_bo_key ).

BREAK-POINT.

* set an example query parameter
ls_selpar-attribute_name = /scmtms/if_trq_c=>sc_query_attribute-root-
query_by_attributes-created_by.
ls_selpar-option         = 'EQ'.
ls_selpar-sign           = 'I'.
ls_selpar-low            = 'SCHIEBELER'.
APPEND ls_selpar TO lt_selpar.

BREAK-POINT.

* use method QUERY of the service manager to start the query
lo_srv_trq->query(
  EXPORTING
    iv_query_key            = /scmtms/if_trq_c=>sc_query-root-
                              query_by_attributes
    it_selection_parameters = lt_selpar
  IMPORTING
    eo_message              = lo_message
```

```
    es_query_info           = ls_query_inf
    et_key                  = lt_key ).

BREAK-POINT.
```

3.2.3 Retrieve

The coding example shows how to retrieve the data for the Root node keys that were found by the query in 2.2.2. Method RETRIEVE of the service manager instance is used:

```
...
BREAK-POINT.

* Use method RRETRIEVE to retrieve ROOT data
lo_srv_trq->retrieve(
  EXPORTING
    iv_node_key             = /scmtms/if_trq_c=>sc_node-root
    it_key                  = lt_key
    iv_edit_mode            = /bobf/if_conf_c=>sc_edit_read_only
  IMPORTING
    eo_message              = lo_message
    et_data                 = lt_root
    et_failed_key           = lt_failed_key ).

BREAK-POINT.
```

3.2.4 Retrieve By Association (Standard)

The coding example shows how to retrieve the data for the Item node keys that were found by the query in 2.2.2. Method RETRIEVE_BY_ASSOCIATION of the service manager instance is used with the composition association from Root to Item:

```
...
BREAK-POINT.

* Use method Retrieve by Association to retrieve ITEM node data
lo_srv_trq->retrieve_by_association(
  EXPORTING
    iv_node_key             = /scmtms/if_trq_c=>sc_node-root
    it_key                  = lt_key
    iv_association          = /scmtms/if_trq_c=>sc_association-root-
                              item
    iv_fill_data            = abap_true
    iv_edit_mode            = /bobf/if_conf_c=>sc_edit_read_only
  IMPORTING
    eo_message              = lo_message
    et_data                 = lt_item
    et_key_link             = lt_link
    et_target_key           = lt_item_key
    et_failed_key           = lt_failed_key ).

BREAK-POINT.
```

3.2.5 Retrieve By Association (XBO)

The coding example shows how to retrieve the data for the Locations stored in the items whose Item node keys were retrieved in 2.2.4. Again, method RETRIEVE_BY_ASSOCIATION of the service manager instance is used with the Cross BO association (XBO) from Item to Source Location Root that is defined on the item node of BO TRQ:

```
…
REAK-POINT.

* Following XBO Association ITEM -> Location
lo_srv_trq->retrieve_by_association(
  EXPORTING
    iv_node_key             = /scmtms/if_trq_c=>sc_node-item
    it_key                  = lt_item_key
    iv_association          = /scmtms/if_trq_c=>sc_association-item-
                              srcloc_root
    iv_fill_data            = abap_true
  IMPORTING
    eo_message              = lo_message
    et_data                 = lt_loc_root
    et_key_link             = lt_link ).

BREAK-POINT.
```

3.2.6 Retrieve By Association (Dependent Objects)

The coding example shows how to retrieve the data from the dependent object TextCollection assigned to the Root node of BO TRQ. Besides method RETRIEVE_BY_ASSOCIATION of the service manager instance, this requires calling helper method GET_DO_KEYS_4_RBA of class /SCMTMS/CL_COMMON_HELPER to map the TextCollection Meta Data node keys into TRQ runtime node keys:

```
…
BREAK-POINT.
* Retrieve by Association (To Dependent Object Nodes)
* Do RbA to ROOT TEXT Collection TEXT CONTENT node
* Get Text Collection ROOT keys
lo_srv_trq->retrieve_by_association(
  EXPORTING
    iv_node_key             = /scmtms/if_trq_c=>sc_node-root
    it_key                  = lt_key
    iv_association          = /scmtms/if_trq_c=>sc_association-root-
textcollection
  IMPORTING
    eo_message              = lo_message
    et_key_link             = lt_link
    et_target_key           = lt_target_key ).

* Map TXC Meta model node keys into TRQ runtime node keys
* --> for all sub nodes of DO ROOT we have to use this helper
* method to get the correct runtime node keys of the DO nodes

/scmtms/cl_common_helper=>get_do_keys_4_rba(
  EXPORTING
    iv_host_bo_key      = /scmtms/if_trq_c=>sc_bo_key
```

```
    "Host BO DO Representation node (TRQ, node TEXTCOLLECTION)
    iv_host_do_node_key = /scmtms/if_trq_c=>sc_node-textcollection
    "not needed here because source node of association is the DO ROOT
    "node for which we can use the TRQ constant
*   iv_do_node_key      = DO Node
    "DO Meta Model Association Key
    iv_do_assoc_key     = /bobf/if_txc_c=>sc_association-root-text
  IMPORTING
    "DO Runtime Model Association Key
    ev_assoc_key        = lv_text_assoc_key ).

lo_srv_trq->retrieve_by_association(
  EXPORTING
    iv_node_key             = /scmtms/if_trq_c=>sc_node-textcollection
    it_key                  = lt_target_key
    "DO runtime model association key
    iv_association          = lv_text_assoc_key
  IMPORTING
    eo_message              = lo_message
    et_key_link             = lt_link_txctext
    et_target_key           = lt_txc_text_key ).

* Map TXC Meta model node keys into TRQ runtime node keys
/scmtms/cl_common_helper=>get_do_keys_4_rba(
  EXPORTING
    iv_host_bo_key      = /scmtms/if_trq_c=>sc_bo_key
    iv_host_do_node_key = /scmtms/if_trq_c=>sc_node-textcollection
    "DO Meta Model Source Node Key
    iv_do_node_key      = /bobf/if_txc_c=>sc_node-text
  IMPORTING
    "DO Runtime Model Node Key
    ev_node_key         = lv_text_node_key ).

/scmtms/cl_common_helper=>get_do_keys_4_rba(
  EXPORTING
    iv_host_bo_key      = /scmtms/if_trq_c=>sc_bo_key
    iv_host_do_node_key = /scmtms/if_trq_c=>sc_node-textcollection
    "DO Meta Model Target Node key
    iv_do_node_key      = /bobf/if_txc_c=>sc_node-text_content
    "DO Meta Model Association Key
    iv_do_assoc_key     = /bobf/if_txc_c=>sc_association-text-
                          text_content
  IMPORTING
    "DO Runtime Model Node Key
    ev_node_key         = lv_content_node_key
    "DO Runtime Model Association Key
    ev_assoc_key        = lv_content_assoc_key ).

lo_srv_trq->retrieve_by_association(
  EXPORTING
    "DO runtime model source node key
    iv_node_key             = lv_text_node_key
    it_key                  = lt_txc_text_key
    "DO runtime model association key
    iv_association          = lv_content_assoc_key
    iv_fill_data            = abap_true
  IMPORTING
```

```
    eo_message              = lo_messagect
    et_data                 = lt_txc_content ).
```

3.2.7 Do Action (Standard)

The coding example shows how to start an action for a given set of TRQ instances represented by the corresponding Root node keys. The action CONFIRM of the TRQ Root node is called:

```
…
BREAK-POINT.

* Calling action CONFIRM of the TRQ Root node
lo_srv_trq->do_action(
  EXPORTING
    iv_act_key           = /scmtms/if_trq_c=>sc_action-root-confirm
    it_key               = lt_key
*   is_parameters        = Action Parameters if available & required
  IMPORTING
    eo_change            = lo_change
    eo_message           = lo_message
    et_failed_key        = lt_failed_key ).

BREAK-POINT.
```

3.2.8 Do Action (Action Parameters)

Again, the coding example shows how to start an action for a given set of TRQ instances represented by the corresponding Root node keys. In this example, the action CONFIRM of the TRQ Root node is called with some of the available action parameters:

```
…
BREAK-POINT.

* fill the action parameters
CREATE DATA lr_action_param.
* Carry out check
lr_action_param->no_check  = abap_true.
lr_action_param->automatic = abap_false.

* Calling action CONFIRM of the TRQ Root node with parameters
lo_srv_trq->do_action(
  EXPORTING
    iv_act_key           = /scmtms/if_trq_c=>sc_action-root-confirm
    it_key               = lt_key
    is_parameters        = lr_action_param
  IMPORTING
    eo_change            = lo_change
    eo_message           = lo_message
    et_failed_key        = lt_failed_key ).

BREAK-POINT.
```

3.2.9 Convert Alternative Key

The coding example shows how to convert a list of TRQ IDs into the corresponding Root node keys. Method CONVERT_ALTERN_KEY of the service manager instance is used:

```
…
BREAK-POINT.

* Prepare a set of TRQ IDs
CLEAR lt_trq_id.
LOOP AT lt_root ASSIGNING <ls_root>.
  APPEND <ls_root>-trq_id TO lt_trq_id.
ENDLOOP.

* Convert IDs into BOPF keys
lo_srv_trq->convert_altern_key(
  EXPORTING
    iv_node_key   = /scmtms/if_trq_c=>sc_node-root
    iv_altkey_key = /scmtms/if_trq_c=>sc_alternative_key-root-trq_id
    it_key        = lt_trq_id
  IMPORTING
    et_key        = lt_trq_root_key ).

BREAK-POINT.
```

3.2.10 Modify

While the coding examples of the previous sub sections demonstrated how to access BOPF business objects, we now take a look at how to create, update and delete BO (node) instances. For these purposes, method MODIFY of the service manager is used. To demonstrate different possibilities of the method, we create a second demo report ZREP_BOPF_DEMO_2 and add corresponding examples step by step.

```
*&---------------------------------------------------------------------*
*& Report  ZREP_BOPF_DEMO_2
*& How to get a service manager instance and use it to access BOPF.
*& How to create update and delete BO (node) instances
*& How to use a transaction manager to save changes.
*&---------------------------------------------------------------------*
REPORT  zrep_bopf_demo_2.

FIELD-SYMBOLS: <ls_root>    TYPE /scmtms/s_trq_root_k,
               <ls_trq_qdb> TYPE /scmtms/s_trq_q_result.

DATA:   lo_srv_trq         TYPE REF TO /bobf/if_tra_service_manager,
        lt_mod             TYPE /bobf/t_frw_modification,
        ls_mod             TYPE /bobf/s_frw_modification,
        lv_trq_new_key     TYPE /bobf/conf_key,
        lo_chg             TYPE REF TO /bobf/if_tra_change,
        lo_message         TYPE REF TO /bobf/if_frw_message,
        lo_msg_all         TYPE REF TO /bobf/if_frw_message,
        lo_tra             TYPE REF TO /bobf/if_tra_transaction_mgr,
        lv_rejected        TYPE abap_bool,
        lt_rej_bo_key      TYPE /bobf/t_frw_key2,
        ls_selpar          TYPE /bobf/s_frw_query_selparam,
        lt_selpar          TYPE /bobf/t_frw_query_selparam,
```

```
        lt_trq_qdb         TYPE /scmtms/t_trq_q_result.

* Get instance of service manager for TRQ
lo_srv_trq = /bobf/cl_tra_serv_mgr_factory=>get_service_manager(
             /scmtms/if_trq_c=>sc_bo_key ).
```

Create: As a first step, a new instance of business object TRQ (Forwarding Order) is created. First the modification table is set up to contain an entry for the creation (change mode is set to CREATE) of a new Root node instance. Then the data for the new Root node instance is assembled. Finally, the modification table is passed to method MODIFY of the service manager

```
…
BREAK-POINT.

*--- Creating a new TRQ instance ---*
ls_mod-node = /scmtms/if_trq_c=>sc_node-root.
ls_mod-key  = /bobf/cl_frw_factory=>get_new_key( ).
ls_mod-change_mode = /bobf/if_frw_c=>sc_modify_create.
CREATE DATA ls_mod-data TYPE /scmtms/s_trq_root_k.

ASSIGN ls_mod-data->* TO <ls_root>.
<ls_root>-trq_type = 'ZENH'.
APPEND ls_mod TO lt_mod.
lv_trq_new_key = ls_mod-key.

lo_srv_trq->modify(
  EXPORTING
    it_modification = lt_mod
  IMPORTING
    eo_change       = lo_chg
    eo_message      = lo_message ).
```

The next step shows how to instantiate a transaction manager which is used for persisting changes to the database. For this purpose, the SAVE method of the transaction manager is called.

```
…
BREAK-POINT.

* Save transaction to get data persisted (NO COMMIT WORK!)
lo_tra = /bobf/cl_tra_trans_mgr_factory=>get_transaction_manager( ).

* Call the SAVE method of the transaction manager
lo_tra->save(
  IMPORTING
    ev_rejected           = lv_rejected
    eo_change             = lo_chg
    eo_message            = lo_message
    et_rejecting_bo_key   = lt_rej_bo_key ).
```

Update: Now the newly created instance of the TRQ Root node is update with some additional data. The example code shows how to prepare the modification table for an update (the change mode will be set to UPDATE). Again, the modification table is then passed to method MODIFY of the service manager (and in this example the update is directly persisted by using the SAVE method of the transaction manager).

```
…
BREAK-POINT.

*--- Update the new instance with a Shipper ID ---*
CLEAR lt_mod.
ls_mod-node = /scmtms/if_trq_c=>sc_node-root.
ls_mod-key  = lv_trq_new_key.
ls_mod-change_mode = /bobf/if_frw_c=>sc_modify_update.
CREATE DATA ls_mod-data TYPE /scmtms/s_trq_root_k.

ASSIGN ls_mod-data->* TO <ls_root>.
<ls_root>-shipper_id = 'B00_CAR002'.
APPEND /scmtms/if_trq_c=>sc_node_attribute-root-shipper_id
    TO ls_mod-changed_fields.
APPEND ls_mod TO lt_mod.

lo_srv_trq->modify(
  EXPORTING
    it_modification = lt_mod
  IMPORTING
    eo_change       = lo_chg
    eo_message      = lo_message ).

BREAK-POINT.

lo_tra->save(
  IMPORTING
    ev_rejected           = lv_rejected
    eo_change             = lo_chg
    eo_message            = lo_message
    et_rejecting_bo_key   = lt_rej_bo_key ).
```

Delete: In the last step of the example report, we use a query to find TRQ instances that then will be deleted. Again, the modification table will be prepared for deleting a given TRQ instance (the change mode will be set to DELETE). Just like in the first steps, the modification table is then passed to method MODIFY of the service manager (and in this example the delete is directly persisted by using the SAVE method of the transaction manager).

```
…
BREAK-POINT.

* set an example query parameter
ls_selpar-attribute_name = /scmtms/if_trq_c=>sc_query_attribute-root-
query_by_attributes-trq_type.
ls_selpar-option         = 'EQ'.
ls_selpar-sign           = 'I'.
ls_selpar-low            = 'ZENH'.
APPEND ls_selpar TO lt_selpar.

* find a TRQ instance to be deleted
lo_srv_trq->query(
  EXPORTING
    iv_query_key            = /scmtms/if_trq_c=>sc_query-root-
qdb_query_by_attributes
    it_selection_parameters = lt_selpar
    iv_fill_data            = abap_true
  IMPORTING
```

```
    eo_message              = lo_message
    et_data                 = lt_trq_qdb ).

BREAK-POINT.

* Delete 1st found instance
READ TABLE lt_trq_qdb ASSIGNING <ls_trq_qdb> INDEX 1.
CLEAR lt_mod.
ls_mod-node = /scmtms/if_trq_c=>sc_node-root.
ls_mod-key  = <ls_trq_qdb>-db_key.
ls_mod-change_mode = /bobf/if_frw_c=>sc_modify_delete.
APPEND ls_mod TO lt_mod.

lo_srv_trq->modify(
  EXPORTING
    it_modification = lt_mod
  IMPORTING
    eo_change       = lo_chg
    eo_message      = lo_message ).

* Call the SAVE method of the transaction manager
lo_tra->save(
  IMPORTING
    ev_rejected            = lv_rejected
    eo_change              = lo_chg
    eo_message             = lo_message
    et_rejecting_bo_key    = lt_rej_bo_key ).
```

Note: When deleting the Root node of a business object instance, the BOPF Framework makes sure that all corresponding sub nodes of the business object instance will be also deleted, i.e. the complete business object instance will be deleted.

3.3 BOPF Enhancement Workbench

In the following section we focus on detailed step-by-step descriptions on how to create enhancements using the BOPF Enhancement Workbench.

3.3.1 Overview

As per TM 8.0, the BOBF Enhancement Workbench is available to enhance the standard TM BOBF Business Objects. It can be used to create, change or delete enhancements of the standard TM BOBF Business Objects. Such enhancements again can be enhanced with the same tool, i.e. nested enhancements are also possible. The BOBF Enhancement Workbench supports the following enhancements:

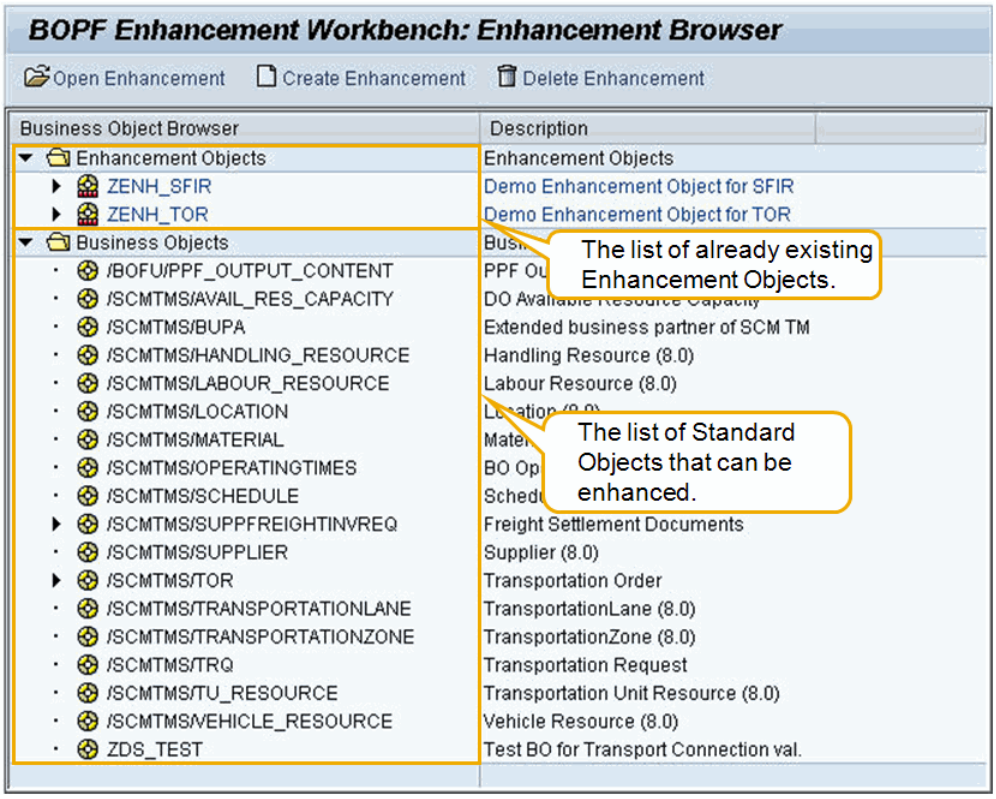
Create, change or delete additional

- Sub nodes.
- Actions and action enhancements.
- Determinations.
- Consistency and action validations.
- Queries.

The BOBF Enhancement Workbench does not allow creating new Business Objects. Moreover, a Standard TM BOBF Business Object must have been declared to be extensible by SAP Development. Only such Business Objects can be enhanced. The same applies to a Business

Object's entities like nodes, actions, etc. They can only be enhanced if SAP Development has declared them to be extensible.

The BOBF Enhancement Workbench is started with transaction **/BOBF/CUST_UI**.

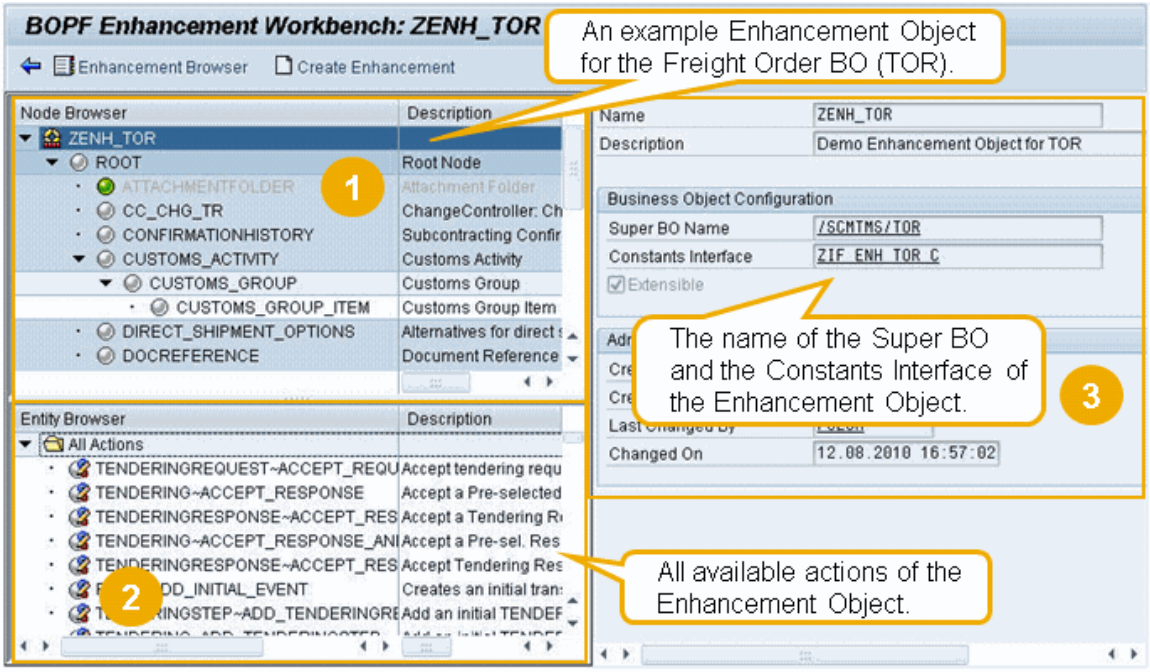


Picture: BOBF Enhancement Workbench Initial Screen.

On the initial screen you can see the Business Objects of the Transportation Management Application that are allowed to be enhanced in general (see Business Objects in the picture above). Whenever you want to enhance one of the listed Business Objects, the first step is to create a so called Enhancement Object for this Business Object. For the Enhancement Object, the original Business Object represents the so called Super Business Object or base object.

Important to know is that this Enhancement Object does neither replace nor represent a copy of the standard Business Object. Instead it serves as a container for all enhancements that you add to the Business Object via the Enhancement Workbench. At runtime, still the standard Business Object functionality is being executed with the enhancements in addition.

A double click on one of the already existing Enhancement Objects will lead you to the corresponding details as shown in the following picture:



Picture: Details of an Enhancement Object.

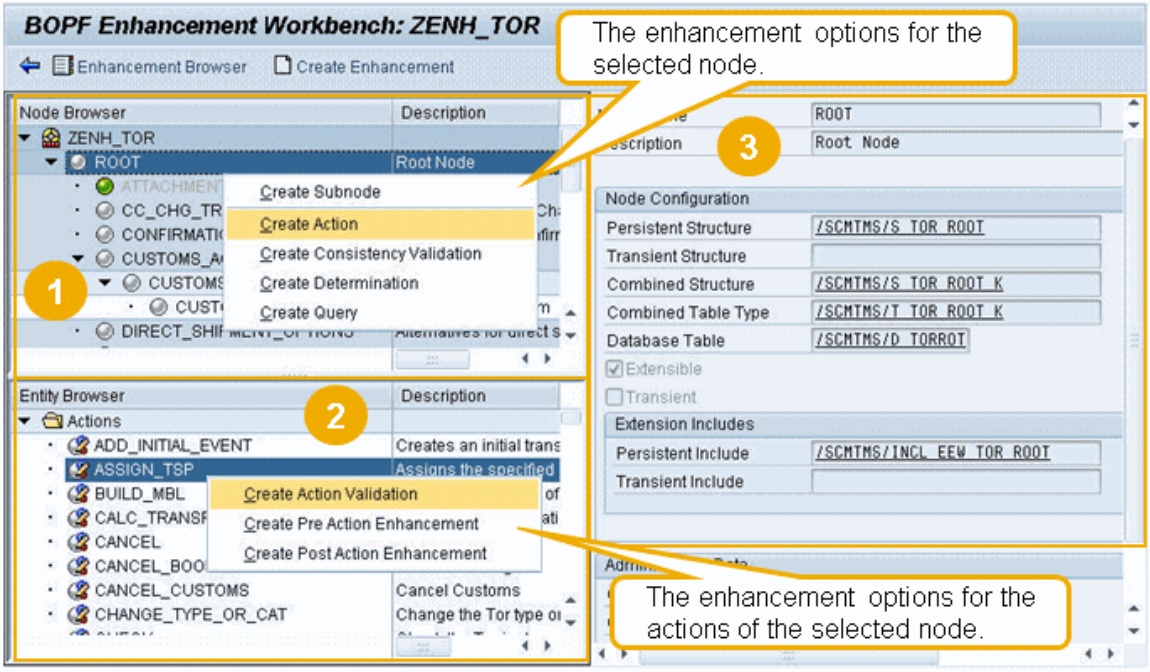
The specific example here shows an Enhancement Object for the Freight Order BO (TOR). The marked sections (1 - 3) show different entities of the Enhancement Object (double click on the very first line in the Node Browser).

Section 1 shows the node structure of the Enhancement Object which includes all nodes (i.e. the complete node hierarchy) of the super business object and all subnodes that might have been added to the business object via the Enhancement Workbench. All nodes which are not grayed out here are allowed to be enhanced. If a node is grayed out, it has been defined to be not extensible. This is especially the case for standard dependent objects like Address, Attachment Folder and Text Collection. On the other hand, dependent objects defined by Transportation Management itself can be enhanced, provided that development has enabled them correspondingly.

Section 2 shows all actions available at the Enhancement Object. This includes all standard actions as well as actions that might have been added to the business object via the Enhancement Workbench (All actions are only shown when you have marked the Enhancement Object in this view. If you double click on one of the nodes, section 2 will only contain those actions which belong to this specific node).

Section 3 shows the name of the Super Business Object associated with the selected Enhancement Object as well as the so called constants interface of the Enhancement Object. This interface will contain all constants which are generated for your enhancements.

A double click on one of the nodes (e.g. the Root Node) will show the following picture with details related to this specific node.



Picture: The node of an Enhancement Object with its details.

The picture above shows the possible enhancement options for the selected node (here: the Root Node of the Freight Order BO) in section 1. Click the right mouse button to view the types of enhancements that can be created for the selected node.

In Section 2, the available actions of the selected node are shown. You can select one of the listed actions and then click the right mouse button to see the types of enhancements that can be created for the selected action.

Moreover, in section 3, the node details (i.e. the data model) of the selected node is displayed, similar to those already mentioned in section 2.1.3 on the BOBF Modeling Tool. Here in the BOBF Enhancement Workbench you can see:

- **Persistent Structure:**
  This DDIC structure contains the attributes of the node, representing the node data.
- **Transient Structure:**
  Contains the transient attributes of a node, i.e. attributes which do not get persisted but are only filled and used during runtime.
- **Combined Structure & Combined Table Type**:
  This DDIC structure (table type) includes the data structure of a node. In addition it includes a fixed BOPF DDIC structure which contains the node instance key (KEY), the key of the direct parent node instance (PARENT_KEY) as well as the key of the related business object instance (ROOT_KEY).
- **Database Table:**
  Shows the database table where the persistent node information gets stored.
- **Extension Includes (persistent & transient)**:
  Important for field extensions on a node is the Extension Include. With this include, all extension fields are added (via Append Structures) which are to be persisted. Extension fields which are only relevant at runtime and not relevant to be persisted are placed in the corresponding transient Extension Include.

By double click on the corresponding structures, tables or table types you can navigate to the details of these DDIC objects. Especially the Extension Includes are most important for field

extensions. Here you add the customer / partner specific persistent and transient fields in corresponding append structures.

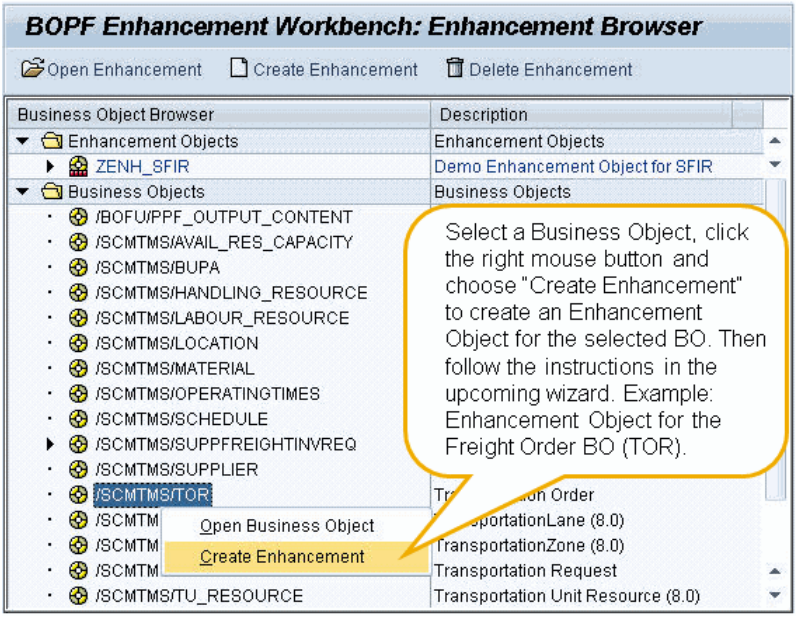
The procedure how to do this and how to create all other indicated enhancement options via the BOBF Enhancement Workbench will be described more detailed in section 3.4 of this document.

3.3.2 First step: Creating an Enhancement Object

The first step to enhance a standard Transportation Management Business Object is to create a so called Enhancement Object for this Business Object. The Business Object associated with this Enhancement Object is also called the Super Business Object of an Enhancement Object.

As already mentioned in section 3.4.1, it is important to know that this Enhancement Object does neither replace nor represent a copy of the standard Business Object. Instead it serves as a container for all enhancements that you add to the Business Object via the Enhancement Workbench. At runtime, still the standard Business Object functionality is being executed with the enhancements in addition (moreover, all code corrections and changes on standard business objects and its entities will of course be present at any time).

1) Start the BOBF Enhancement Workbench (/BOBF/CUST_UI) and select the Business Object to be enhanced. Let's assume we create an Enhancement Object for the Freight Order BO (technical name is /SCMTMS/TOR).
2) Click the right mouse button on the selected BO and select the option "Create Enhancement" in the upcoming popup menu.
3) A wizard will now guide you through the next steps to create the Enhancement Object.



Picture: Creating an Enhancement Object.

4) On the first wizard screen click on button "Continue".
5) On the next wizard screen you can see the name of the Super BO and the following list of fields ready for input:

- **Enhancement Name:** The name of your enhancement.
  Example: ENH_TOR
- **Description:** A description of your enhancement.

Example: Demo Enhancement Object for TOR

- **Namespace:** The namespace that your enhancement shall be associated with. It will be added at the beginning of the final technical name for your Enhancement Object. Example: Z (i.e. Customer Namespace).
- **Prefix:** A prefix that will be added between the Namespace and the Enhancement Name in the final technical name of your enhancement. It is not a mandatory field and can be left on "space" if not required.
  Example: HP (this can of course also be left space)

6) Click on button "Continue". With the entries made before, the next wizard step will propose the name of your enhancement as well as the name of the constants interface that will be created for the new Enhancement Object. Example (with the given entries):

   Technical Name : ZHP_ENH_TOR
   Constants Interface : ZIF_HP_ENH_TOR_C

   On this screen you can manually adjust the two fields. As an example, let's remove the prefix from the names so that the final technical entities get the following names:

   Technical Name : ZENH_TOR
   Constants Interface : ZIF_ENH_TOR_C

7) Click on button "Continue" to get to the next wizard step. Here you define (yes/no) whether you allow your enhancement to be enhanced in further enhancements (i.e. nested enhancements are possible).

8) At any step of the wizard you can go back to all preceding steps again by clicking button "Back". With this, adjusting the entered data is of course possible until you have completed the wizard. Click on button "Complete" to finally create your Enhancement Object with the entered specification.

The new Enhancement Object can now be used to create enhancements of the corresponding Super Business Object. The creation of the different types of enhancements on node and action level is described in the following sections.

3.3.3 General remarks on creating enhancements

Some general remarks that are valid for creating enhancements via the wizards provided by the BOBF Enhancement Workbench:

- Implementing Classes: Some types of enhancements require providing an implementing class. This class contains the business logic of the enhancement. The system creates it automatically after finishing the wizard. You must implement it manually. Because the implementing class name should meet naming conventions, the wizard automatically suggests a valid class name. You can also define a class that already exists, by implementing the corresponding BOBF Interface (e.g. /BOBF/IF_FRW_ACTION for actions or /BOBF/IF_FRW_VALIDATION for validations, etc.) as the implementing class. The system does not overwrite the implementing class if it already exists.

- The enhancement name should start with the namespace or prefix of the open enhancement (in our example this would be "ZENH_"). This ensures there is a clear separation between the entities of different enhancements. The system automatically enters the value in the field for the enhancement name. You should add a meaningful enhancement name.

- When completing the wizard, further required objects will be generated automatically. The system adds the new enhancement to the enhancement object. It displays the new enhancement in the *Entity Browser* when you select the corresponding assigned node or action. In case an implementing class is required for the enhancement, it is generated and must be implemented manually afterwards. The constants interface of the enhancement object is regenerated and contains a unique constant identifying the new enhancement.

- Every enhancement created with the BOBF Enhancement Workbench can also be deleted again. For each create wizard a corresponding delete wizard is available which guides you through the relevant step and also checks the preconditions to be fulfilled for a deletion.

3.3.4 Creating Field Extensions

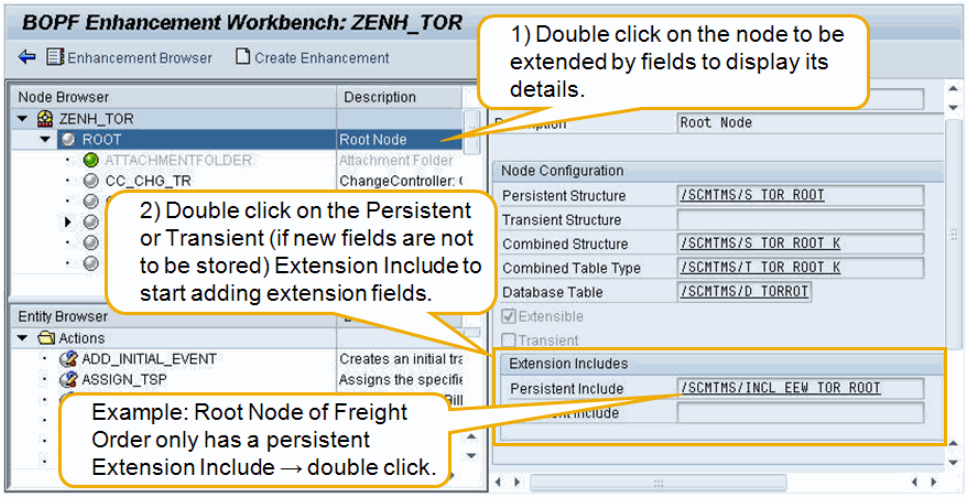
Customers and Partners may require additional fields to be stored with the business objects, get them entered and displayed on the User Interface or get them transferred between external systems (e.g. ERP) and Transportation Management via corresponding services.

Creating field extensions on the Business Objects delivered with Transportation Management is the basis for these kinds of enhancements. Such field extensions can be created using the BOBF Enhancement Workbench.

1) Start the BOBF Enhancement Workbench (/BOBF/CUST_UI) and select the Enhancement Object for the Business to be enhanced with additional fields. Let's assume we create a field extension for the Freight Order BO (Enhancement Object ZENH_TOR created in section 3.4.2).

2) Double click on the node that shall be enhanced by additional fields (in our example the Root Node of the Freight Order BO). In the details of the node in the right area you can see the Extension Includes that will carry the additional fields. Field Extensions are always assigned to such an Extension Include.

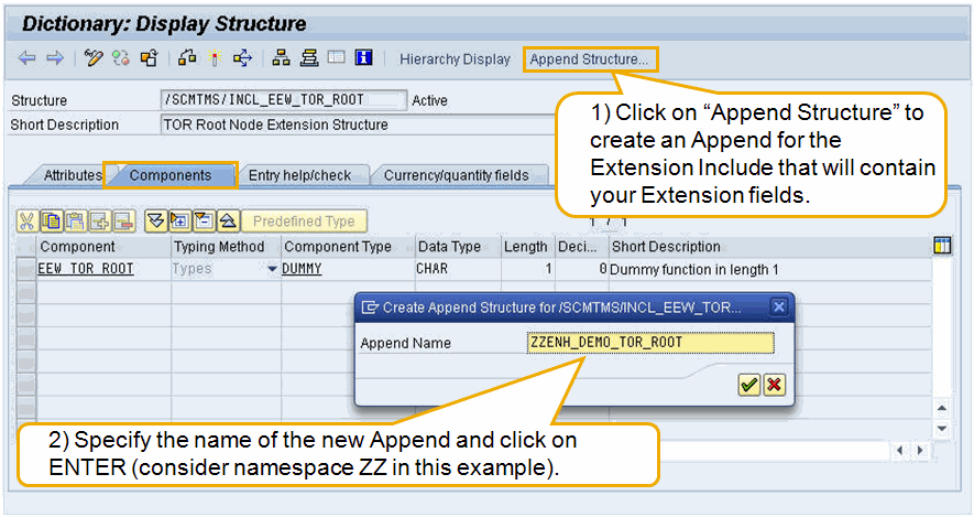
   - Double click on the ***Persistent Extension Include*** to start adding fields that are to be persisted on the database.
   - Double click on the ***Transient Extension Include*** to start adding fields that are intended to be only used during runtime and do not get persisted on the database.



Picture: The Extension Includes of a BO node.

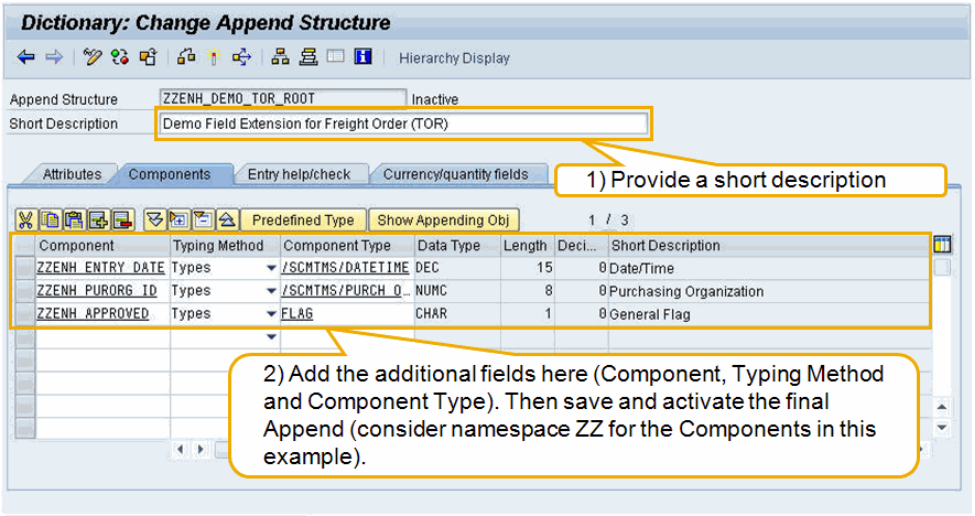
3) On the following screen you can see the DDIC Editor (analog to transaction SE11 for DDIC objects). Here click on the menu button ***Append Structure…*** to create a new Append for the chosen Extension Include.

   This append will contain your extension fields. Usually, you just need one such append to contain all your extension fields. But it is also possible to create additional Appends for the Extension Include e.g. to separate extensions from different partners. Example append: ZZENH_DEMO_TOR_ROOT.



Picture: Creating an Append for the Extension Include.

4) Enter a short description for the Append and add the extension fields to be included in this Append (Component, Typing Method and Component Type). After the extension fields are correctly specified, save and activate the Append.



Picture: Specifying the extension fields in the new Append.

With the described four steps, the new extension fields are now part of the corresponding node structures, table types and the database table (provided that you have added the extension fields in the Persistent Extension Include). Both, transient and persistent extension fields are now ready

to be used within further enhancements, e.g. in the business logic, the User Interface or in the context of services that send or receive corresponding information.

3.3.5 Creating Subnodes

The Enhancement Workbench allows extending a business object with additional nodes. Subnodes can be added via a corresponding wizard that guides you through the required steps.

1) Open the corresponding Enhancement Object and select the node that shall be extended with a new subnode. In the context menu of the node (click right mouse button) choose ***Create Subnode*** to start the wizard. Example:

   Root Node of the Freight Order BO in the example Enhancement Object ZENH_TOR.

2) The first step in the wizard is to specify the name for the new subnode and a description on the semantic and purpose of the new subnode. Example:

Node Name	ZENH_SUBNODE
Description	Demo Enhancement Subnode

   Remark: The name of the subnode must be unique in the business object and should start with the namespace of the used enhancement object. If no namespace has been entered, the node name must start with the prefix of the used enhancement (in our example this would be "ZENH_"). This ensures you have clear separation between the nodes of different enhancements that belong to the same business object. The namespace (or prefix) value is automatically inserted in this field and must be completed with a meaningful node name.

3) In the second step you need to define whether this new subnode is itself extensible. Set the flag *Node is extensible* if you want to add additional enhancements to the new subnode (i.e. further subnodes, actions, determinations, etc.). If the flag is set, you can specify the names of a Persistent Extension Include and a Transient Extension Include to allow field extensions for the new subnode.

   a) Enter the names of these includes. Example:

Persistent Extension Include	ZENH_INCL_P_SUBNODE
Transient Extension Include	ZENH_INCL_T_SUBNODE

   b) On the wizard screen double click on these structures to right away start creating the corresponding DDIC objects. You will be guided to the DDIC Editor where you can define the initial information for the Extension includes. Repeat the following steps for both Extension Includes:
   c) Under menu path Extras → Enhancement Category choose either the category "*Can be enhanced (deep)"* or "*Can be enhanced (character-like or numeric)"*.
   d) Provide a short description.
   e) Create a dummy component (required for technical reasons). Example for the Persistent Extension Include:

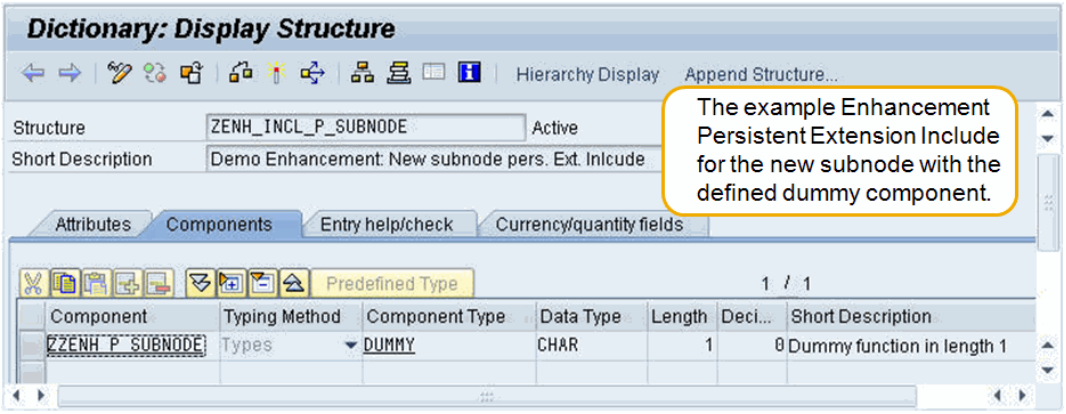
Component	Typing Method	Component Type
ZZENH_P_SUBNODE	Types	DUMMY

   Do the same for the Transient Extension Include (if you have defined one). Example for the Transient Extension Include:

Component	Typing Method	Component Type

ZZENH_T_SUBNODE	Types	DUMMY

f) Save and activate the corresponding Extension Include.



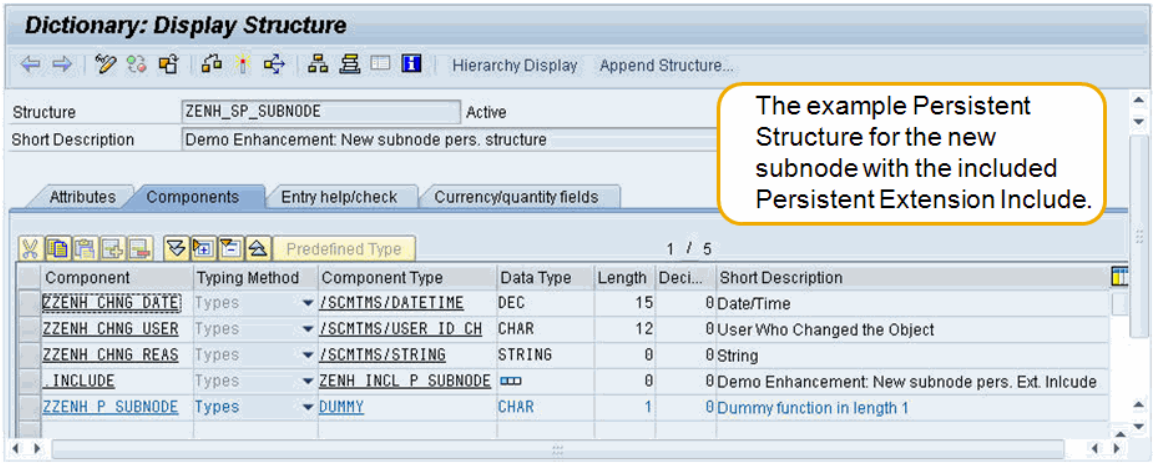
Picture: Example Enhancement Extension Include with dummy component.

4) The third step is to define and create the Persistent Structure and/or the Transient Structure for the subnode.

a) Enter the names for these structures. Example:

Persistent Structure	ZENH_SP_SUBNODE
Transient Structure	ZENH_ST_SUBNODE

b) On the wizard screen double click on these structures to right away start creating the corresponding DDIC objects. You will be guided to the DDIC Editor where you can define the initial information for the structures:
c) Under menu path Extras → Enhancement Category choose either the category "*Can be enhanced (deep)"* or "*Can be enhanced (character-like or numeric)"*.
d) Provide a short description.
e) Define the attributes that shall be part of the new subnode and get persisted on the database in the Persistent Structure.
f) At the end of the Persistent Structure include the Persistent Extension Include from step 3 to allow persistent field extensions for the new subnode.
g) Define the attributes that shall be part of the new subnode and are only available at runtime in the Transient Structure.
h) At the end of the Transient Structure include the Transient Extension Include from step 3 to allow transient field extensions for the new subnode.
i) Save and activate the corresponding Extension Include.

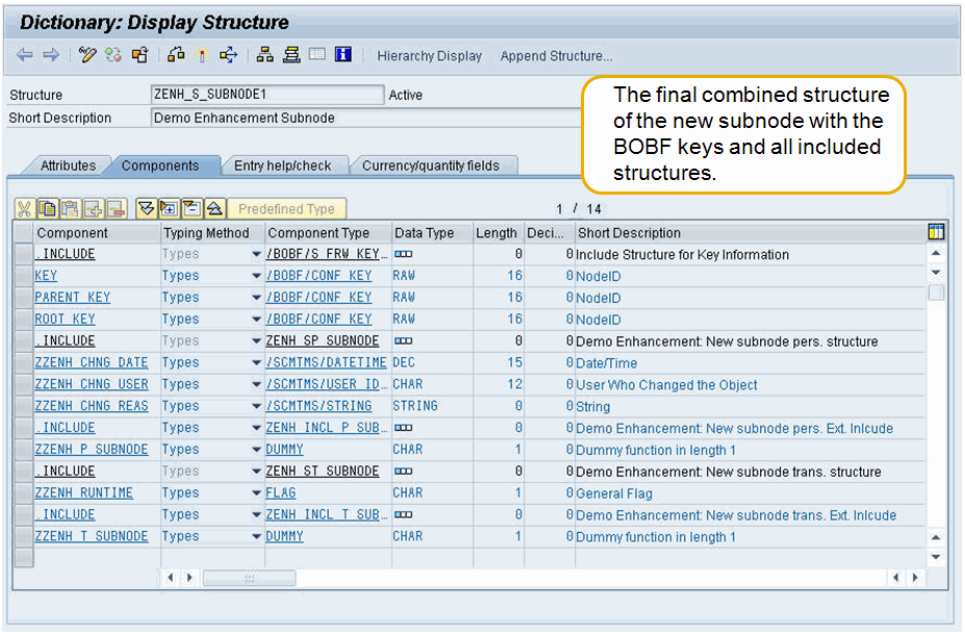


Picture: Example Persistent Structure.

5) In step four, the database types are defined. For this, the name of the Combined Structure, the Combined Table Type as well as the Database Table name is entered. Example:

Combined Structure	ZENH_S_SUBNODE1
Combined Table Type	ZENH_T_SUBNODE1
Database Table Name	ZENH_D_SUBNODE1

The content of these three DDIC objects will be automatically generated by the system. The combined structure will contain the attributes of the persistent and transient structure from step 4 as well as BOBF-specific key attributes. Moreover, the combined structure will contain the Extension Includes with corresponding extension fields (if available). The combined table type and the database table will have the same structure like the combined structure.

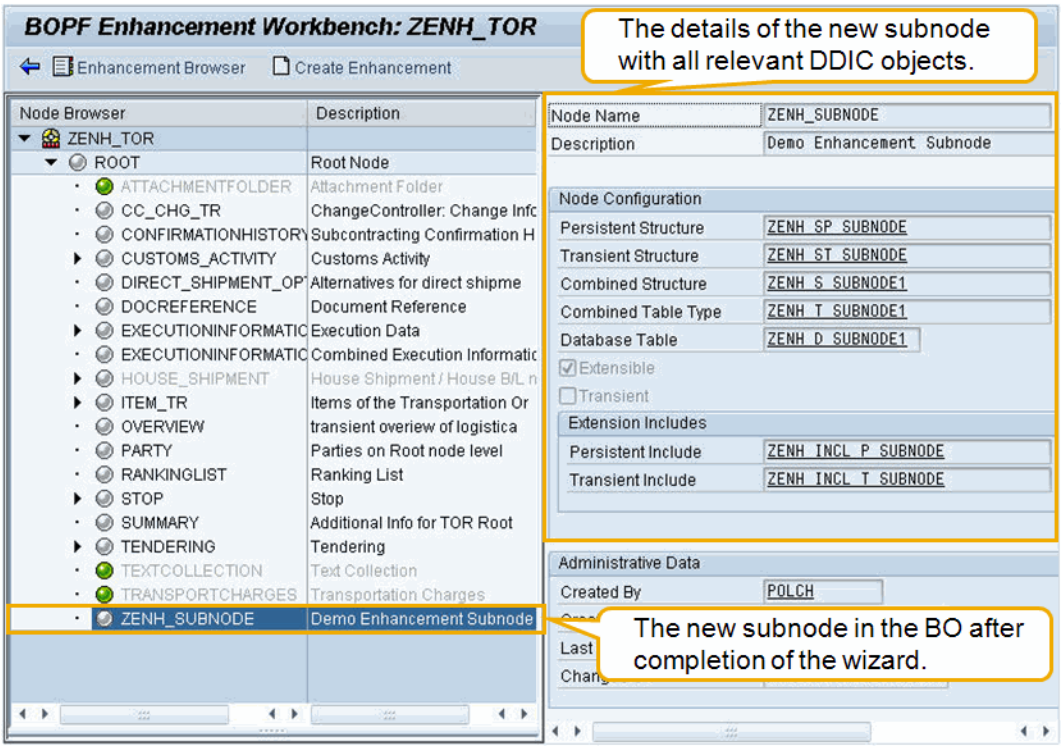


Picture: The final combined structure of the new subnode.

6) Click on button *Complete* to finalize the creation of the new subnode. With this step, further required objects for the subnode will be generated automatically. Afterwards, the subnode can be used like any other node of the enhanced business object. If you have declared it to

be extensible, any enhancements for the new node are done the same way like for the standard nodes, i.e. you can add fields via field extensions, add actions, etc.

On completion of the subnode, also the constants interface of the enhancement is regenerated and contains a unique constant identifying the subnode (this constant is necessary in order to access the data of the node).



Picture: The final new subnode.

3.3.6 Creating Actions

You can use an action to allow the explicit external triggering of business logic. Actions can be added to extensible standard nodes and new sub nodes. The wizard for this task guides you through the following required steps.

1) Open the corresponding Enhancement Object and select the node that shall be extended with a new action. In the context menu of the node (click right mouse button) choose ***Create Action*** to start the wizard. Example:

   Root Node of the Freight Order BO in the example Enhancement Object ZENH_TOR.

2) The first step in the wizard is to specify the name for the new action and a description on the semantic and purpose of the new name. Example:

Action Name	ZENH_DEMO_ACTION
Description	Demo Enh. Action for Freight Order Root

3) In the second step you need to define the following information on the new action.

   a) Implementing Class: Example: ZCL_ENH_A_DEMO_ACTION.

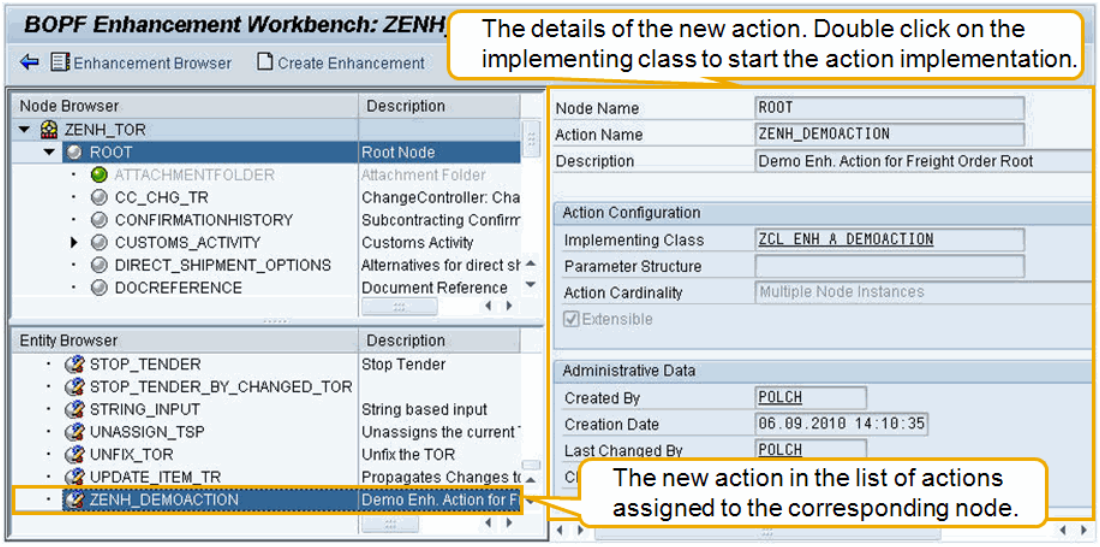
      The implementing class must implement interface /BOBF/IF_FRW_ACTION.

   b) Action Cardinality:
      Defines how many node instances the action can operate on during one action call. The following are the action cardinality types:
      - Multiple Node Instances: Select if the action always operates on one or more node instances.
      - Single Node Instance: Select if the action operates on exactly one single node instance for each call.
      - Static Action (No Node Instances): Select if the action does not operate on any node instances.

   c) Parameter Structure:
      Some actions need an additional importing parameter. Enter a name for the parameter structure and create the structure by double-clicking the name.

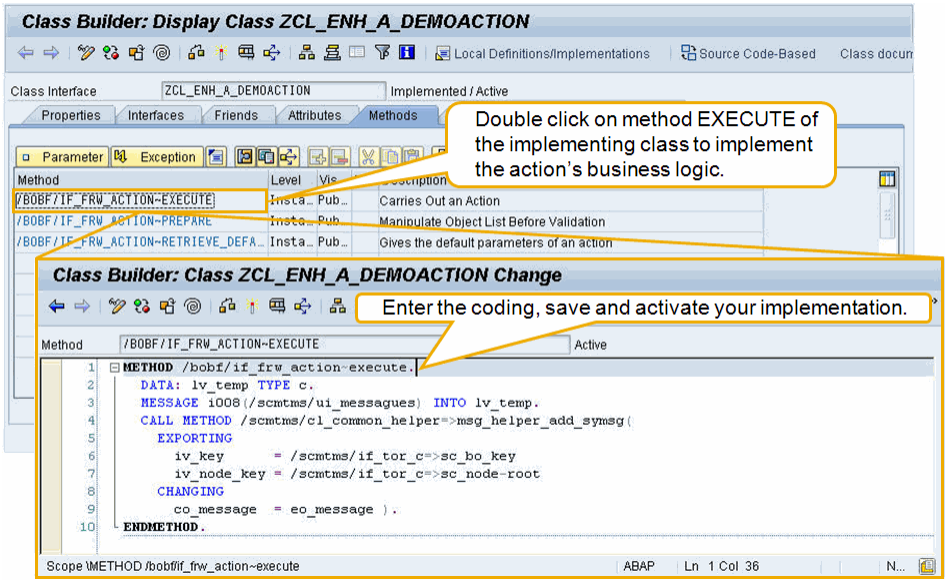
7) On the next wizard screen you can specify whether the new action shall be extensible or not. Set the flag "*Action can be enhanced"* if you want to allow adding enhancements to the new action (i.e. adding Pre- and Post Action Enhancements and Action Validations).

8) Click on button *Complete* to finalize the creation of the new action.



Picture: The final new action assigned to the respective node.

9) Finally, you need to implement your business logic in the Action's implementing class that you have specified in the previous steps. Double click on the implementing class in the action details to start the implementation.



Picture: Implementing the business logic of the new action

3.3.7 Creating Action Validations

An action validation is referred to a certain action. It contains checking logic which is automatically executed before the action is processed. It can be used to check if an action can be carried out. An action validation is carried out when an action is called, and before it is performed. If some validations fail, the action is not performed for the instances where the validation failed.

The BOBF Enhancement Workbench provides a corresponding wizard to create new action validations for extensible standard actions and enhancement actions.

1) Open the corresponding Enhancement Object and navigate to the action that shall be extended with a new action validation. In the context menu of the node (click right mouse button) choose ***Create Action Validation*** to start the wizard. Example:

   Action ZENH_DEMO_ACTION created in section 3.4.4 (Root Node of the Freight Order BO in the example Enhancement Object ZENH_TOR).

2) The first step in the wizard is to specify the name for the new action validation and a description on the semantic and purpose of this new entity. Example:

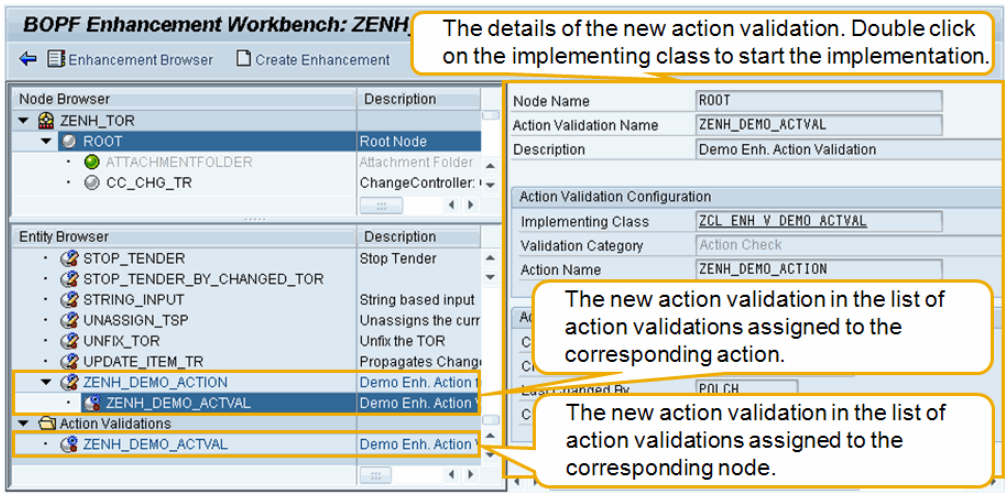
Validation Name	ZENH_DEMO_ACTVAL
Description	Demo Enh. Action Validation

3) In the second step you need to define the implementing class of the new action validation. Example: ZCL_ENH_V_DEMO_ACTVAL.

   The implementing class must implement interface /BOBF/IF_FRW_VALIDATION.

4) Click on button *Complete* to finalize the creation of the new action validation.

5) Finally, you need to implement your business logic in the action validation's implementing class that you have specified in the previous steps. Double click on the implementing class in the action validation details to start the implementation.



Picture: The final new action validation assigned to the respective action.

3.3.8 Creating Pre- and Post-Action Enhancements

A pre- or post-action enhancement can be used to extend the functionality of a certain action that is located in the base object (i.e. they are created for extensible standard actions only).

- A pre action enhancement is automatically executed by the BOBF framework, before a certain action of the base object is performed.
- A post action enhancement is automatically executed by the BOBF framework after a certain action of the base business object was performed.

If an importing parameter structure is maintained on the base action, this parameter is also handed over to the pre or post action enhancement and can be used in the implementation of the corresponding business logic.

The BOBF Enhancement Workbench provides corresponding wizards for creating pre and post action enhancements. As an example, we describe the creation of a pre action enhancement (the procedure works analog for post action enhancements).

1) Open the corresponding Enhancement Object and navigate to the standard action that shall be extended with a new pre action enhancement. In the context menu of the node (click right mouse button) choose ***Create Pre Action Enhancement*** to start the wizard. Example:

   Action ASSIGN_TSP assigned to the Freight Order BO Root Node (in the example Enhancement Object ZENH_TOR).

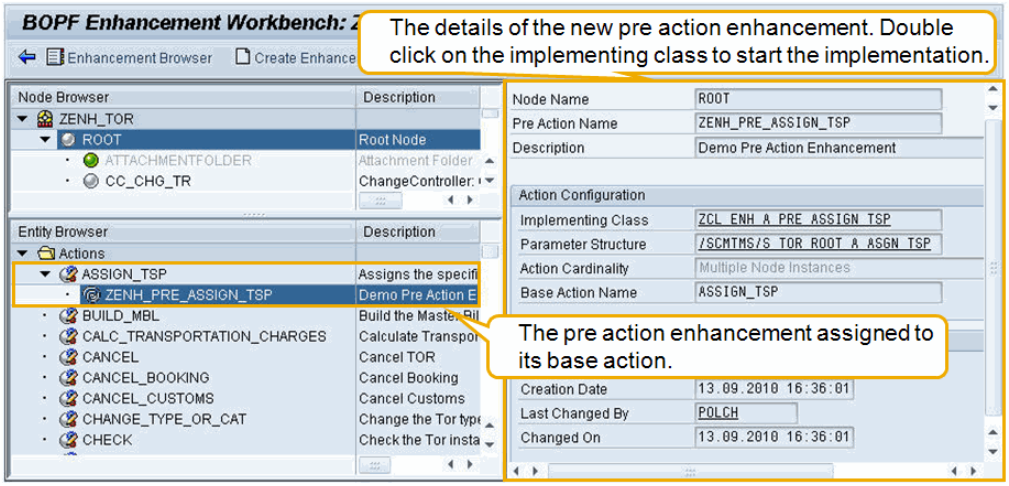
2) The first step in the wizard is to specify the name for the new pre action enhancement and a description on the semantic and purpose of this new entity. Example:

Action Name	ZENH_PRE_ASSIGN_TSP
Description	Demo Pre Action Enhancement

3) In the second step you need to define the implementing class of the new action validation. Example: ZCL_ENH_A_PRE_ASSIGN_TSP.

   The implementing class must implement the interface /BOBF/IF_FRW_ACTION.

4) Click on button *Complete* to finalize the creation of the new pre action enhancement.



Picture: The final new pre action enhancement assigned to the respective action.

5) Finally, you need to implement your business logic in the consistency validation's implementing class that you have specified in the previous steps. Double click on the implementing class in the consistency validation details to start the implementation.

3.3.9 Creating Consistency Validations

Consistency validations can be used to check the consistency of a business object. It is possible to check whether or not a certain set of node instances of a certain node are consistent. The consistency validation implementation returns a set of failed keys identifying all handed over node instances that are inconsistent.

New enhancement consistency validations can be added to extensible standard nodes and new subnodes. The wizard for this task guides you through the following required steps.

1) Open the corresponding Enhancement Object and select the node that shall be extended with a new consistency validation. In the context menu of the node (click right mouse button) choose ***Create Consistency Validation*** to start the wizard. Example:

   The new subnode ZENH_SUBNODE of the Freight Order BO in the example Enhancement Object ZENH_TOR created in section 3.4.3.

2) The first step in the wizard is to specify the name for the new consistency validation and a description on the semantic and purpose of this new entity. Example:

Validation Name	ZENH_DEMO_CONVAL
Description	Demo Enh. Cons. Validation

3) In the second step you need to define the implementing class of the new consistency validation. Example: ZCL_ENH_V_DEMO_CONVAL):

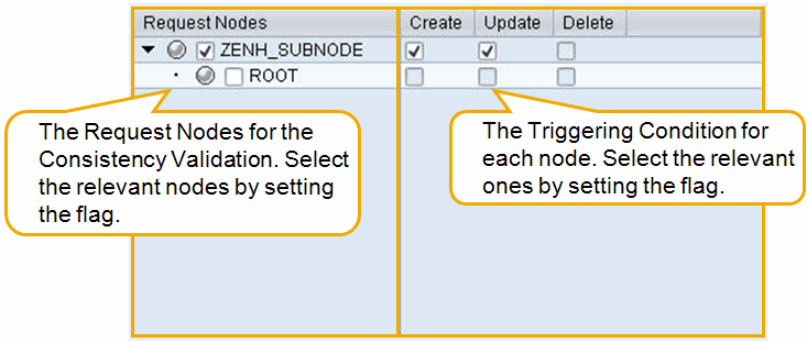
   The implementing class must implement interface /BOBF/IF_FRW_VALIDATION.

4) Maintain Request Nodes: A consistency validation is automatically executed as soon as one of the triggering conditions of its request nodes is fulfilled. In this wizard step, the request nodes and the corresponding triggering condition are defined.

   On this screen, all nodes are shown that are connected to the assigned node by an association. To maintain a request node, select the request node checkbox and the appropriate triggering condition (Create, Update or Delete). Example:

Request Node	Node	Create	Update	Delete
Yes	ZENH_SUBNODE	Yes	Yes	No
No	ROOT	No	No	No

   With these settings, the consistency validation will be triggered when instances of node ZENH_SUBNODE are created or updated. Assume we declared node ROOT as a request node and marked the triggering condition Update. In this case, the consistency validation would also be triggered when the Root node is updated.

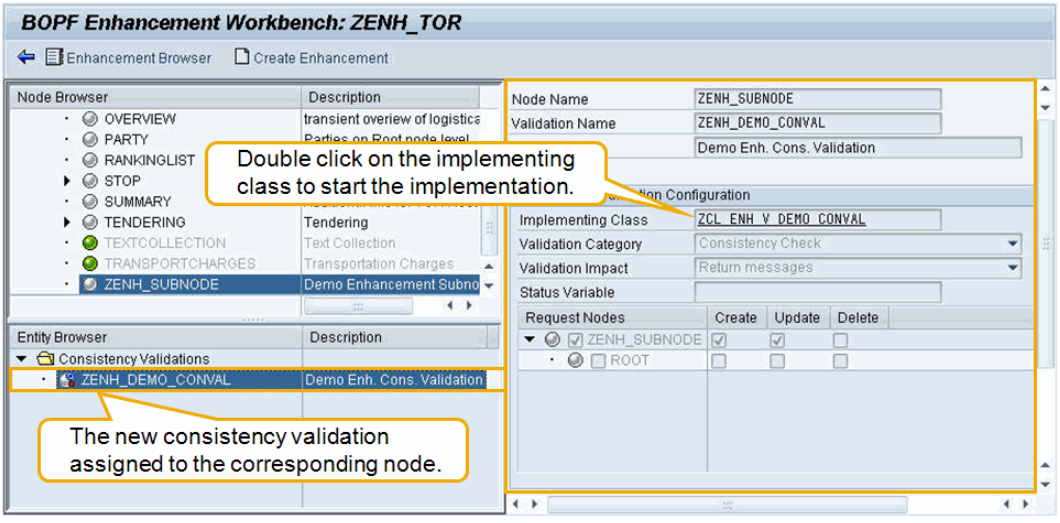


Picture: Request Nodes and Triggering Conditions.

5) Maintain the Impact: The consistency validation shall indicate changed node instances that are inconsistent by the help of messages. You can prevent the system from saving the entire transaction if a changed instance fails the consistency validation, or fails to set a consistency status. You can maintain the type of reaction on inconsistent node instances as validation impacts in this wizard screen. Options:

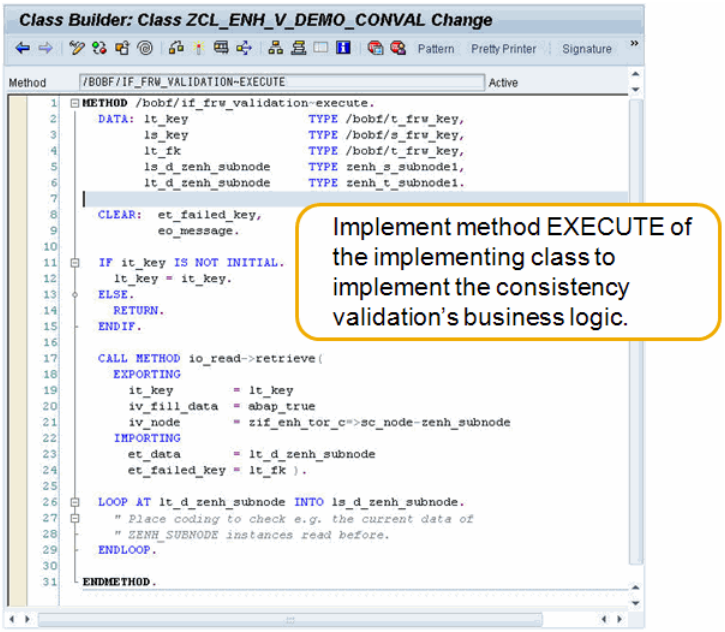
- **Return messages:**
  This represents the default behavior of consistency validation. The validation implementation returns messages for inconsistent instances to the consumer.
- **Return messages and prevent saving:**
  Select this option for the validation impact if the inconsistency of a node instance must be solved before saving the transaction.
- **Return messages and set a consistency status:**
  If the base object (super object) contains a consistency status, this status can be influenced by a consistency validation. Choose the appropriate status variable. When a changed instance fails the consistency validation, this status is automatically set to inconsistent.

6) Click on button *Complete* to finalize the creation of the new consistency validation.



Picture: The final new consistency validation assigned to the respective node.

7) Finally, you need to implement your business logic in the consistency validation's implementing class that you have specified in the previous steps. Double click on the implementing class in the consistency validation details to start the implementation.



Picture: Implementing the business logic of the new consistency validation.

3.3.10 Creating Determinations

A determination is mainly used to compute data that can be derived from the values of other attributes. The determined attributes and the determining attributes of the triggering condition can belong to the same node or to different nodes. There are also values that do not depend on any other value but still have to be determined automatically on the creation or modification of a node instance, for example IDs.

A determination is assigned to a business object node. It describes internal changing business logic on the business object. A determination is automatically executed by the BOBF as soon as the BOBF triggering condition is fulfilled. This triggering condition is checked by the framework at different points in the transaction, depending on the pattern of the determination. For each determination, it is necessary to specify the changes that build the triggering condition. Changes can include creating, updating, deleting, or loading node instances.

As soon as the framework checks the trigger conditions of determinations and there is more than one determination to be executed, the dependencies of the determinations are considered. With the help of a determination dependency, a determination can be maintained either as a predecessor or a successor of another determination.

The four supported determination patterns (in the following referenced with A, B, C and D) are:

A) Derive dependent data immediately after modification (After Modify):
The trigger condition of the determination is evaluated at the end of each modification. A modification roundtrip is defined as one single modification core service call from the consumer to the framework. The call contains arbitrary creations, updates, or deletions of node instances. Additionally, the trigger condition is checked after each action core service execution.

The pattern shall be used if creating, updating, or deleting of node instances causes unforeseen errors. These errors are handled during the same roundtrip. If there is no need to react immediately on the modification, and the handling of the side effect is very time consuming, we recommend you use the Derive dependent data before saving determination pattern instead.

Example: As soon as a new ITEM node instance of the CUSTOMER_INVOICE business object is added, the changed item amount (price x quantity) must be immediately recalculated in order to show the new amount on the consumer's user interface.

B) Derive dependent data before saving (Before Save):
The trigger condition is checked as soon as the consumer saves the whole transaction. If the save of the transaction fails, these determinations could run multiple times.

In contrast to the "Derive dependent data immediately after modification" pattern, the framework evaluates all changes done so far in the current transaction to check the trigger condition. Because this evaluation only takes place at the save phase of the transaction, this pattern is recommended for time consuming determinations.

Example: The data of each invoice must additionally be stored in a XML file. A determination is configured to extract the XML code from each changed invoice. Because this is very time consuming the determination does not run immediately after each change of an invoice. Instead, it runs once before saving for all invoices changed during the current transaction.

C) Fill transient attributes of persistent nodes (After Loading):
The determination is automatically executed before the consumer accesses a transient node attribute of the assigned node for the first time. This allows you to initially derive the values of the attribute. In addition, these determinations are executed after each modification of a node instance. This allows you to recalculate the transient field if its derivation source attribute has been changed by the modification.

These determinations are used to derive the values of transient attributes of a node.

Example: The volume of a certain item of a customer invoice can be derived out of the length, width, and depth of this item unit, and the quantity. The volume attribute is a transient attribute of the item node, and its value can be derived as soon as an item is loaded from the database. Therefore, you can use a determination that calculates and fills the volume at this point in time.

D) Derive instances of transient nodes (Before Retrieve):
The determination is executed before the consumer accesses the assigned transient node of the determination and allows the creation, update or deletion of transient node instances.

These determinations are used to create and update instances of transient nodes. Because the determinations are executed before each access to their assigned transient node, they must ensure that the requested instances are in a consistent state.

Example: The customer invoice business object does not store payment options. The payment option node is a transient node buffering detail information that is located in another system.

New enhancement determinations can be added to extensible standard nodes and new subnodes. The wizard for this task guides you through the following required steps.

1) Open the corresponding Enhancement Object and select the node that shall be extended with a new determination. In the context menu of the node (click right mouse button) choose ***Create Determination*** to start the wizard. Example:

   The new subnode ZENH_SUBNODE of the Freight Order BO in the example Enhancement Object ZENH_TOR created in section 3.4.3.

2) The first step in the wizard is to specify the name for the new determination and a description on the semantic and purpose of this new entity. Example:

Determination Name	ZENH_DEMO_DET
Description	Demo Enhancement Determination

3) In the second step you need to define the implementing class of the new determination. Example: ZCL_ENH_D_DEMO_DET):

   The implementing class must implement interface /BOBF/IF_FRW_DETERMINATION.

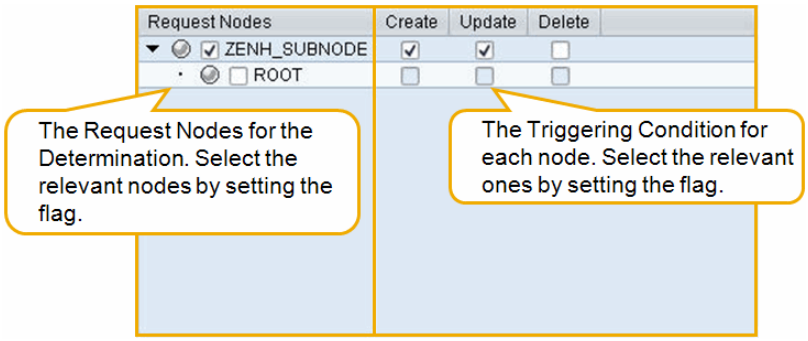
4) Maintain the determination pattern: In this step you can choose one of the determination patterns described before via a radio button.

5) Maintain Request Nodes (***only required and done for determination patterns A and B***): A determination is automatically executed as soon as one of the triggering conditions of its request nodes is fulfilled. In this wizard step, the request nodes and the corresponding triggering condition are defined.

   On this screen, all nodes are shown that are connected to the assigned node by an association. To maintain a request node, select the request node checkbox and the appropriate triggering condition (Create, Update or Delete). Example:

Request Node	Node	Create	Update	Delete
Yes	ZENH_SUBNODE	Yes	Yes	No
No	ROOT	No	No	No

   With these settings, the determination will be triggered when instances of node ZENH_SUBNODE are created or updated. Assume we declared node ROOT as a request node and marked the triggering condition Update. In this case, the determination would also be triggered when the Root node is updated.



Picture: Request Nodes and Triggering Conditions.

6) Maintain Transient Node (***only required and done for determination pattern D***): Select the transient node whose instances shall be modified by the determination.

Maintain Write Nodes: Select all the nodes whose instances are created or modified by the determination. Example:

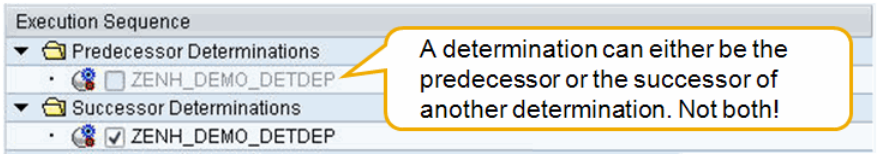
Write Node	Node
Yes	ZENH_SUBNODE
No	ROOT

7) Maintain Determination Dependencies:

As mentioned before, enhancement determinations are only executed after all standard determinations have been executed to ensure that the standard business logic is not disrupted and leads to inconsistencies. Nevertheless, you can define dependencies between enhancement determinations with the same determination pattern (this can only be the case for pattern A and B), i.e. this step will only come up in the wizard in case there is more than one determination of the same pattern present.

On the wizard screen select the determinations which must be processed before or after the determination currently being created or configured. The triggering condition of the determination must also be fulfilled to get executed.

For each determination you can define if it is either executed before (predecessor) or after the current determination (successor). This allows defining an execution sequence of the enhancement determinations.



Picture: Defining the execution sequence of a determination.

In the picture above our determination ZENH_DEMO_DET is assigned a successor determination ZENH_DEMO_DETDEP (for this determination ZENH_DEMO_DET will automatically be defined as a predecessor determination).

8) Click on button *Complete* to finalize the creation of the new determination.

9) Finally, you need to implement your business logic in the determination's implementing class that you have specified in the previous steps. Double click on the implementing class in the determination details to start the implementation.

3.3.11 Creating Queries

Queries are the initial point of access to business objects. They allow performing searches on a business object to receive the keys or the data of certain or all node instances. Each query has an associated parameter structure. To allow different search criteria at runtime, the consumer may hand over the query data type. A query returns the queried keys and data of the business object node instances, i.e. a set of all the record IDs in a business object that match the query criteria.

The BOBF Enhancement Workbench allows creating new queries of two different types:

- **Node Attribute Query:**
  The search parameters are equal to the assigned node of the query. The search criteria can consist of value comparisons and value ranges on the attributes of the nodes. The query returns the instances of the assigned node whose attributes match the provided search parameters.

  Node attribute queries are recommended for all cases that do not need complex query logic. In contrast to custom queries, node attribute queries are only modeled and therefore do not have to be implemented.

- **Custom Query:**
  Queries of this type execute application specific logic. In contrast to the node attribute query, this logic must be implemented in the implementing class of the query. The custom query can have an arbitrary data type structure that is handed over by the consumer to the query implementation at runtime.

  Custom queries must be used if the recommended node attribute queries do not fulfill the requirements, e.g. if specific query parameters must be handed over, or if the query logic is more complex than comparing attribute values.

Note: The BOBF Enhancement Workbench does not support enhancing existing standard BO queries. Moreover, it is e.g. not possible to assign a query to the ROOT node, which returns instances or their keys of the ITEM node. **How to enhance existing standard queries is described in section 7.1 of this document**.

New enhancement queries can be added to extensible standard nodes and new subnodes. The wizard for this task guides you through the following required steps.

1) Open the corresponding Enhancement Object and select the node that the new query shall be assigned to. In the context menu of the node (click right mouse button) choose ***Create Query*** to start the wizard. Example:

   The new subnode ZENH_SUBNODE of the Freight Order BO in the example Enhancement Object ZENH_TOR created in section 3.4.3.

2) The first step in the wizard is to specify the name for the new query and a description on the semantic and purpose of this new entity. Example:

Query Name	ZENH_DEMO_DET
Description	Demo Enhancement Determination

3) Maintain the Query Type: If you choose Node Attribute Query finalize the creation of the new query with step 5. Otherwise continue with step 4.

4) Define the implementing class and a query data type for the new Query (***only required and done in case of a Custom Query***). Example:

Implementing Class	ZCL_ENH_Q_DEMO_QUERY
Data Type	ZENH_S_SUBNODE1

The implementing class must implement interface /BOBF/IF_FRW_QUERY.

In the example, we used the structure of the node that the query gets assigned to which is the fixed standard query structure in case of a Node Attribute Query. If you create a Custom Query, you can place an arbitrary structure that contains the required search parameters.

5) Click on button *Complete* to finalize the creation of the new query.

6) (***Only required and done in case of a Custom Query***) Finally you need to implement the query logic in the query's implementing class that you have specified in the previous steps. Double click on the implementing class in the query details to start the implementation.

4 Techniques for Enhancing the Business Logic

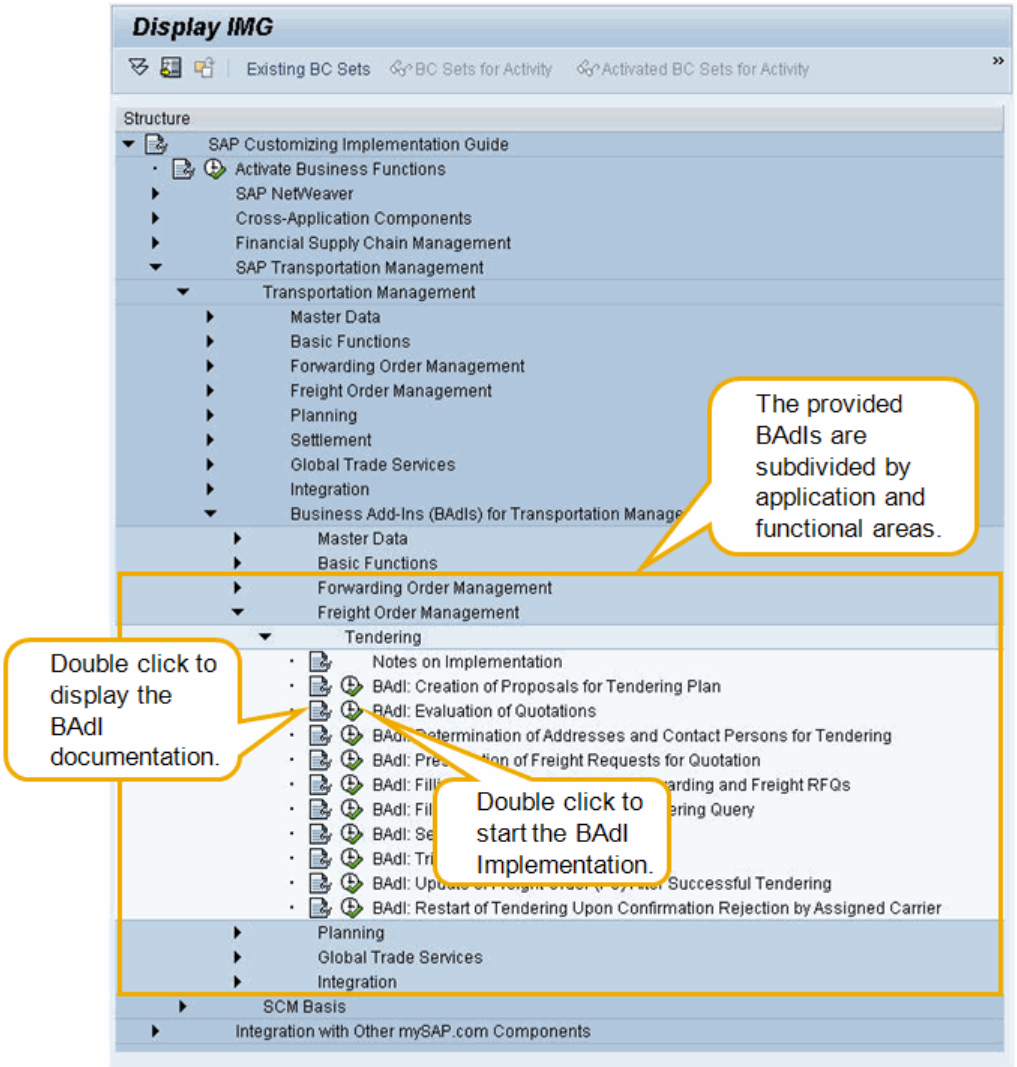
4.1 BAdIs

The Business Add-In (BAdI) concept is SAP's object-oriented plug-in concept for ABAP. BAdIs are a mechanism for planned extensibility. Planned means that the developer of the standard software already anticipates that others may want to change or enhance the standard behavior at certain points in the application. BAdIs are used to plug in custom behavior either in an additive way or by replacing the standard behavior.

4.1.1 Where and how to find BAdIs related to TM

For Transportation Management 8.0, more than 70 BAdIs are available in all application areas. They can be found in the IMG (transaction SPRO) under the following path:

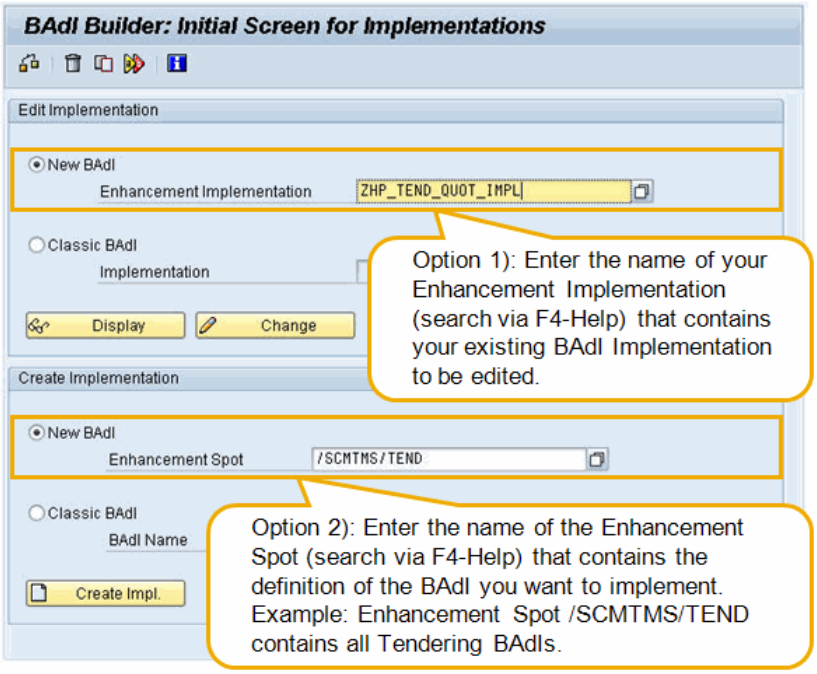
SAP Transportation Management → Transportation Management → Business Add-Ins (BAdIs) for Transportation Management.



Picture: TM BAdIs in the IMG.

4.1.2 Implementing a BAdI

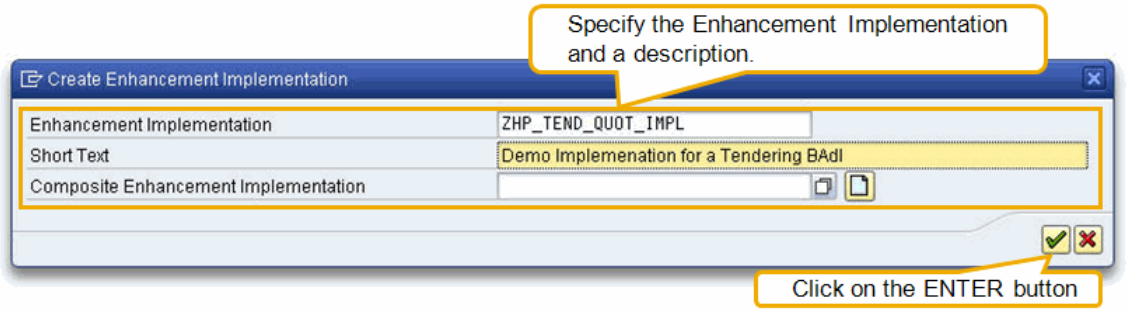
A BAdI implementation can be started directly from the IMG. As an alternative, transaction SE19 can be used to either edit existing enhancement implementations or create new ones. Besides the initial screen, the other steps to implement a BAdI with SE19 are the same as the procedure starting from the IMG.



Picture: Defining the required Enhancement Implementation.

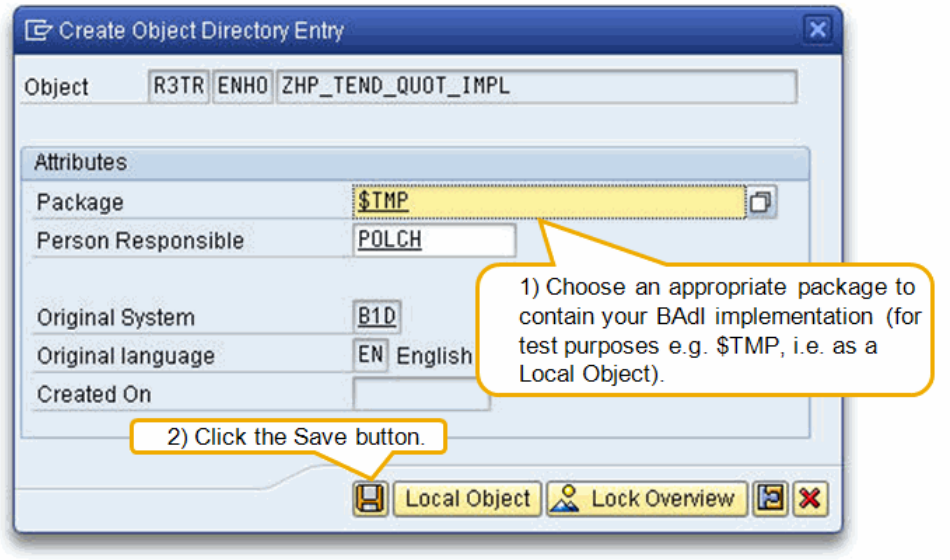
When starting from the IMG, just click on the second icon next to the BAdI name (see picture 6). This allows also the navigation to existing implementations of the corresponding BAdI.

1) When starting a BAdI Implementation directly from the IMG, the first step is to specify an Enhancement Implementation and a Short Text for it. This Enhancement Implementation serves as a container for your implementation steps done in the following.



Picture: Defining the required Enhancement Implementation.

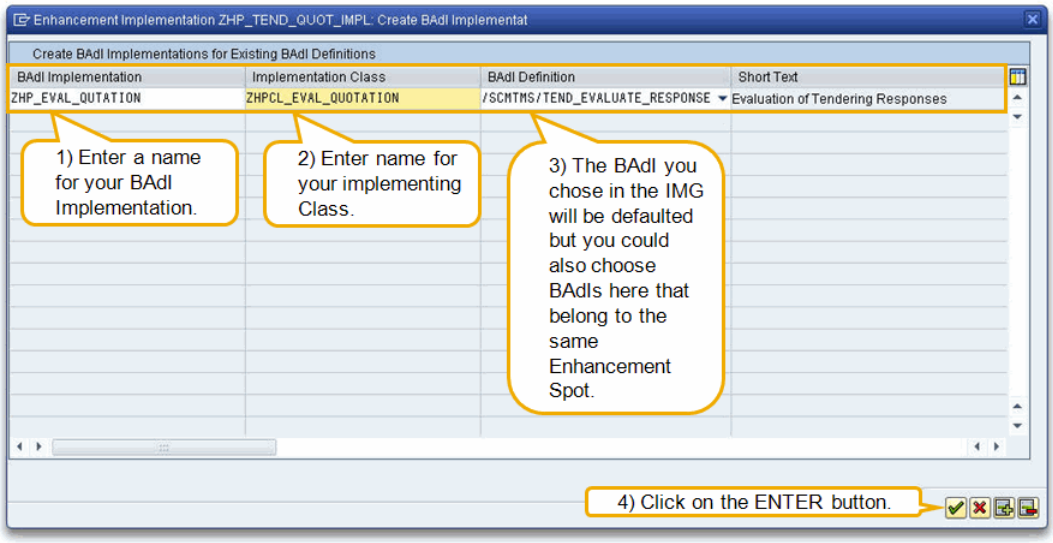
2) On the next popup, choose a package where you store your implementation and click on SAVE.



Picture: Defining the required Enhancement Implementation.

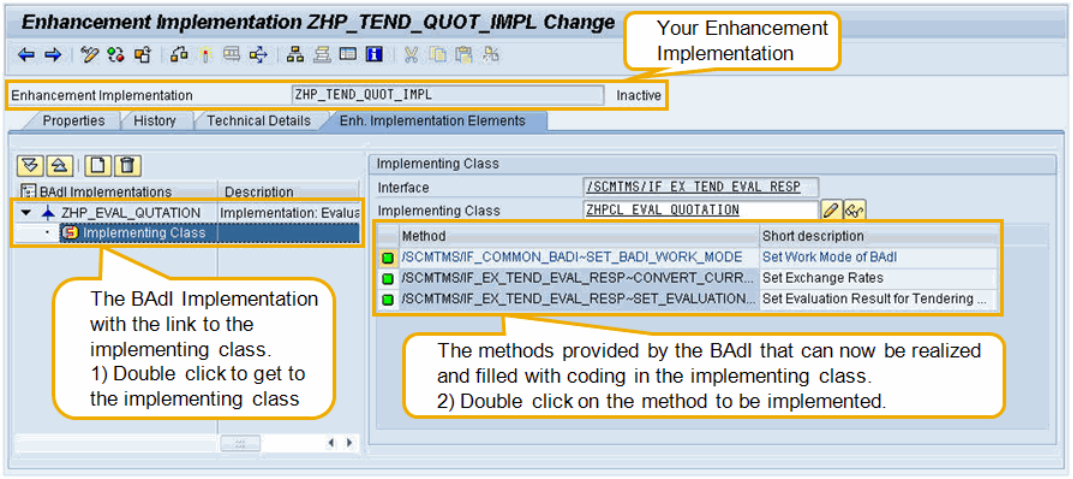
On the following screen you need to enter a BAdI Implementation and an Implementation Class. If you started your implementation from the IMG, the correct BAdI Definition is already defaulted.

Optionally, you could also choose another or additional BAdI Definitions here that belong to the same Enhancement Spot. In this example you can choose from the group of BAdIs that belong to the Enhancement Spot /SCMTMS/TEND which contains all Tendering related BAdIs.



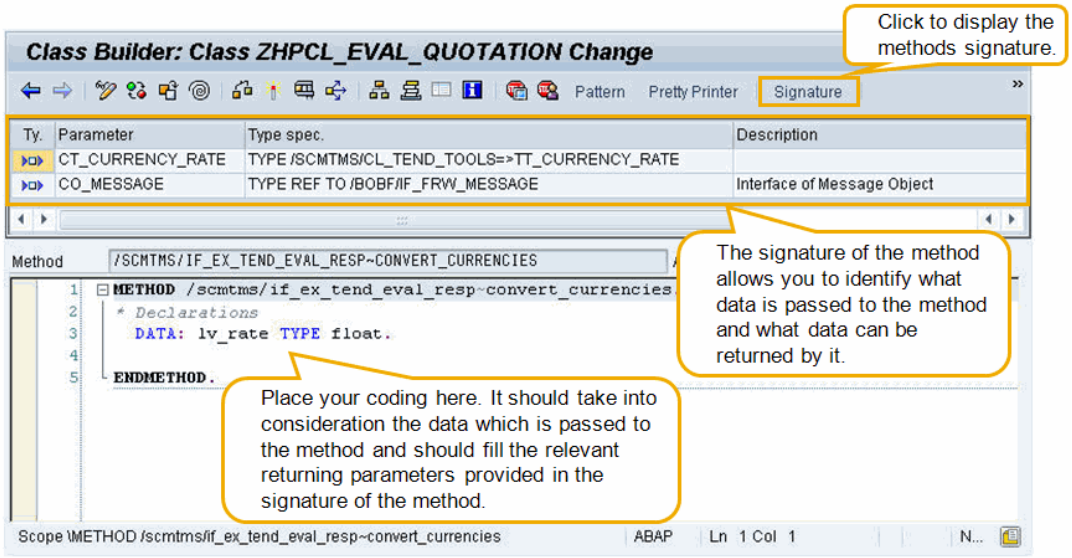
Picture: Specifying a BAdI Implementation and the implementing Class.

3) A BAdI can provide one or more methods that serve different purposes. So the next step is to navigate to the implementing class to get the required methods implemented.



Picture: Navigating to the implementing Class of a BAdI.

4) Finally create an implementation for desired BAdI methods. Within this step it is helpful to display the signature of the method to see what data it receives and what data it is able to return as a result. The displayed signature allows direct navigation to the DDIC objects used for its parameters.



Picture: Implementing a selected BAdI method.

Finally, after having implemented the required BAdI methods, the implementation needs to be activated. This comprises activating the method implementations as well as activating the Enhancement Implementation (see also picture in step 4 where the Enhancement Implementation is still inactive). To get your implementation up and running, both need to be active.

4.2 Process Controller Strategies

The Process Controller Framework (PCF) allows the flexible definition of application processes. This is accomplished by defining a process as a sequence of methods which represent the single process steps. Such a sequence of methods is called a Strategy.

Using the PCF means the definition of an application process as a sequence of methods (a Strategy) in customizing by SAP, partners and customers. Pieces of functionality can be packed into a method, which can then be included and used in a strategy. Partners and Customers can define their own methods and combine them either to completely new strategies or they can include their own methods in SAP standard strategies, i.e. they also can enhance them with their customer specific functionality.

The following table with predefined services provides an overview of different application areas and functionalities within Transportation Management 8.0 that make use of the Process Controller Framework:

Service	Description / Purpose
COPY_CONTR	Copy Control
DDD_DET	Distance and Duration Determination
GEO_DET	Geo Coordinate Determination
GEO_ROUTE	Geo Route Determination
RG_DYNAMIC	Dynamic Routing Guide
RG_FIX	Fixed Routing Guide
TM_DG	TM Dangerous Goods
TM_GT_GRP	Customs Groups
TM_INVOICE	TM Invoicing
TM_TSPS	TM Carrier Selection
TOR_CHACO	TM Change Controller for Changes (Freight Order)
TOR_CREATE	TM Change Controller for Creation (Freight Order)
TOR_DELETE	TM Change Controller for Deletion (Freight Order)
TOR_DSO	TM Direct Shipment Options (Freight Order)
TOR_SAVE	TM Change Controller for Saving (Freight Order)
VSR	TM VSR Optimizer
VSR_INTER	TM VSR Interactive Planning

4.2.1 Relevant parts of the Process Controller

The Process Controller Framework comprises the following entities:

- **Service:**
  A service is the definition of strategies and methods working on the same process. It is used to clearly separate the maintenance.

- **Method:**
  All methods share the same interface of an object for providing parameters and a list of mutually independent requests. Some methods comprise functionality themselves, whereas others mainly encapsulate existing functionality (like EH&S check within RGE). There is a method pool for each process, and each method pool contains all methods which the application process requires in order to define its strategies.

- **Strategy:**
  A strategy serializes a selection of methods from the method pool. It brings them in the sequence in which they shall be executed by the Controller.

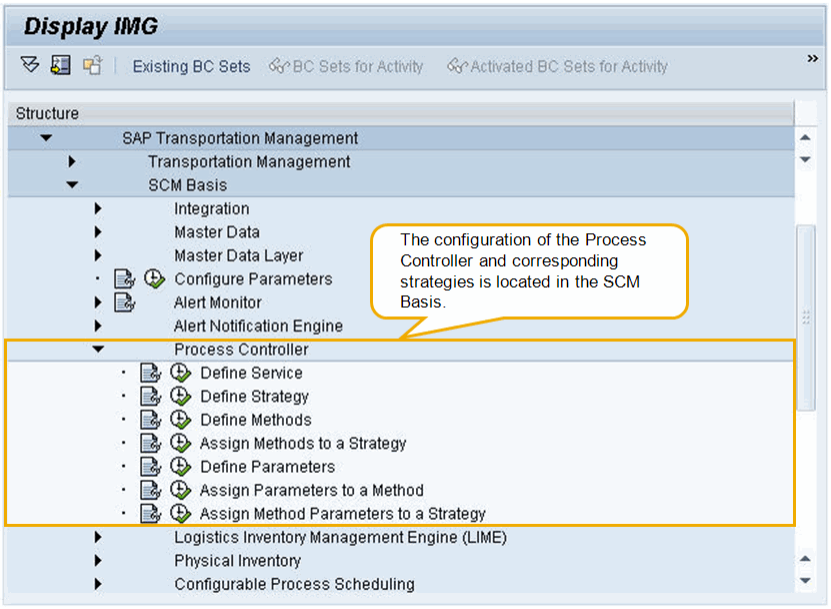
- **Parameter:**
  Parameters influence the behavior of the respective methods, but do not change the sequence in which the methods are executed. The Controller passes them on to each method through its interface. A parameter may not only have different values in different methods, but also in the same method as part of different strategies, or even in the same method of the same strategy as part of different requests.

- **Request:**
  The requests represent the various business demands (e.g. determination of a best route) on an application process. The Controller processes the requests by passing them on to the strategy methods through their interfaces. The requests may further allow storing possible solutions.

- **Application Class:**
  The methods in the pool of the Controller are provided by so-called application classes. Method execution by the Controller works (dynamically) since the definition of a new method includes the name of the providing application class. The results produced by a method are either passed on to all succeeding methods with the corresponding requests or they are stored externally, if the calling application, but not succeeding methods take advantage of these results.

4.2.2 Setting up a Process Controller Strategy

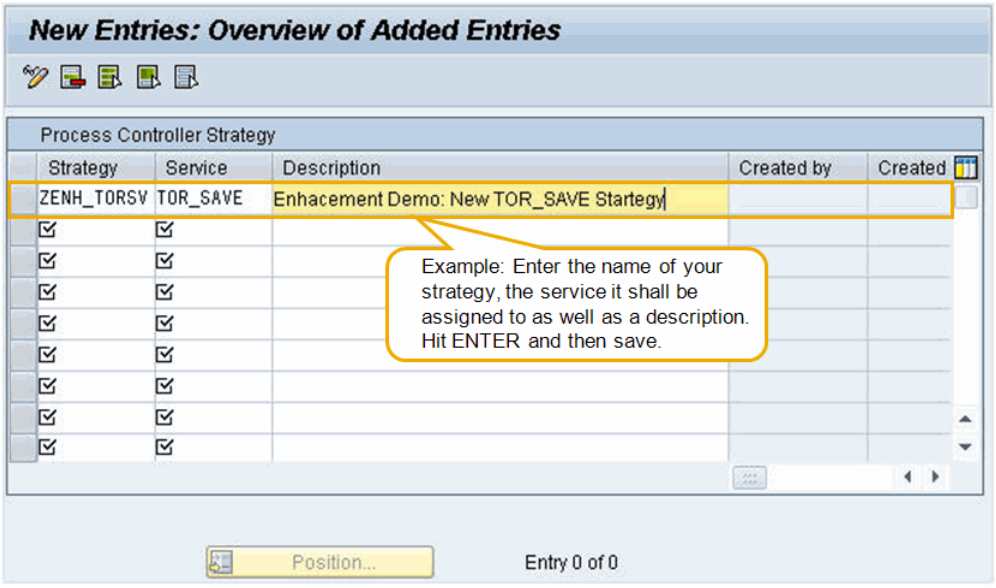
The configuration of Process Controller Strategies is done in the IMG (Transaction SPRO), located under the path shown below:



Picture: Configuration of PCF in IMG.

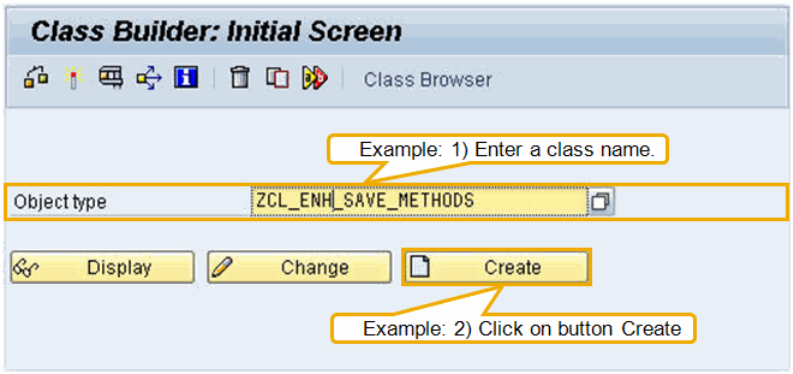
The path in IMG (Transaction SPRO) is: SAP Transportation Management → SCM Basis → Process Controller. From here all required steps for defining a strategy can be triggered.
As an example for the configuration of a Process Controller Strategy and the implementation of an example method, we create a new strategy for the SAP Standard Service TOR_SAVE. In the application area Freight Oder Management you can assign a Save Strategy to a Freight Order Type which allows executing follow-on functions when saving Freight Orders.

1) The first step is to create a new strategy belonging to the service TOR_SAVE. In the mentioned IMG path click on *Define Strategy* and on the following screen on *New Entries* (you could also mark an existing strategy and copy it with a new name).



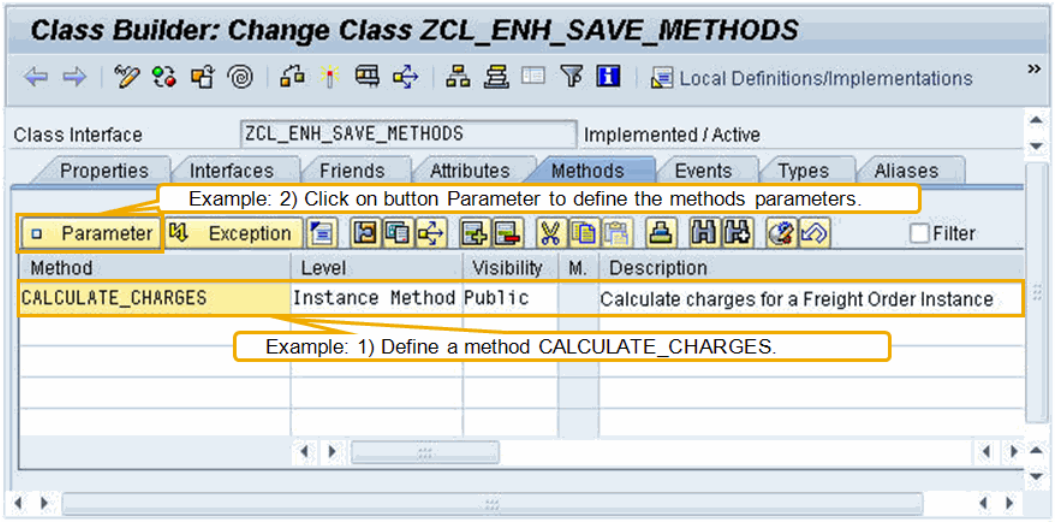
Picture: Creating a new strategy.

2) In the next step, we will define a class that provides a new method to be part of the method pool for the used service TOR_SAVE. The example method shall do a Charge Calculation for a Freight Order. For the definition of the class and its implementation, transaction SE24 is used (for demo purposes, you should use the customer namespace and save as local object).

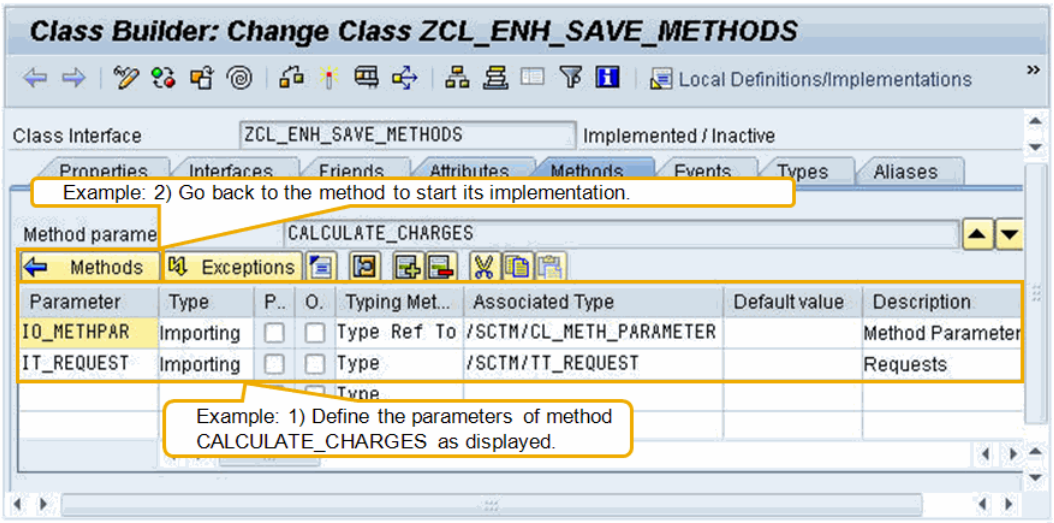


Picture: Creating a new class with transaction SE24.

3) Within the class we define a method CALCULATE_CHARGES which has to provide specific parameters so that the Process Controller Framework can execute it with the relevant data. After the parameters have been defined, the implementation of the method can be started by double clicking on the methods name in the methods overview (see picture 15). When the class implementation is complete, save and activate it



Picture: Defining a method with transaction SE24.



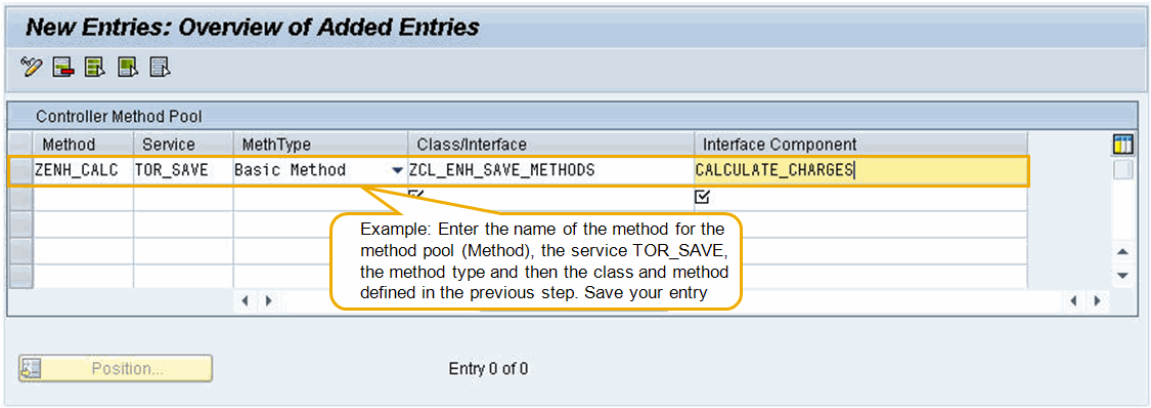
Picture: Defining method parameters with transaction SE24.

At runtime, the example method receives Process Controller Requests and executes the action CALC_TRANSPORTATION_CHARGES of all instances of the business Object TOR (e.g. Freight Orders) provided with each request. The example coding for the method looks as follows:

```
METHOD calculate_charges.

  DATA: lo_request             TYPE REF TO /sctm/cl_request,
        lo_tor_save_request    TYPE REF TO /scmtms/cl_chaco_request,
        lt_failed_key          TYPE /bobf/t_frw_key,
        lo_message             TYPE REF TO /bobf/if_frw_message.

  LOOP AT it_request INTO lo_request.
    lo_tor_save_request = /scmtms/cl_tor_helper_chaco=>cast_request
    ( lo_request ).
    CHECK lo_tor_save_request IS BOUND.

**********************************************************************
```

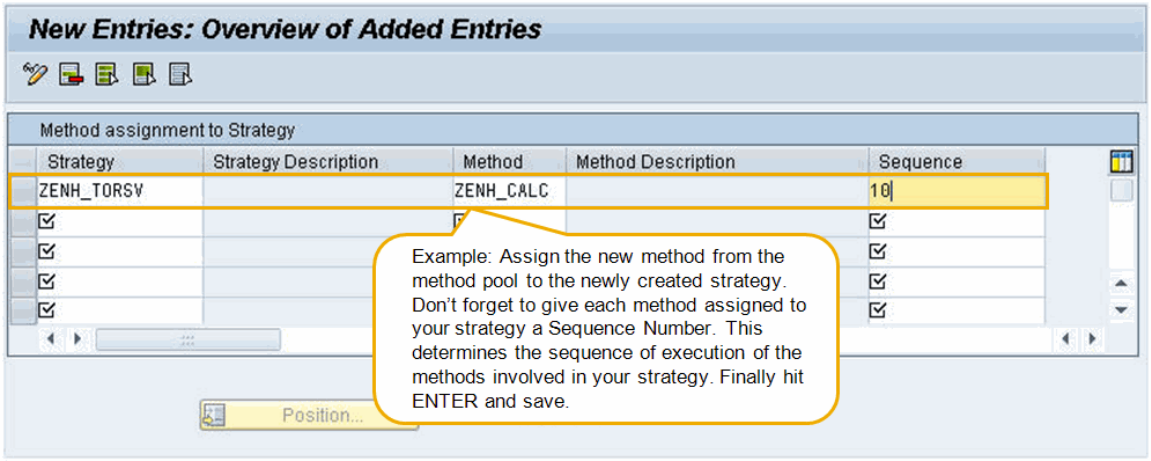
```
* calc. the charges for the uncancelled and unfinalized instances
**********************************************************************
    CALL METHOD
      lo_tor_save_request->mo_tor_srvmgr->do_action(
      EXPORTING
        iv_act_key    = /scmtms/if_tor_c=>sc_action-root-
                        calc_transportation_charges
        it_key        = lo_tor_save_request->mt_tor_key_active
      IMPORTING
        eo_message    = lo_message
        et_failed_key = lt_failed_key ).

    APPEND LINES OF lt_failed_key TO lo_tor_save_request->
                                     mt_failed_key.

* add messages to change controller request
    /scmtms/cl_common_helper=>msg_helper_add_mo(
              EXPORTING
                io_new_message = lo_message
              CHANGING
                co_message     = lo_tor_save_request->mo_message ).
  ENDLOOP.

ENDMETHOD.
```

4) Now we can assign our new method to the method pool of the TOR_SAVE service. This is again done in the IMG. In the IMG path click on *Define Methods* and on the following screen on *New Entries*.



Picture: Assigning the method to the method pool of service TOR_SAVE.

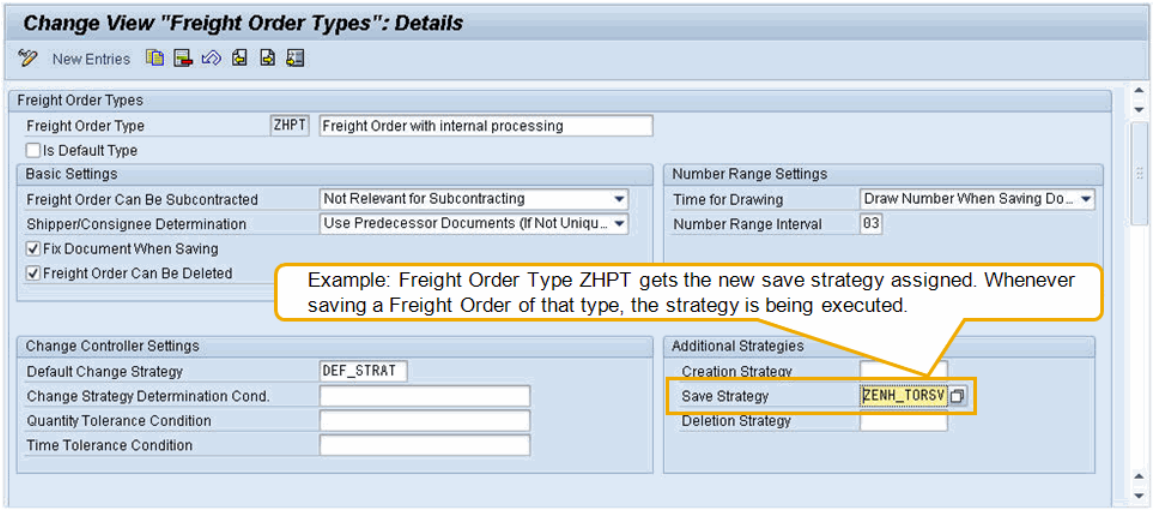
5) Finally, we assign the new method from the method pool to our new strategy which was defined in the first step. In the mentioned IMG path click on *Assign Methods to a Strategy* and on the following screen on *New Entries*.



Picture: Assigning the method from method pool to the strategy.

The example strategy is now ready to be used and allows triggering a Charge Calculation when saving e.g. a Freight Order that has this save strategy assigned in its corresponding Freight Oder Type. Further methods can be added to the strategy by repeating the described steps 3 - 5. Further methods can be added and implemented in the defined class to realize additional functionality that shall be executed on save of a Freight Order. These additional methods are then assigned to the method pool of the underlying service and to the strategy. The execution of the methods is done in the sequence defined in the strategy.

Now the new save strategy can be assigned to a Freight Order Type and is executed whenever a Freight Order of this specific type is saved. This assignment is done in the IMG under the following path: SAP Transportation Management → Transportation Management → Freight Order Management → Freight Order → Define Freight Order Types.



Picture: Assigning the new strategy to a Freight Order Type.

With similar steps customers and partners can not only create their very own strategies but can also enhance SAP standard strategies to execute additional, customer specific functionality.

4.2.3 Using the Process Controller Framework for a new process

The following section describes an example how to use the Process Controller Framework for the implementation of a new process. Running your own Process Controller application requires corresponding customizing settings as described in the previous sections as well as a technical implementation part.

1) Create a new Process Controller Service in customizing under the path: SAP Transportation Management → SCM Basis → Process Controller → Define Service. Example:

Service	**Description**
ZENHDEMO	Enhancement Demo Service

2) Define an external and internal request and result structure: The request data must contain the information on which process specific strategy shall be executed. An example set of the required structures and table types:

Structure		**Description**
ZENH_S_DEMO_REQUEST_STR		Demo Request: Single Request (internal)
Component	**Typing Method**	**Component Type**
TOR_ID	Types	/SCMTMS/TOR_ID
TEXT	Types	/SCMTMS/STRING
APPROVAL	Types	BOOLEAN
APPROVALDATE	Types	/SCMTMS/DATETIME

Structure		**Description**
ZENH_S_DEMO_RESULT		Demo Request: Result (external)
Component	**Typing Method**	**Component Type**
ITEM_KEY	Types	/BOBF/CONF_KEY
ROOT_KEY	Types	/BOBF/CONF_KEY
GRO_WEI_VAL	Types	/SCMTMS/QUA_GRO_WEI_VAL
GRO_WEI_UNI	Types	/SCMTMS/QUA_GRO_WEI_UNI

Also define the corresponding table types:

Table Type	**Description**
ZENH_T_DEMO_REQUEST_STR	Demo Request: Request Table (internal)
Line Type	
ZENH_S_DEMO_REQUEST_STR	

Table Type	**Description**
ZENH_T_DEMO_RESULT	Demo Request: Result Table (external)
Line Type	
ZENH_S_DEMO_RESULT	

Define the internal request and result structure: These structures are used within the request objects and could be the same as the external structures in a simple process.

Structure		**Description**
ZENH_S_DEMO_REQUEST_INT		Demo Request: Internal View
Component	**Typing Method**	**Component Type**
.INCLUDE	Types	ZENH_S_DEMO_REQUEST_STR

.INCLUDE	Types	ZENH_S_DEMO_RESULT
RETURN_CODE	Types	/SCMTMS/STRING

Structure		**Description**
ZENH_S_DEMO_REQUEST		Demo Request: External View
Component	**Typing Method**	**Component Type**
STRATEGY	Types	/SCTM/DE_STRATEGY
REQUESTS	Types	ZENH_T_DEMO_REQUEST_INT

Also define the corresponding table types:

Table Type	**Description**
ZENH_T_DEMO_REQUEST_INT	Demo Request: Internal View Table
Line Type	
ZENH_S_DEMO_REQUEST_INT	

Table Type	**Description**
ZENH_T_DEMO_REQUEST	Demo Requests: External View Table
Line Type	
ZENH_S_DEMO_REQUEST	

3) Create a **Request Object Class**: The request object represents the container for request and result data as well as process specific options. It will be filled by the controller and passed through the Process Controller Framework from method to method (i.e. it is the generic interface between the methods of a strategy).

- Create a class [namespace]CL_[process]_REQUEST which inherits from the super class /SCTM/CL_REQUEST. Example: **ZENH_CL_DEMO_REQUEST**.

- Add public attributes for request and result data as well as (if required) process specific options. In example class ZENH_CL_DEMO_REQUEST add the following attributes:

Attribute	**Level**	**Visibility**	**Typing**	**Associated Type**
MV_STRATEGY	Instance Attribute	Public	Type	/SCTM/DE_STRATEGY
MT_REQUESTS	Instance Attribute	Public	Type	ZENH_T_DEMO_REQUEST_INT
MT_RESULTS	Instance Attribute	Public	Type	ZENH_T_DEMO_RESULT
MO_MESSAGE_ HANDLER	Instance Attribute	Public	Type Ref To	/BOBF/IF_FRW_MESSAGE

- Implement a constructor for the class with the following parameters (the method CONSTRUCTOR is a public instance method):

Parameter	**Pass Value**	**Optional**	**Typing Method**	**Associated Type**
IV_REQUEST_ID			Type	/SCTM/DE_REQUEST_ID
IV_STRATEGY			Type	/SCTM/DE_STRATEGY
IT_REQUESTS			Type	ZENH_T_DEMO_REQUEST_INT

The example coding for the constructor looks as follows:

```
METHOD constructor.
* call constructor of super class
  super->constructor( iv_request_id ).

* assign constructor parameters to member varialbles
  mv_strategy = iv_strategy.
  mt_requests = it_requests.

ENDMETHOD.
```

4) Create a **Controller Class**: The controller object is responsible for mapping input data to internal structures, creating requests, starting the Process Controller Framework and finally mapping the results to the external structures.

- Create a class [namespace]CL_[process]_CONTROLLER which inherits from the super class /SCTM/CL_CONTROLLER. Example: **ZENH_CL_DEMO_CONTROLLER**.

- Create a private instance method CREATE_REQUEST_OBJECTS with the following parameters:

Parameter	Type	Pass Value	Typing Method	Associated Type
IT_REQUEST_DATA	Importing		Type	ZENH_T_DEMO_REQUEST
ET_STRATEGY_REQUESTS	Exporting	Yes	Type	/SCTM/TT_CON_REQUEST_STRATEGY
MR_MESSAGE	Changing		Type Ref To	/BOBF/IF_FRW_MESSAGE

The method is responsible for mapping the input data to internal structures, creating requests and sorting them into the Process Controller Framework.

The example coding for method CREATE_REQUEST_OBJECTS looks as follows and can be used as a “template”:

```
METHOD create_request_objects.

  DATA: lv_message           TYPE string,           "#EC NEEDED
        lo_request           TYPE REF TO zenh_cl_demo_request,
        lt_strategy_ids      TYPE /sctm/tt_strategy_id,
        lv_exists            TYPE boole_d,
        lv_request_id        TYPE /sctm/de_request_id.

  FIELD-SYMBOLS: <fs_request> TYPE zenh_s_demo_request.

  CLEAR et_strategy_requests.

* Fill complete strategy, method sequence, parameter and detail
* buffer
  CLEAR lt_strategy_ids.
  LOOP AT it_request_data ASSIGNING <fs_request>.
    INSERT <fs_request>-strategy INTO TABLE lt_strategy_ids.
  ENDLOOP.
  fill_strategy_buffer( lt_strategy_ids ).

* Create the requests according to their strategy
  lv_request_id = 0.
```

```
  LOOP AT it_request_data ASSIGNING <fs_request>.
    lv_exists = check_strategy( <fs_request>-strategy ).
    IF lv_exists = abap_false.
* Given Strategy does not exist; all requests assigned can
* not be handled
* MESSAGE e033(/sctm/rg) WITH <fs_request>-
* request_id INTO lv_message.
      CONTINUE.
    ENDIF.

*##############################################
* Insert your data mapping here if required!!!
*##############################################

    lv_request_id = lv_request_id + 1.
    CREATE OBJECT lo_request
      EXPORTING
        iv_request_id = lv_request_id
        iv_strategy   = <fs_request>-strategy
        it_requests   = <fs_request>-requests.


    assign_request_to_strategy(
      EXPORTING
        io_request   = lo_request
        iv_strategy  = <fs_request>-strategy
      CHANGING  ct_strategy_requests = et_strategy_requests ).

  ENDLOOP.

ENDMETHOD.
```

- Create a public instance method EXECUTE_DETERMINATION with the following parameters:

Parameter	Type	Opt.	Typing Method	Associated Type
IT_REQUEST_DATA	Importing		Type	ZENH_T_DEMO_REQUEST
IT_INPUT_METHPAR	Importing	Yes	Type	/SCTM/TT_CON_INPUT_METHPAR
ET_RESULT	Exporting		Type	ZENH_T_DEMO_RESULT
CT_REQUEST	Changing	Yes	Type	ZENH_T_DEMO_REQUEST
CO_MESSAGE_HANDLER	Changing	Yes	Type Ref To	/BOBF/IF_FRW_MESSAGE

The method is responsible Process Controller Framework execution including the data mapping.

The example coding for method EXECUTE_DETERMINATION looks as follows and can be used as a “template”:

```
METHOD execute_determination.

  DATA: lt_strategy_requests TYPE /sctm/tt_con_request_strategy.

  DATA: lo_request           TYPE REF TO /sctm/cl_request,
```

```
        lo_demo_request      TYPE REF TO zenh_cl_demo_request,
        lt_bapiret2          TYPE bapirettab.

  FIELD-SYMBOLS:
     <fs_strategy_request> TYPE /sctm/s_con_request_strategy,
     <fs_result>           TYPE zenh_s_demo_result.

  CLEAR et_result.

* Transform the supplied request data into request objects
  CLEAR lt_strategy_requests.

  create_request_objects(
    EXPORTING it_request_data      = it_request_data
    IMPORTING et_strategy_requests = lt_strategy_requests
    CHANGING  mr_message           = co_message_handler ).

* Fill created request objects into controller
  clear_refill_attributes( it_input_methpar = it_input_methpar
                 it_strategy_requests = lt_strategy_requests ).

  CLEAR lt_bapiret2.
  start_perform_requests( IMPORTING et_bapiret2 = lt_bapiret2 ).

* Get results / messages from every single request
  LOOP AT mt_strategy_requests ASSIGNING <fs_strategy_request>.
    LOOP AT <fs_strategy_request>-t_request INTO lo_request.
      lo_demo_request = zenh_cl_demo_methods=>
                        cast_request( lo_request ).
      CHECK lo_demo_request IS BOUND.

* Take over results
      LOOP AT lo_demo_request->mt_results ASSIGNING <fs_result>.
        INSERT <fs_result> INTO TABLE et_result.
      ENDLOOP.

* Take over request specific messages
    ENDLOOP.
  ENDLOOP.

ENDMETHOD.
```

5) Create a Method Pool Class: This class contains all the required functionality for the new process, i.e. it contains the implementation of the methods that can be combined to strategies

- Create a class [namespace]CL_[process]_METHODS.
  Example: **ZENH_CL_DEMO_METHODS**.

- Create a static public method CAST_REQUEST with the following parameters:

Parameter	Type	Pass Value	Typing Method	Associated Type
IO_REQUEST	Importing		Type Ref To	/SCTM/CL_REQUEST
RO_REQUEST	Returning	Yes	Type Ref To	ZENH_CL_DEMO_REQUEST

The method is responsible for casting the generic request into the process specific request. The example coding for method CAST_REQUEST looks as follows and can be used as a “template”:

```
METHOD cast_request.
  TRY.
      ro_request ?= io_request.
    CATCH cx_sy_move_cast_error.
      CLEAR ro_request.
  ENDTRY.
ENDMETHOD.
```

- For each of the required steps for the new process create a public instance method with the following parameters:

Parameter	Type	Typing Method	Associated Type
IO_METHPAR	Importing	Type Ref To	/SCTM/CL_METH_PARAMETER
IT_REQUEST	Importing	Type	/SCTM/TT_REQUEST

A general template for an implementation of the methods looks as follows:

```
METHOD your_functionality.
  DATA: lo_request    TYPE REF TO /sctm/cl_request,
        lo_[PROCESS]_request  TYPE REF TO [YOUR REQUEST
                                           OBJECT].

  LOOP AT it_request INTO lo_request.
    lo_[PROCESS]_request = cast_request( lo_request ).
    CHECK lo_[PROCESS]_request IS NOT INITIAL.

*################################################
*Execute your process here; take request data out
*of lo_[PROCESS]_request and put in result
*################################################
  ENDLOOP.
ENDMETHOD.
```

The process controller strategies can also include methods from other method pool classes. This possibility can be used to combine standard method with customer specific methods in a strategy where the customer specific methods are implemented in a separate, customer method pool class.

Add the following two example methods to class ZENH_CL_DEMO_METHODS with the following example code and the parameters as shown above.

```
METHOD first_enh_method.

  DATA: lo_request       TYPE REF TO /sctm/cl_request,
        lo_demo_request  TYPE REF TO zenh_cl_demo_request,
        ls_result        TYPE zenh_s_demo_result.
```

```
    BREAK-POINT.

  * get the demo request object and execute it
    LOOP AT it_request INTO lo_request.
      TRY.
          lo_demo_request ?= lo_request.
        CATCH cx_sy_move_cast_error.
          lo_request->mv_interrupt = abap_true.
          RETURN.
      ENDTRY.

      ls_result-root_key    = '2'.
      ls_result-item_key    = '10'.
      ls_result-gro_wei_uni = 'PC'.
      ls_result-gro_wei_val = 100.
      APPEND ls_result TO lo_demo_request->mt_results.

    ENDLOOP.

    BREAK-POINT.

  ENDMETHOD.

  METHOD second_enh_method.

    DATA: lo_request       TYPE REF TO /sctm/cl_request,
          lo_demo_request  TYPE REF TO zenh_cl_demo_request,
          ls_requests      TYPE zenh_s_demo_request_int.

    FIELD-SYMBOLS: <fs_result> TYPE zenh_s_demo_result.

    BREAK-POINT.

  * get the demo request object and execute it
    LOOP AT it_request INTO lo_request.
      TRY.
          lo_demo_request ?= lo_request.
        CATCH cx_sy_move_cast_error.
          lo_request->mv_interrupt = abap_true.
          RETURN.
      ENDTRY.

      LOOP AT lo_demo_request->mt_results ASSIGNING <fs_result>.
  *     Use the input data of the request to influence the result
        READ TABLE lo_demo_request->mt_requests
              INTO ls_requests INDEX 1.
        IF ls_requests-approval = abap_true.
          <fs_result>-gro_wei_val = <fs_result>-gro_wei_val * 10.
        ENDIF.
      ENDLOOP.

    ENDLOOP.

    BREAK-POINT.

  ENDMETHOD.
```

6) Configure a strategy in customizing as shown in the previous sections to test the new process. The following report allows direct execution of a strategy which is based on the new example process that was created with steps 1 - 5.

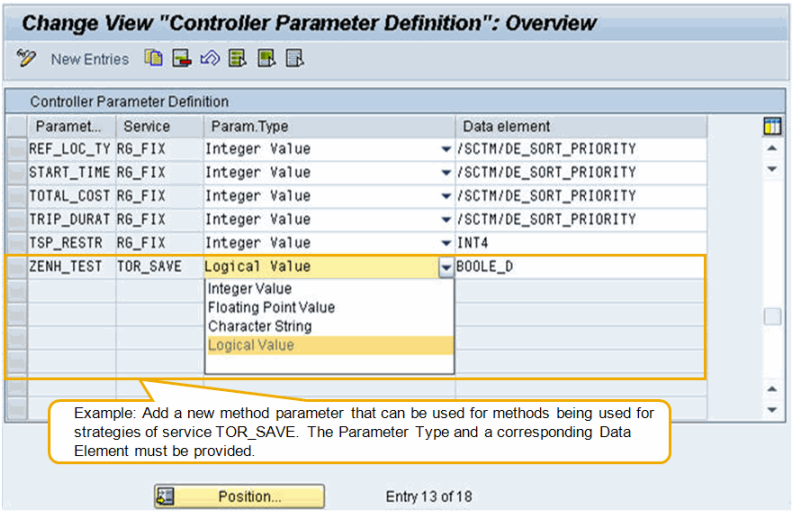
```
*&---------------------------------------------------------------------*
*& Report  ZREP_PCF_DEMO_DIRECT
*&---------------------------------------------------------------------*
*& This demo report allows direct execution of a demo strategy.
*&---------------------------------------------------------------------*
REPORT  zrep_pcf_demo_direct.

* declarations
DATA: lo_demo_controller TYPE REF TO zenh_cl_demo_controller,
      ls_req             TYPE zenh_s_demo_request,
      lt_req             TYPE zenh_t_demo_request,
      lt_demo_result     TYPE zenh_t_demo_result,
      ls_data            TYPE zenh_s_demo_request_int,
      lt_data            TYPE zenh_t_demo_request_int.

FIELD-SYMBOLS: <fs_result> TYPE zenh_s_demo_result.

BREAK-POINT.

* create an instance of the demo controller
CREATE OBJECT lo_demo_controller.

* define strategy to be executed (prepare in customizing!)
CLEAR ls_req.
* PLACE YOUR CONFIGURED TEST STRATEGY HERE!
ls_req-strategy = 'ZENHDEMO'.

* assemble some example input data for the strategy
CLEAR lt_data.
ls_data-tor_id       = '2'.
ls_data-approval     = abap_false.
ls_data-approvaldate = sy-datum.
ls_data-text         = 'Test'.
INSERT ls_data INTO TABLE lt_data.
ls_req-requests = lt_data.
INSERT ls_req INTO TABLE lt_req.

* execute the
lo_demo_controller->execute_determination(
                    EXPORTING it_request_data = lt_req
                    IMPORTING et_result       = lt_demo_result ).

BREAK-POINT.

WRITE: /,'A direct call of the Demo Controller'.
LOOP AT lt_demo_result ASSIGNING <fs_result>.
  WRITE: / 'Gross Weight Value',<fs_result>-gro_wei_val.
ENDLOOP.
```

Execute the example report with a consistent example strategy and debug it to see how it finally works in general. The example code contains implemented break-points at all relevant places in the code to see the different aspects of the strategy being executed.

4.2.4 Using Method Parameters

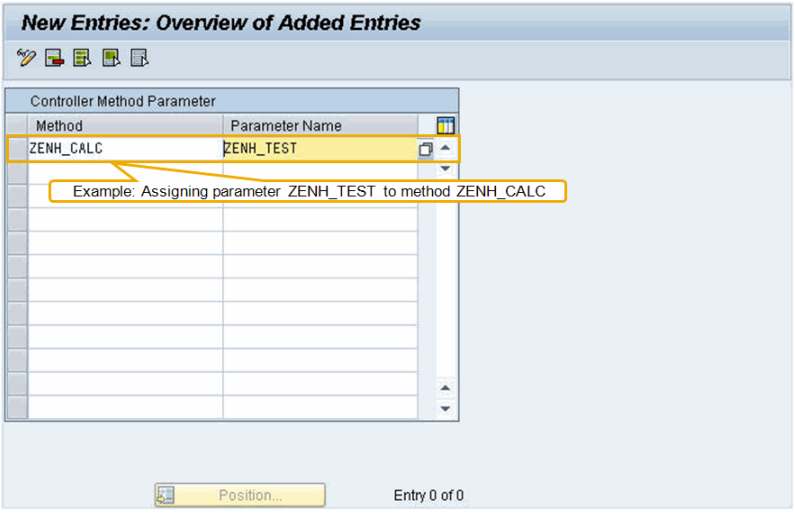
In case you define additional, similar strategies that only differ in minor parts of a method, you can use method parameters to reuse the same method for several strategies with a deviating logic. The logic of such a parameter must be implemented in the corresponding standard method.

1) In the IMG path for the Process Controller click on *Define Parameters* for defining method parameters. As an example, we define the new parameter ZENH_TEST for service TOR_SAVE which shall be a logical value defined by data element BOOLE_D. Save this customizing entry.



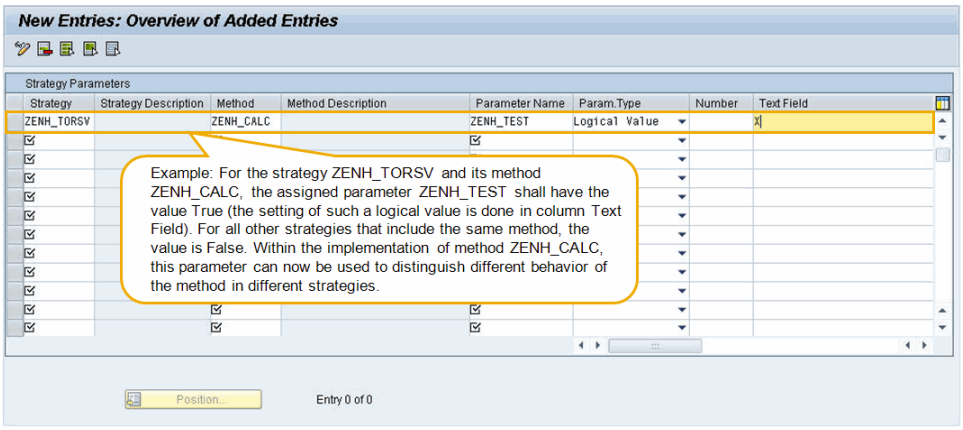
Picture: Defining a new parameter.

2) Now click on *Assign Parameters to a Method* in the IMG path for assigning the new parameter to our example method ZENH_CALC.



Picture: Assigning the new parameter to the method.

3) Parameter ZENH_TEST can now be used by the method ZENH_CALC in a strategy. Assume we have multiple strategies defined for service TOR_SAVE and all of them make use of example method ZENH_CALC. In the next step, we define that the parameter ZENH_TEST of method ZENH_CALC shall have the value True in the context of our example strategy ZENH_TORSV. In the IMG path click on *Assign Method Parameters to a Strategy*.



Picture: Setting the value for a method parameter for a strategy.

In the implementation of the method the parameter value can be retrieved as follows (the example code for reading the parameter is highlighted):

```
METHOD calculate_charges.

  DATA: lo_request              TYPE REF TO /sctm/cl_request,
        lo_tor_save_request     TYPE REF TO /scmtms/cl_chaco_request,
        lt_failed_key           TYPE /bobf/t_frw_key,
        lo_message              TYPE REF TO /bobf/if_frw_message.

  DATA: lv_zenh_test            TYPE boole_d.

  LOOP AT it_request INTO lo_request.
    lo_tor_save_request = /scmtms/cl_tor_helper_chaco=>
                          cast_request( lo_request ).
    CHECK lo_tor_save_request IS BOUND.

**********************************************************************
* read the parameters assigned to the method and take over the value
* depending on the parameter type you must use method
* - io_methpar->get_bool_par
* - io_methpar->get_float_par
* - io_methpar->get_int_par
* - io_methpar->get_string_par
* to get the corresponding parameter values returned
**********************************************************************
    lv_zenh_test = io_methpar->get_bool_par(
      iv_request_id = lo_tor_save_request->mv_id
      iv_method     = 'ZENH_CALC'
      iv_param      = 'ZENH_TEST' ).

**********************************************************************
* use the parameter to define/change the methods logic
**********************************************************************
    IF lv_zenh_test = abap_true.
      ...
    ENDIF.
  ...
  ENDLOOP.
ENDMETHOD.
```

4.3 Conditions

In TM 8.0 conditions can be defined and configured to influence the business logic. Such conditions are used as filters and for automated decision making in many areas of the TM application.

Conditions use a set of input values which can e.g. come from attributes of the TM Business Objects. These input values are then mapped onto corresponding output values. The output of a condition can be a simple Boolean which indicates to select a business object instance (yes/no), it can be a simple value like an ID of a business partner or it can be a set of output values which are determined by the condition based on the input values.

Example: In the customizing for a Forwarding Order Type, you can place a condition that will determine the Freight Unit Building Rule that shall be used when processing a Forwarding Order of this type. The condition can e.g. determine a Freight Unit Building Rule to be used based on source and destination location provided in the Forwarding Order. In the same customizing, you can define a similar condition that determines the sales organization to be used with the Forwarding Order.

4.3.1 Customizing: Condition Types and Data Access Definitions

A condition type defines possible input values as well as the output of conditions of that type. The input values are defined by so called data access definitions.

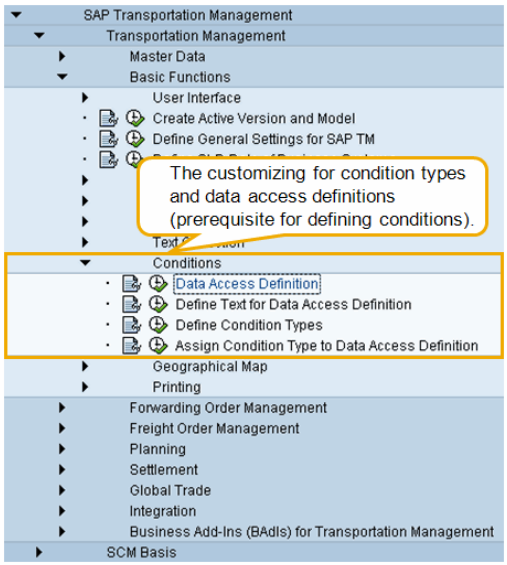
Data access definitions define how the content of the input values is read during runtime. This can e.g. be a generic access to a defined BO, BO node and BO node attribute (can be configured in the data access definition) or a specific class method that will provide the data (implementation required). A condition type gets assigned one or more such data access definitions. When creating a condition of this type, the input can be build up from these assigned data access definitions.

The output defined with a condition type can be single values like e.g. a simple Boolean or a Product ID. It can also be a complete structure with multiple attributes as the output result.

Example:

- Condition type /SCMTMS/FUBR allows defining conditions to determine Freight Unit Building Rules for Forwarding Orders. The data access definitions assigned to it is /SCMTMS/TRQ (Forwarding Order Type) and /SCMTMS/TRQ_ITEM_PRD (Product ID in the Forwarding Order Item). The output of this condition type is defined to be the Freight Unit Building Rule ID.
- Conditions of this type can now be defined to use either the Forwarding Order Type or the Product IDs of the Forwarding Order Items or even both to determine a Freight Unit Building Rule.
- The condition can be assigned to a Forwarding Order Type in customizing. Whenever creating a Forwarding Order of this type, condition will then determine a required Freight Unit Building Rule.

TM 8.0 delivers a set of predefined condition types and data access definitions. Customers and partners can also define their own condition types and data access definitions in the customizing if required. You can find the customizing for condition types and data access definitions via transaction SPRO under the following path: SAP Transportation Management → Transportation Management → Basic Functions → Conditions.



Picture: Conditions Customizing.

Besides the condition types and data access definitions delivered with TM 8.0, customers and partners can define their own corresponding entities.

4.3.2 Creating Data Access Definitions

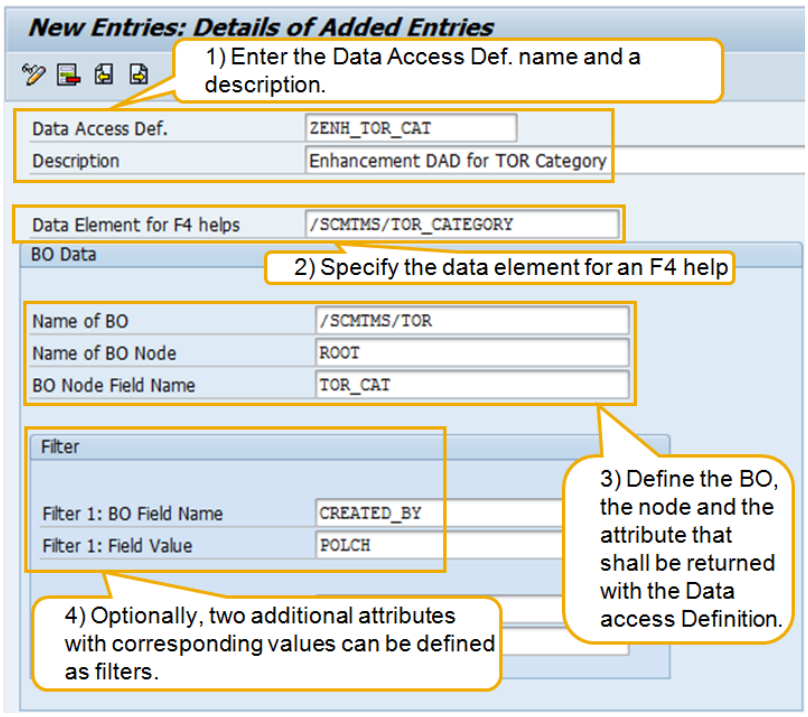
Data Access Definitions can be created using different approaches.

1) Defining a Data Access Definition by providing required **Business Object data** to access a single attribute of a given node. In the customizing follow the path SAP Transportation Management → Transportation Management → Basic Functions → Conditions → Data Access Definition.

   - Click on button *New Entries*.
   - Define a name and a description for the new Data Access Definition and provide the required details in section *BO Data*. Example: A Data Access Definition that returns the attribute TOR_CAT from the Root node of Business Object /SCMTMS/TOR (used for Freight Order, Freight Unit and others).

Field	Content	Comment
Data Access Def.	ZENH_TOR_CAT	The name of the new Data Access Definition.
Description	Enhancement DAD for TOR Category	A description of the new Data Access Definition.
Data Element for F4 help	/SCMTMS/TOR_CATEGORY	
Name of BO	/SCMTMS/TOR	Business Object Name
Name of BO Node	ROOT	The node of the Business Object where the attribute is read from.
BO Node Field Name	TOR_CAT	The name of the node attribute on the provided node.
Filter 1: BO Field Name	CREATED_BY	An additional filter attribute that has to be available on the same node.
Filter 1: Field Value	POLCH	The value for the filter.

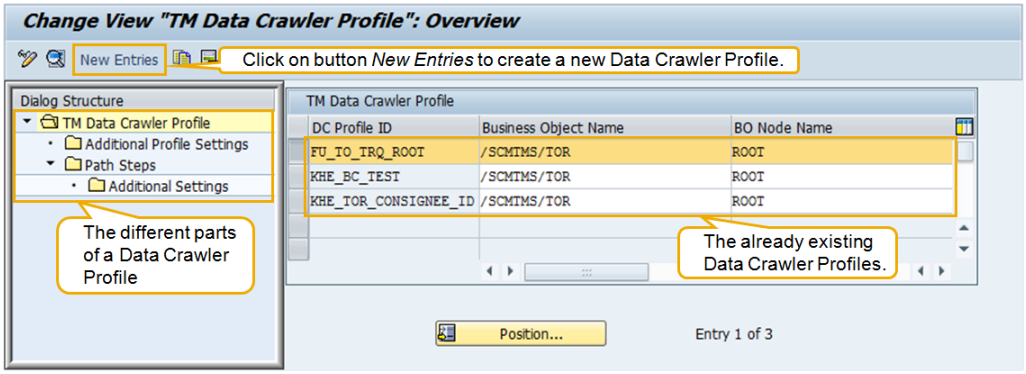
The Data Access Definition in this example realizes a generic access to the attribute TOR_CAT on the Root node of business object /SCMTMS/TOR with a corresponding data element assigned that provides a suitable F4 help during further usage of the Data Access Definition. As indicated in the example, you can also define up to two further attributes of the same specified node to serve as filters (example: only return the value for attribute TOR_CAT if attribute CREATED_BY = "POLCH"). This type of Data Access Definition does not require further implementation and can be used right away.



Picture: Creating a new Data Access Definition.

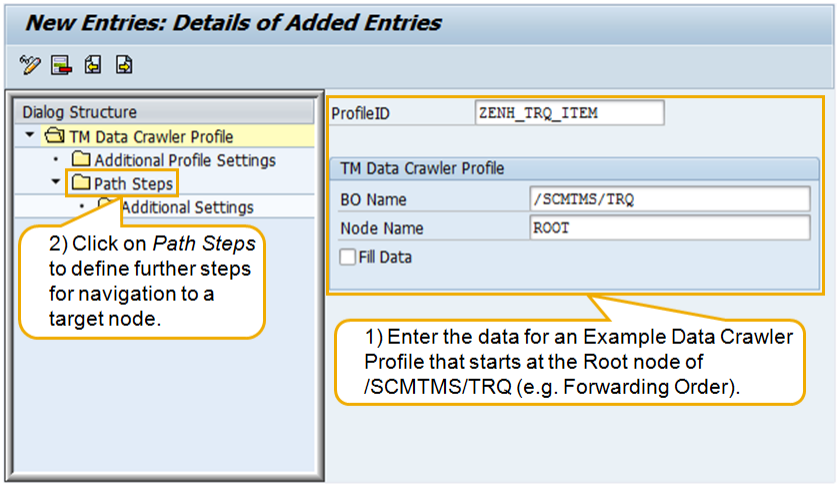
2) Define a Data Access Definition by defining a **Data Crawler Profile**. The Data Crawler is a tool that allows to define a (cross BO) navigation path from a source node to a target node and to retrieve required data from the nodes of the included nodes. Again, this type of Data Access Definition does not require further implementation and can be used right away.

The Data Crawler Profile information can be maintained with transaction **SM34**. The corresponding View Cluster is **/SCMTMS/VC_DCPRF**. In transaction SM34 click on button ***Maintain*** to create or change profile data (note that the View Cluster represents client independent data).



Picture: Maintaining View Cluster for Data Crawler Profiles.

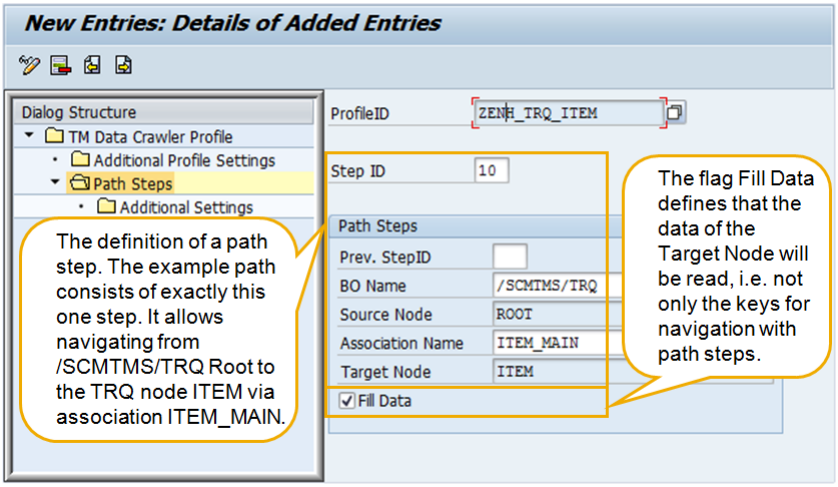
- Click on button ***New Entries*** (see picture above) to create the following example Data Crawler Profile.



Picture: Example Data Crawler Profile.

- The example Data Crawler Profile shall simply allow navigation from the Forwarding Order Root node to the Item Node. Enter the following data:

Field	Content	Comment
Profile ID	ZENH_TRA_ITEM	The name of the new Data Crawler Profile.
BO Name	/SCMTMS/TRQ	Name of the BO where the profile starts reading data → Source BO.
Node Name	ROOT	Name of the BO node where the profile starts reading data → Source BO node.
Fill Data	(space)	Optional. If this flag is set, the data of the defined source node will be read during execution of the profile.



Picture: An example path step of a Data Crawler Profile.

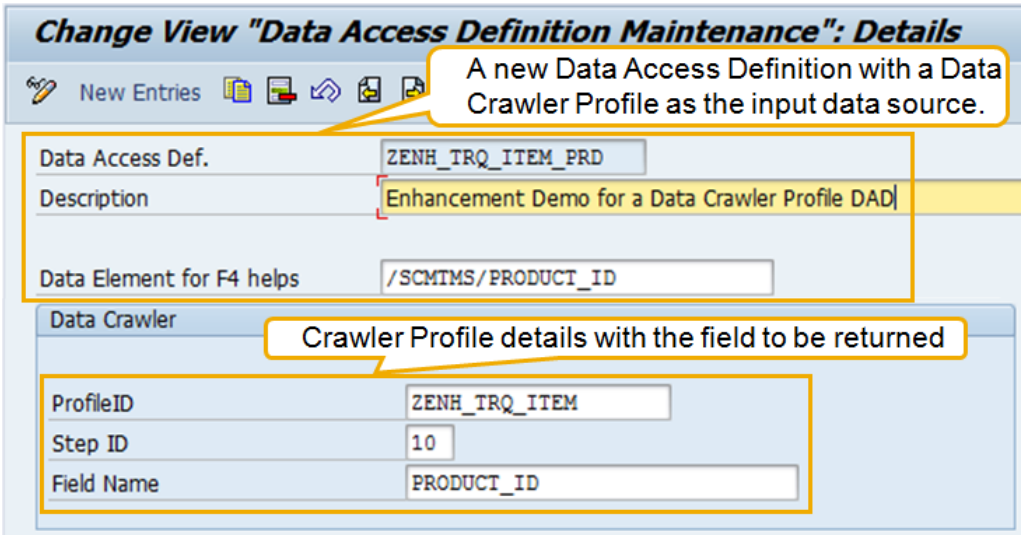
- In the dialog structure (see picture above) double click on ***Path Steps*** to add further target nodes that shall be navigated to. For the example enter the following path step:

Field	Content	Comment
Step ID	010	The number of the step. A Data Crawler Profile can have multiple steps that are combined to a path through the involved BOs and corresponding nodes.
Prev. Step ID	(space)	Allows specifying the previous step in the path after which the new step shall be executed.
BO Name	/SCMTMS/TRQ	The name of the Business Object
Source Node	ROOT	Predefined by the source node defined in the profile header.
Association	ITEM_MAIN	The association to be used for navigating to the Item node.
Target Node	ITEM	Predefined by the association and its target node.
Fill Data	(flag is set)	In case the flag is set, the data of the target node instances will be read. Otherwise if the flag is not set, it just returns source and target node keys that are used for potential navigation to further nodes in the node hierarchy, i.e. further path steps.

When using the Data Crawler in your own coding, it can be accessed by creating an instance of class /SCMTMS/CL_DATA_CRAWLER The class provides the implementation of all methods that are required for the usage of Data Crawler Profiles. The following example report shows how to read data with the Data Crawler Profile defined above:

```
*&---------------------------------------------------------------------*
*& Report  ZREP_DC_TEST
*&---------------------------------------------------------------------*
*& This report demonstrates the usage of a Data Crawler Profile to
*& read and retrieve data from a business object.
*&---------------------------------------------------------------------*
REPORT  zrep_dc_test.

DATA: ls_dc_prof_id  TYPE /scmtms/dc_profile_id,
      lt_dc_prof_id  TYPE /scmtms/t_dc_profile_id,
      ls_bo_inst_key TYPE /bobf/s_frw_key,
      lt_bo_inst_key TYPE /bobf/t_frw_key,
      lo_crawler     TYPE REF TO /scmtms/cl_data_crawler,
      lt_dc_data     TYPE /scmtms/cl_data_crawler=>tt_data,
      lo_message     TYPE REF TO /bobf/if_frw_message.

BREAK-POINT.

CLEAR: ls_dc_prof_id,
       lt_dc_prof_id.

* Secify the Data Crawler Profile to be used
ls_dc_prof_id = 'ZENH_TRQ_ITEM'.
APPEND ls_dc_prof_id TO lt_dc_prof_id.

* Specify the key of an example BO instance (here: a TRQ instance)
ls_bo_inst_key-key = '4D08C2BEC9015E16E10000000A421A6A'.
APPEND ls_bo_inst_key TO lt_bo_inst_key.

* Create an instance of the Data Crawler class
```

```
CREATE OBJECT lo_crawler
  EXPORTING
    it_profile_id = lt_dc_prof_id.

* Call the Data Crawler with the given profile and BO instance
CALL METHOD lo_crawler->get_data
  EXPORTING
    it_profile_id = lt_dc_prof_id
    it_key        = lt_bo_inst_key
  IMPORTING
    et_data       = lt_dc_data
    eo_message    = lo_message.

* The resulting data can be found in LT_DC_DATA

BREAK-POINT.
```



Picture: A Data Access Definition with a Data Crawler Profile as data source.

The Data Access Definition example in the following table makes use of the Data Crawler Profile ZENH_TRQ_ITEM defined above to read the Product ID from the items of a given Forwarding Order.

Field	Content	Comment
Data Access Def.	ZENH_TRQ_ITEM_PRD	The name of the Data Access Definition.
Description	Enhancement DAD	Description for the Data Access Definition.
Data Element for F4 helps	/SCMTMS/PRODUCT_ID	The data element that provides a suitable F4 help for the field to be returned.
Profile ID	ZENH_TRQ_ITEM	The Data Crawler Profile to be used.
Step ID	10	Defines that step in the path of the profile that provides the content for the field to be returned.
Field Name	PRODUCT_ID	The field/attribute to be returned by the Data Access definition.

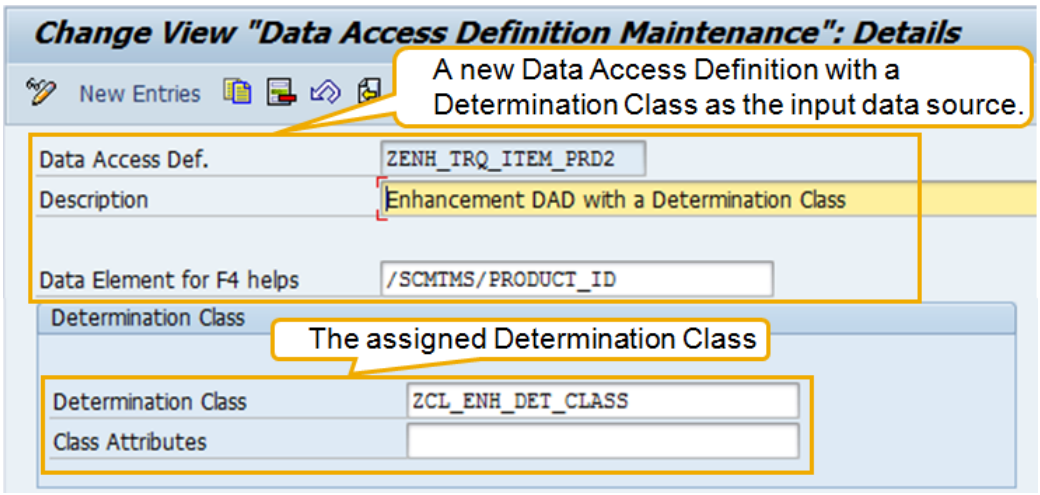
3) Realizing a Data Access Definition by implementing a **Determination Class**. While the first two options allow defining Data Access Definitions via configuration, this option requires creating a new class that implements interface /SCMTMS/IF_COND_DETERM_CLASS. The only method defined in this interface is EXTRACT_DATA_MASS.

   Class /SCMTMS/CL_COND_CAPA_CHECK represents an example for an implementation of such a determination class. Within method EXTRACT_DATA_MASS, the capacity utilization of provided Freight Orders is read and compared with the maximum capacity. The result returned by the method is a statement whether the capacity is sufficient (returned result = “S”) or is the capacity is overloaded (returned result = “O”). Using Determination Classes as the data source for a Data Access Definition especially makes sense when data needs to be read and analyzed to return an aggregated result rather than the data itself.

   The following example implementation can e.g. be used to define a Data Access Definition that realizes the same functionality as the Data Crawler Profile example before. Create a class ZCL_ENH_DET_CLASS that implements method EXTRACT_DATA_MASS as follows:

```
METHOD /scmtms/if_cond_determ_class~extract_data_mass.

  FIELD-SYMBOLS: <fs_data> TYPE any.

  DATA: lo_srvmgr      TYPE REF TO /bobf/if_tra_service_manager,
        lo_message     TYPE REF TO /bobf/if_frw_message,
        ls_item_data   TYPE /scmtms/s_trq_item_k,
        lt_item_data   TYPE /scmtms/t_trq_item_k,
        ls_dobo_link   TYPE /scmtms/s_cond_do_data_k,
        ls_key         TYPE /bobf/s_frw_key,
        ls_key_data    TYPE /scmtms/s_bokey_dokey_data.

  BREAK-POINT.

* Get a service manager to access the TRQ BO
  lo_srvmgr = /bobf/cl_tra_serv_mgr_factory=>
              get_service_manager( /scmtms/if_trq_c=>sc_bo_key ).

* Retrieve the Item Data for a given TRQ key
* via association ITEM_MAIN
  lo_srvmgr->retrieve_by_association(
    EXPORTING
      iv_node_key    = /scmtms/if_trq_c=>sc_node-root
      it_key         = it_boinst_key
      iv_association = /scmtms/if_trq_c=>sc_association-root-
                       item_main
      iv_fill_data   = abap_true
    IMPORTING
      eo_message     =  lo_message
      et_data        =  lt_item_data ).

* Build up the result data from the read bo data
  LOOP AT it_boinst_key INTO ls_key.
    UNASSIGN <fs_data>.
    CREATE DATA ls_key_data-data TYPE /scmtms/product_id.
    ASSIGN ls_key_data-data->* TO <fs_data>.

    LOOP AT it_dobo_link INTO ls_dobo_link.
      ls_key_data-bokey = ls_key-key.
```

```
        ls_key_data-dokey = ls_dobo_link-dobj_id.

        " Example: Take over the first Product ID found
        READ TABLE lt_item_data INTO ls_item_data INDEX 1.
        IF sy-subrc = 0.
          " Return the BO key, the link between Data Object
          " and the BO as well as the resulting Prodcut ID
          ls_key_data-bokey = ls_key-key.
          ls_key_data-dokey = ls_dobo_link-dobj_id.
          <fs_data>         = ls_item_data-product_id.
        ENDIF.

        " Insert result data to the return patameter
        INSERT ls_key_data INTO TABLE et_bokey_dokey_data.

      ENDLOOP.

    ENDLOOP.

    BREAK-POINT.

ENDMETHOD.
```



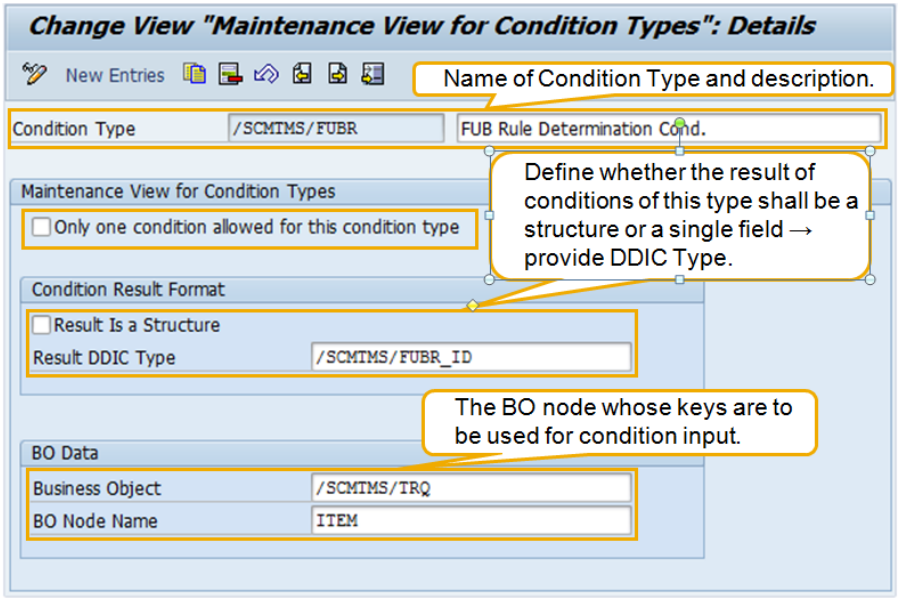
Picture: A Data Access Definition with a Determination Class as data source.

Field	Content	Comment
Data Access Def.	ZENH_TRQ_ITEM_PRD2	The name of the Data Access Definition.
Description	Enhancement DAD	Description for the Data Access Definition.
Data Element for F4 helps	/SCMTMS/PRODUCT_ID	The data element that provides a suitable F4 help for the field to be returned.
Determination Class	ZCL_ENH_DET_CLASS	The name of the Determination Class.
Class Attribute	(optional)	

4.3.3 Creating Condition Types

Just like Data Access definitions, customers and partners can define new Condition types. In the customizing follow the path SAP Transportation Management → Transportation Management → Basic Functions → Conditions → Define Condition Types.

- Click on button *New Entries*.
- Define a name and a description for the new Condition Type and provide the required details in section *Maintenance View for Condition Types*. Example: The standard Condition Type /SCMTMS/FUBR that returns a Freight Unit Building Rule ID. Conditions of this type use the Forwarding Order Type and Forwarding Order Item Product (see assignment of Data Access Definitions to this type in customizing).



Picture: A (standard) Condition Type.

Field	Content	Comment
Condition Type	/SCMTMS/FUBR	The name of the new Data Access Definition.
Description	FUB Rule Determination Cond.	A description of the new Data Access Definition.
Only one condition allowed for this condition type	[space]	If this flag is set, only one single condition can be defined with this type.
Result is a structure	[space]	If this flag is set, the condition is intended to return a result structure instead of a single attribute. In this case enter the structure name in field Result DDIC Type.
Result DDIC Type	/SCMTMS/FUBR_ID	The DDIC type for the result of a condition of this type.
Business Object	/SCMTMS/TRQ	The Business Object node whose keys are
BO Node Name	ITEM	

		used as input for the condition (check for consistency?).

4.3.4 Assign Data Access Definitions to Condition Types

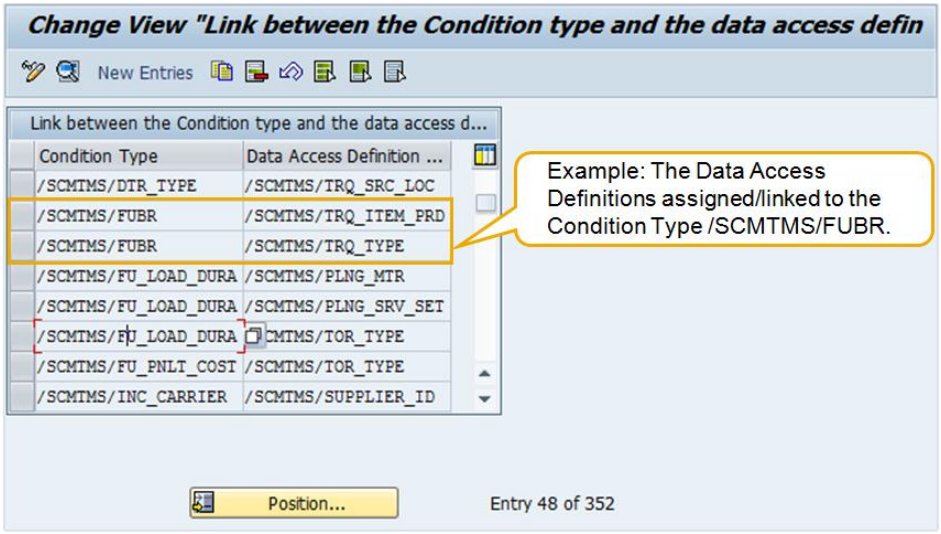
In this step, Data Access Definitions are assigned to a Condition type. When defining a condition of a given type, the assigned Data Access Definitions represent the pool of possible input data for the condition.

In the customizing follow the path SAP Transportation Management → Transportation Management → Basic Functions → Conditions → Assign Condition Type to Data Access Definition.

- Click on button *New Entries*.
- Define the Condition Type and the Data Access Definition on the following screen.
- Repeat this for all Data Access Definitions to be assigned to the Condition type.
- Save your data.

Example: The standard Condition Type /SCMTMS/FUBR has assigned two Data Access Definitions which serve as input and can be used for the definition of conditions of this type:

Condition Type	Data Access Definition	Comment
/SCMTMS/FUBR	/SCMTMS/TRQ_TYPE	The type of the Forwarding Order.
/SCMTMS/FUBR	/SCMTMS/TRQ_ITEM_PRD	The Forwarding Order Item Product ID.



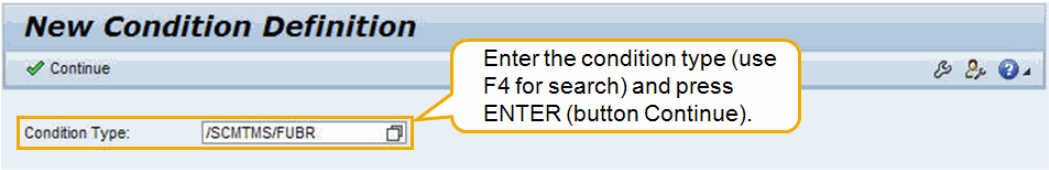
Picture: Assigning Data Access Definitions to a Condition Type.

4.3.5 Creating Conditions

Prerequisite for defining conditions is the proper setup and availability of the before mentioned condition types and data access definitions. The following examples describe how to set up a condition based on the standard condition types and data access definitions delivered with TM 8.0. The transactions for creating and editing conditions can be found in the user menu under the following path: Application Administration → General Settings → Conditions.

1) Choose ***Create Condition*** to start the creation of a new condition.

2) On the initial screen, enter the Condition Type that shall be the basis for the new condition.



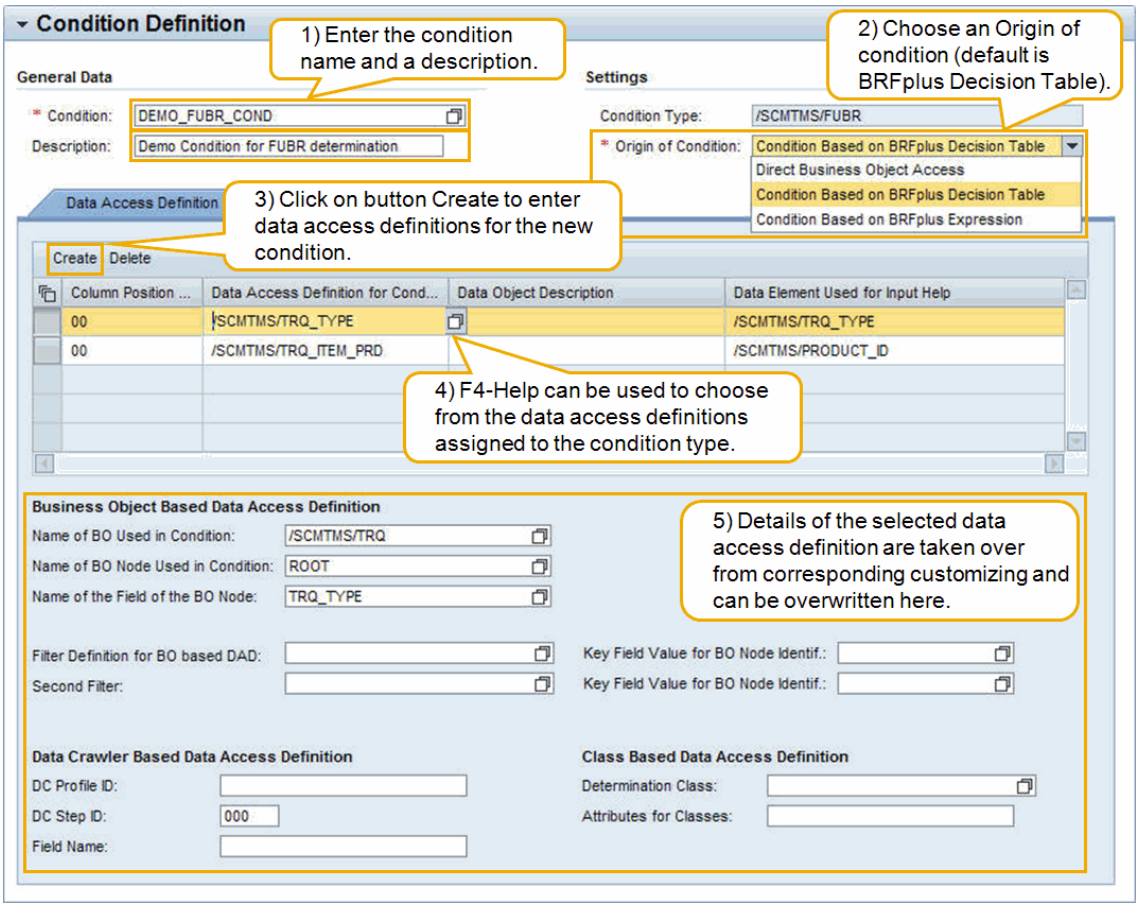
Picture: Enter condition type on the initial screen.

3) On the next screen enter the name of the new condition and a description. Moreover, select a corresponding Origin of Condition. For our example, we choose ***Condition based on BRFplus Decision Table*** which represents the default. In general, you can choose from three options:

- **Direct Business Object Access:**
  The system directly takes over the input values of a condition as the output values.
- **Condition based on BRFplus Decision Table:**
  The system maps a set of input values onto corresponding output values. This mapping is defined in a decision table (default).
- **Condition based on BRFplus Expression:**
  (To be clarified)

Example values to enter in this step:

Field	Value
Condition	DEMO_FUBR_COND
Description	Demo Condition for FUBR determination
Origin of Condition	Condition based on BRFplus Decision Table



Picture: Entering the first condition details.

4) The next step is to define the input values that shall be used by the new condition. On the tab *Data Access Definition* (see picture above) click on button Create to define a data access definition to be used by the new condition. You can choose any data access definition that was assigned to the used condition type in customizing before. Example:

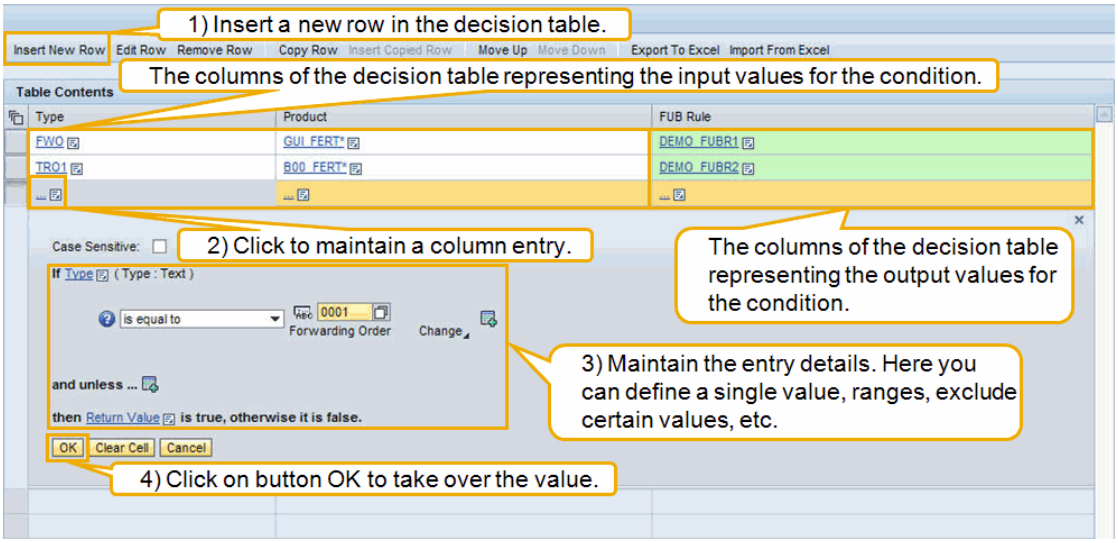
Data Access Definition for Condition	Comment
/SCMTMS/TRQ_TYPE	Forwarding Order Type
/SCMTMS/TRQ_ITEM_PRD	Forwarding Order Item - Product ID

On the same screen you can also adjust and add further details for the currently selected data access definition if required.

5) Change to tab *Decision Table* to maintain the entries in the decision table for the condition. With this decision table, input values are mapped onto corresponding output values of the condition. Example:

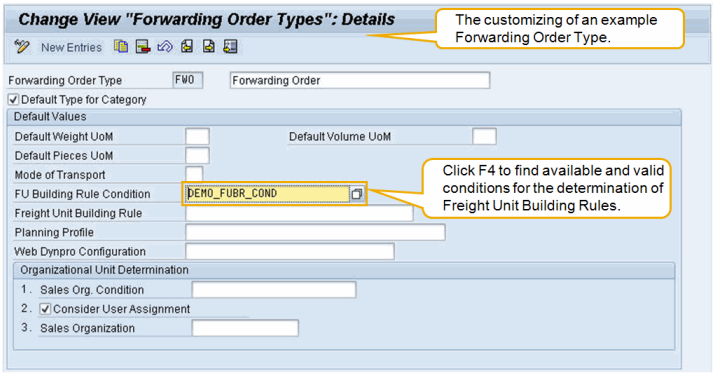
Input values as per the used data access definitions.				Output values as defined in the used condition type.
Comparison Operation	Type	Comparison Operation	Product	FUB Rule
Is equal to	FWO	Contains String	GUI_FERT	DEMO_FUBR1
Is equal to	FWO	Contains String	B00_FERT	DEMO_FUBR2
Is equal to	TRO1	Contains String	GUI_FERT	DEMO_FUBR1
Is equal to	TRO1	Contains String	B00_FERT	DEMO_FUBR3

Is equal to	0001	Contains String	B01_HAWA	DEMO_FUBR1
…	…	…	…	…



Picture: Maintaining the content of the decision table.

6) Save the defined condition. The condition is now ready to be used. The described example condition can be used in the customizing for Forwarding Order Types to define its way how to determine a Freight Unit Building. The Freight Unit building rule is determined when creating a Forwarding Order of a corresponding type (note: in case you enter a Freight Unit Building Rule on the Forwarding Order UI, the system is implemented in a way that this will override the rule determined by the condition).



Picture: The condition in customizing for FWO Type.

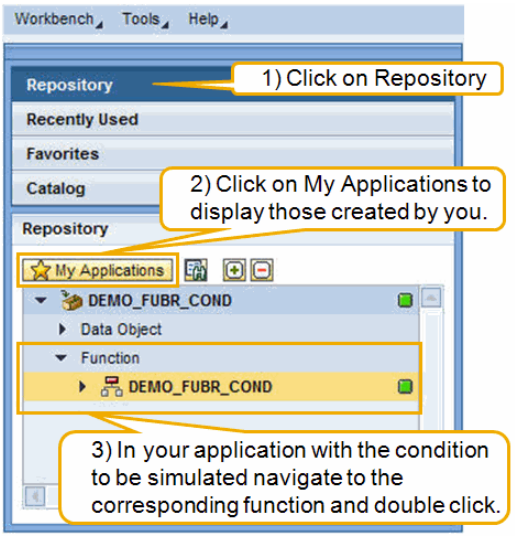
4.3.6 Simulating Conditions

Before using a newly created condition the function that it is supposed to realize can be simulated. This allows verifying the expected functional correctness in advance of using the condition in a production environment. This can help to prevent inconsistencies and unwanted results.

1) Start transaction BRF+. The Business Rule Framework Plus (BRF+) is the technical framework that is used within Transportation Management to handle conditions.

2) Click on tab *Repository* and then on button *My Applications*. You can find here a so called BRF+ application that contains the condition you created as a function. Navigate to your condition (Example: DEMO_FUBR_COND) in the Functions sub tree and double click on it. If

the selected function is in status *Active* and already signed with a green traffic light, the condition is already active and can be used.



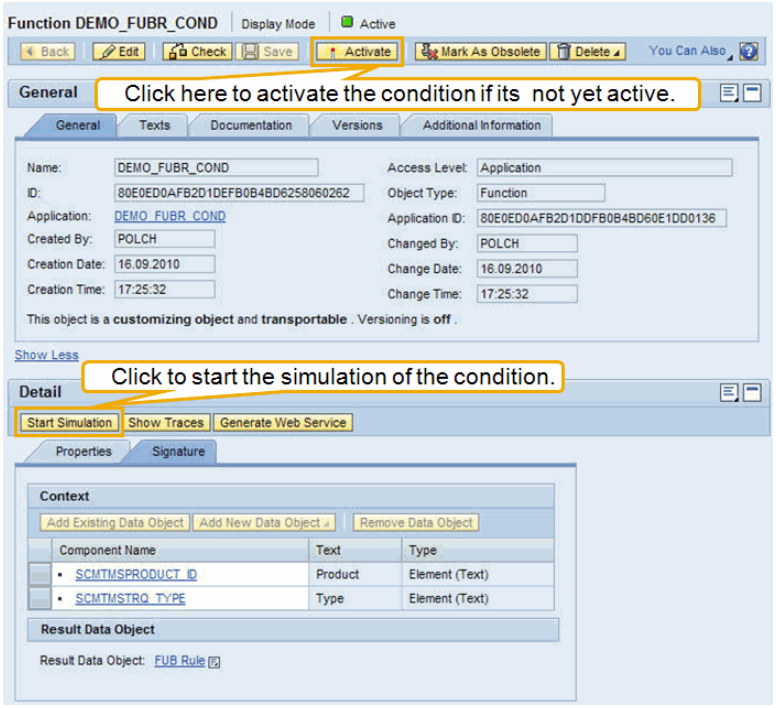
Picture: Initial Screen of BRF+.

3) On the right side of the screen you can now see the details of the condition as represented in the BRF+ framework. If the selected function does not yet show status Active, you can click on button Activate to activate the condition. After activating, the condition should be signed with a green traffic light. The active condition is now ready to be simulated or executed.

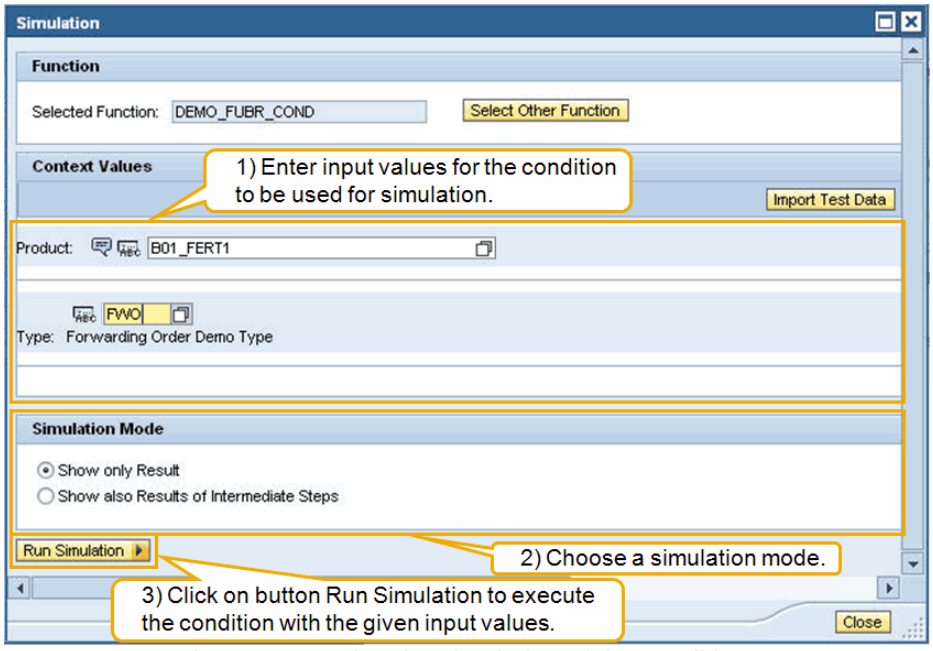
4) Click on button *Start Simulation* to get to the simulation screen. On the simulation screen you can enter a set of input values that will be used for the simulation run. The fields to be entered correspond to the input fields defined in the condition via its assigned data access definitions.

   Moreover, you can specify a simulation mode:
   - Show only Results: The simulation returns only the result of the condition.
   - Show also Results of Intermediate Steps: The simulation returns the result of the condition as well as a detailed log on how the result got determined. This simulation mode can be used for a more detailed analysis of the condition behavior

5) Click on button *Run Simulation*. The system displays either the result value or a detailed list of input values and how they were used to determine the result, depending on the before mentioned Simulation Mode that was used.



Picture: General and detailed data of the condition in BRF+.



Picture: Preparing the simulation of the condition.

4.3.7 Implementing a condition call in your coding

To see the execution of a condition, you can set a breakpoint in method ***PROC_CONDITIONS*** of class ***/SCMTMS/CL_COND_OL***. This class provides a variety of methods that help to implement condition calls. Especially, it helps to abstract from the more complex coding which is required to call BRF+ (Business Rules Framework +) which is used for the realization of conditions in TM 8.0.

The following example report implements the invocation of a condition for a given business object instance. It calls the example condition created in section 3.3.3, i.e. the determination of a Freight Unit Building rule for a given Forwarding Order instance. The condition must be assigned to the Forwarding Order Type as also described in section 3.3.3.

```
*&---------------------------------------------------------------------*
*& Report  ZREP_COND_TEST
*&---------------------------------------------------------------------*
*& This report demonstrates the usage of class /SCMTMS/CL_COND_OL,
*& methodPROC_CONDITIONS to execute conditions and receive back a
*& result.
*&---------------------------------------------------------------------*
REPORT  zrep_cond_test.

DATA: ls_bo_inst_key       TYPE /bobf/s_frw_key,
      lt_bo_inst_key       TYPE /bobf/t_frw_key,
      ls_condition_id      TYPE /scmtms/s_condition_id,
      lt_condition_id      TYPE /scmtms/t_condition_id,
      co_message           TYPE REF TO /bobf/if_frw_message,
      lt_cond_result       TYPE /scmtms/t_boid_cond_result,
      lt_cond_result_all   TYPE /scmtms/t_boid_cond_result.

CLEAR: ls_bo_inst_key,
       ls_bo_inst_key,
       ls_condition_id,
       lt_condition_id.

BREAK-POINT.

* Specify the key of an example BO instance (here: a TRQ instance)
ls_bo_inst_key-key = '4D08C62BC9015E16E10000000A421A6A'.
APPEND ls_bo_inst_key TO lt_bo_inst_key.

* Specify the condition to be executed
ls_condition_id-condition_id = 'DEMO_FUBR_COND'.
APPEND ls_condition_id TO lt_condition_id.

* Call method PROC_CONDITIONS
CALL METHOD /scmtms/cl_cond_ol=>proc_conditions
  EXPORTING
    it_boinst_key            = lt_bo_inst_key
    it_cond_id               = lt_condition_id
    iv_do_not_return_no_hits = abap_true
  IMPORTING
    et_bokey_cond_result     = lt_cond_result
  CHANGING
    co_message               = co_message.

* Collect all results from condition for later processing
INSERT LINES OF lt_cond_result INTO TABLE lt_cond_result_all.

BREAK-POINT.
```

The report also allows debugging the processing of a condition to learn more details on how it is actually executed during runtime. During execution, jump into method PROC_CONDITION and set further breakpoints to see the different parts of the condition processing. For this, the method calls further methods defined in class /SCMTMS/CL_COND_OL.

4.4 Implicit Enhancements

For ABAP programs, a number of so called implicit enhancement options exist, for example:

- At the end of an include,
- At the end of a structure definition (`types, data, constants, statics`),
- At the start and at the end of a method or function module,
- Replacing method implementations by overwrite-methods.

These options provide very powerful means to alter standard code. In some cases, there are no other ways to enhance, for example when adding a type or data definition. In other cases, SAP strongly recommends to use BAdIs instead, since they provide a defined interface. Nevertheless, some of the mentioned options shall be described here to be used as a means to enhance Transportation Management 8.0.

4.4.1 Use Implicit Enhancements with care

Implicit Enhancements should be used with care. The following aspects should be kept in mind when making use of this enhancement technique:

- Detailed knowledge on the application code is required for identifying the objects to be enhanced for a specific purpose.
- In case of methods that are not part of a stable interface, the signature can potentially change.
- This can lead to problems in case a pre- or post-method implementation relies on parameters from the methods signature, especially when parameters might have been removed.
- Enhancement SPAU might become necessary after updates to analyze conflict situations related to your Enhancement Implementations.
- In case of overwriting methods by copying the code of a standard method and adjusting it within an overwrite method implementation, you will not get the changes / corrections for the standard portion of your implementation.

4.4.2 Pre- and post-methods for existing methods

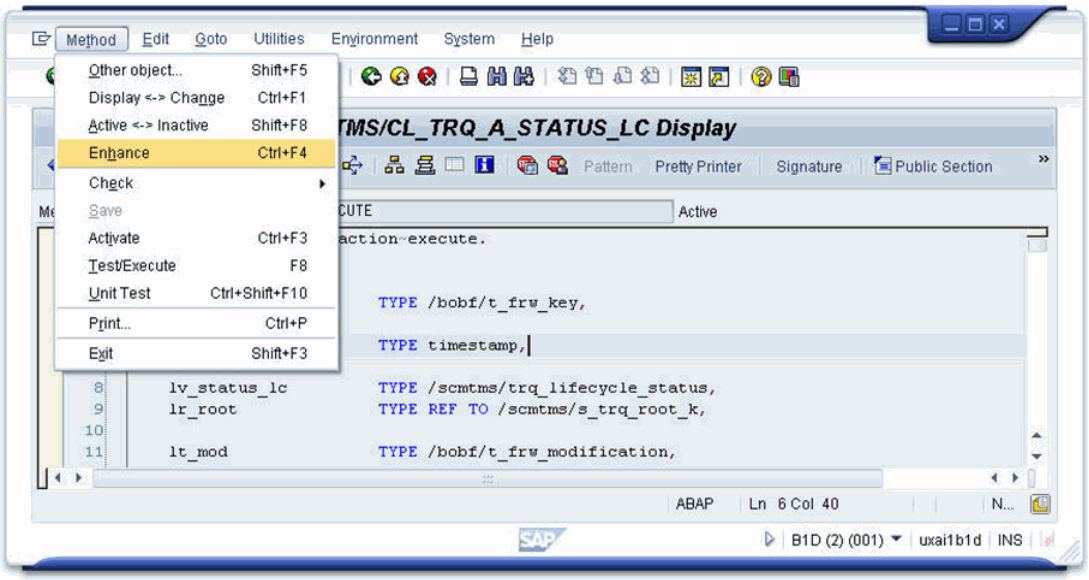
ABAP objects classes or interfaces can be enhanced by pre- or post-methods that are executed before or after the original method implementation. As an example on how to realize a pre- or post-method let's assume that we have identified the right method of a class where a customer-specific behavior needs to be added.

1) Navigate to the class that shall be enhanced by the implementation of pre- or post methods and display the class.

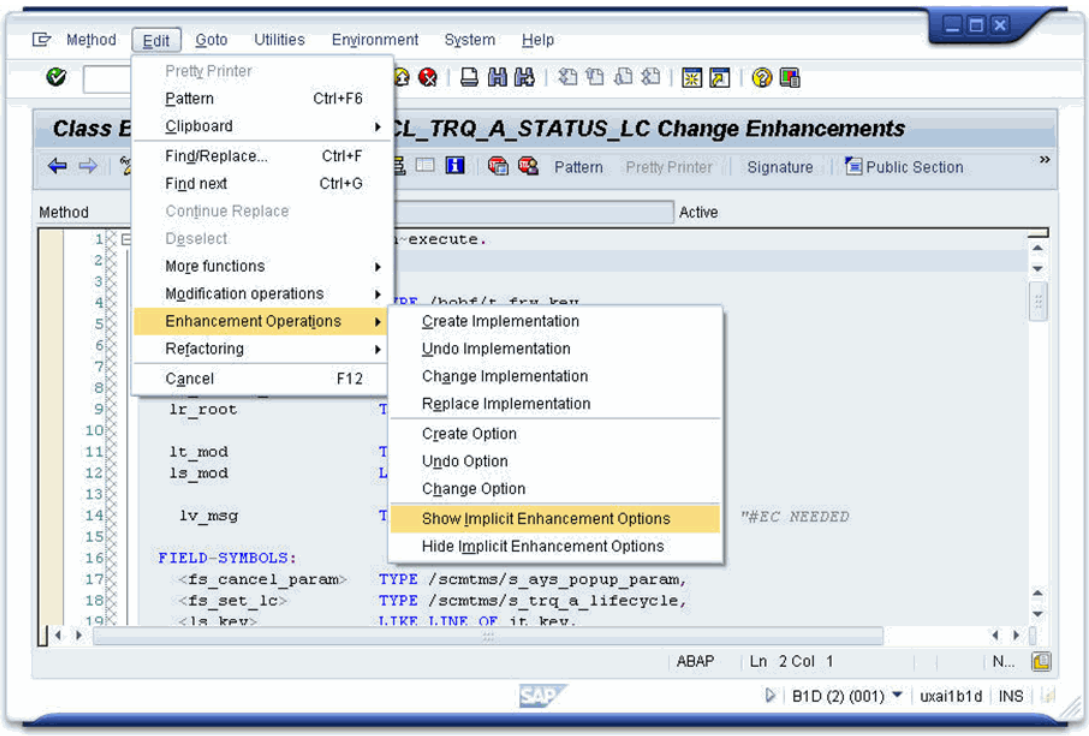
   - Transaction SE24 can be used, in case the class is already known.
   - Transaction SE80 can be used to navigate to the class.
   - Transactions /BOBF/CONF_UI and/or /BOBF/CUST_UI can be used to navigate to the implementing class of BO node elements like Actions, Determinations or Validations of the BO to be enhanced.

2) Double click on the method that shall be enhanced to display its current implementation.

3) Follow the menu path *Method → Enhance (Ctrl + F4)* to set the method into the enhancement mode. Then follow the menu path *Edit → Enhancement Operations → Show Implicit Enhancement Options* to display the pre- and post-method area for the selected method.

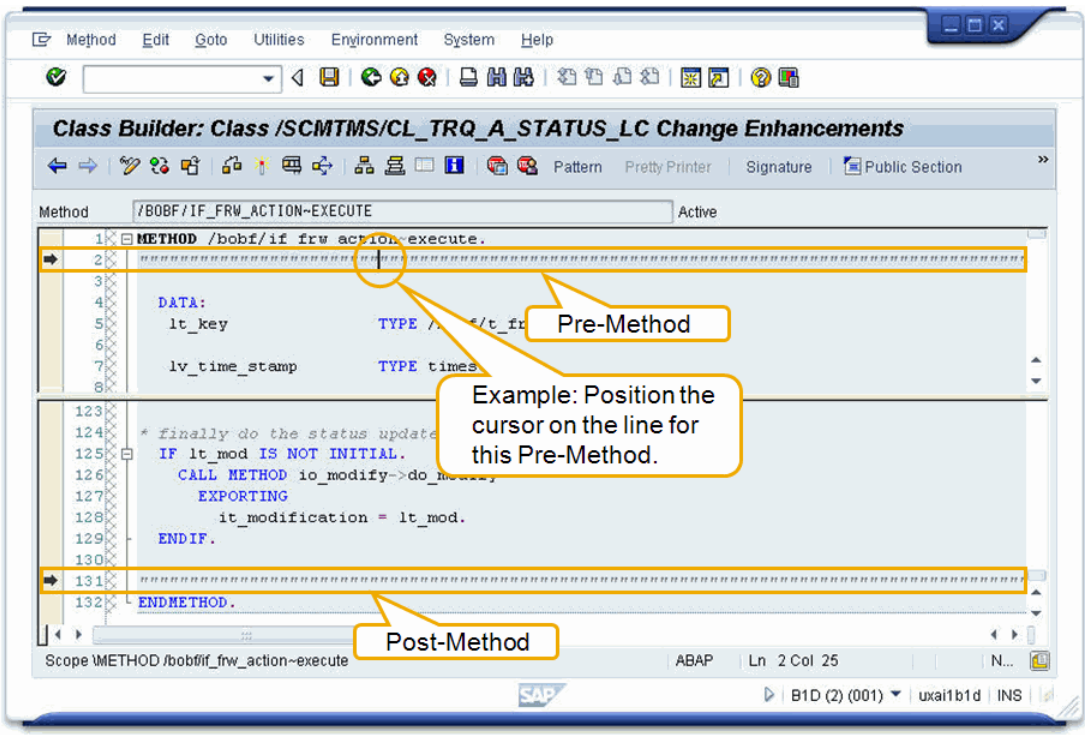


Picture 22: Set the method into the Enhancement mode.

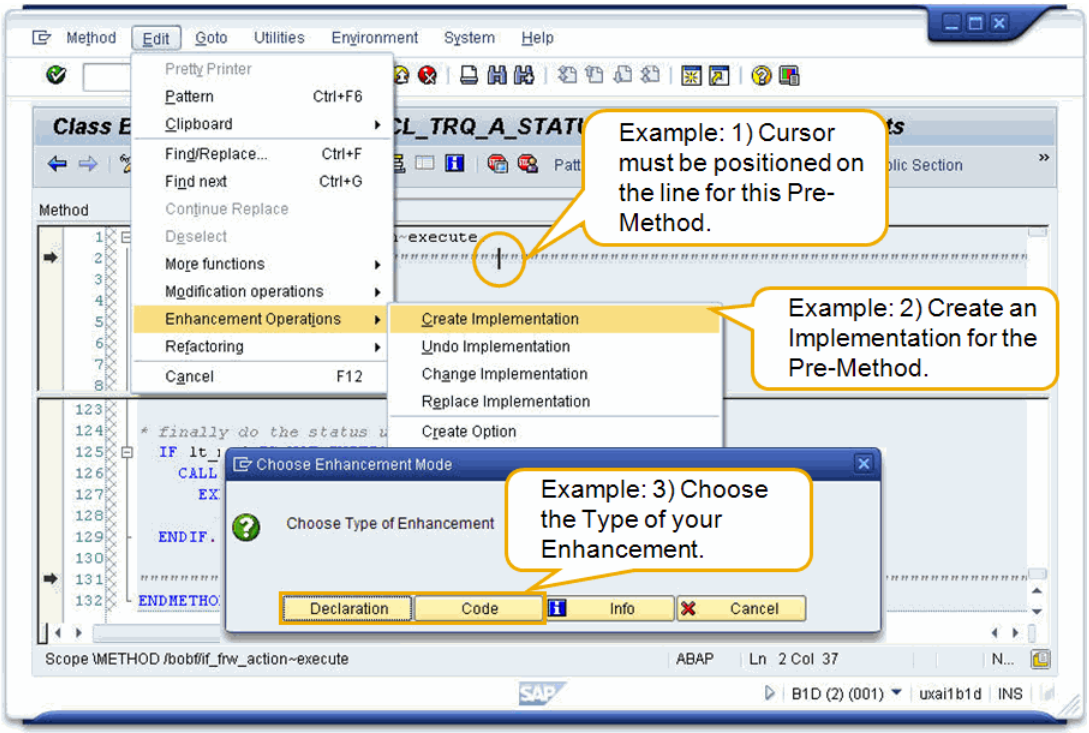


Picture 23: Display the implicit Enhancement Options of the method.

4) Position the cursor on the Pre- or the Post-Method and then follow the menu path *Edit* → *Enhancement Options* → *Create Implementation*. **Make sure that the cursor is (it must be) placed on the pre- or post-method line at this time**. On the following pop-up, choose the type of enhancement (Declaration or Code).



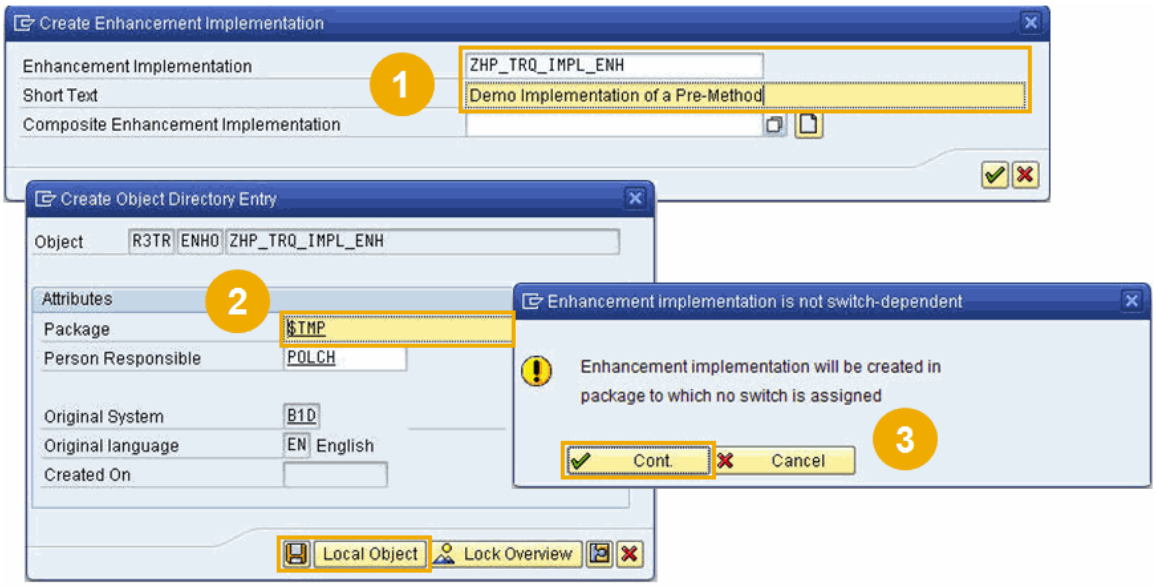
Picture 24: The pre- and post-methods the selected method.



Picture 25: Creating an Implementation for the pre-method.

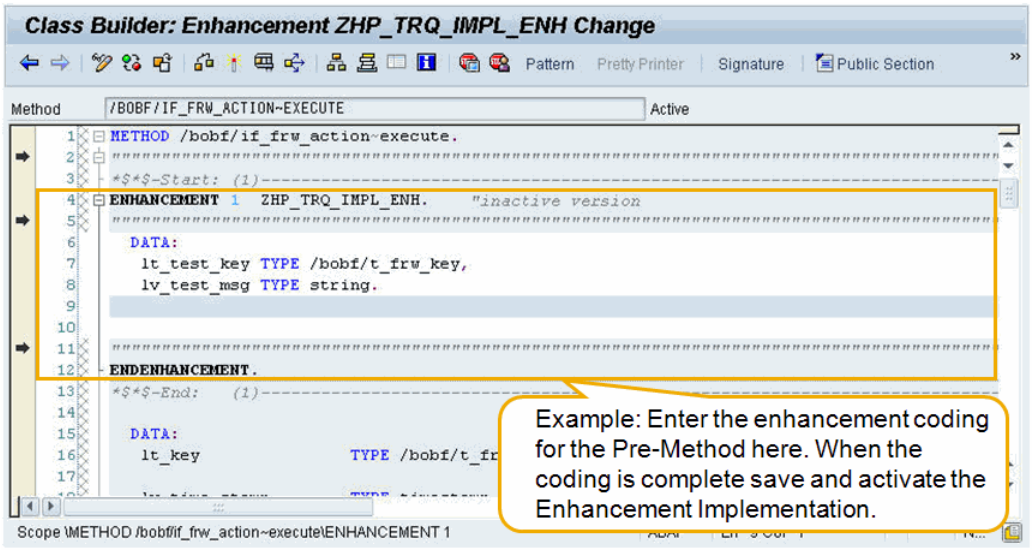
5) On the next popup specify a name for your Enhancement Implementation (example used here is ZHP_TRQ_ENH_IMPL) with a corresponding short text (e.g. Demo Implementation of a Pre-Method). Save your Enhancement Implementation under the required package (or as shown in the example as a local object). Acknowledge the next popup by clicking on the

button Continue (in the example we save our Enhancement Implementation in a package that is not assigned to a switch).



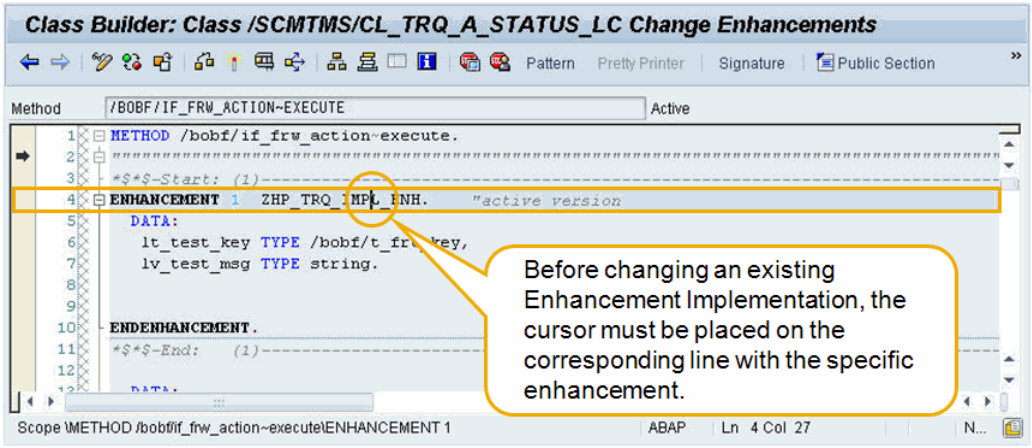
Picture 25: Specifying an Enhancement Implementation and a package.

6) Now you can enter the coding for your Enhancement Implementation. When finished, save and activate the Enhancement Implementation. It is now ready to be executed.



Picture 26: Entering the code of an Enhancement Implementation.

7) To change an existing Enhancement Implementation, follow the menu path *Method → Enhance (Ctrl + F4)* to set the method into the enhancement mode as already mentioned in step 3. Then follow the menu path *Edit → Enhancement Options → Change Implementation* (menu path also shown in step 4).



Picture 27: Placing the cursor for changing an existing Enhancement Implementation.

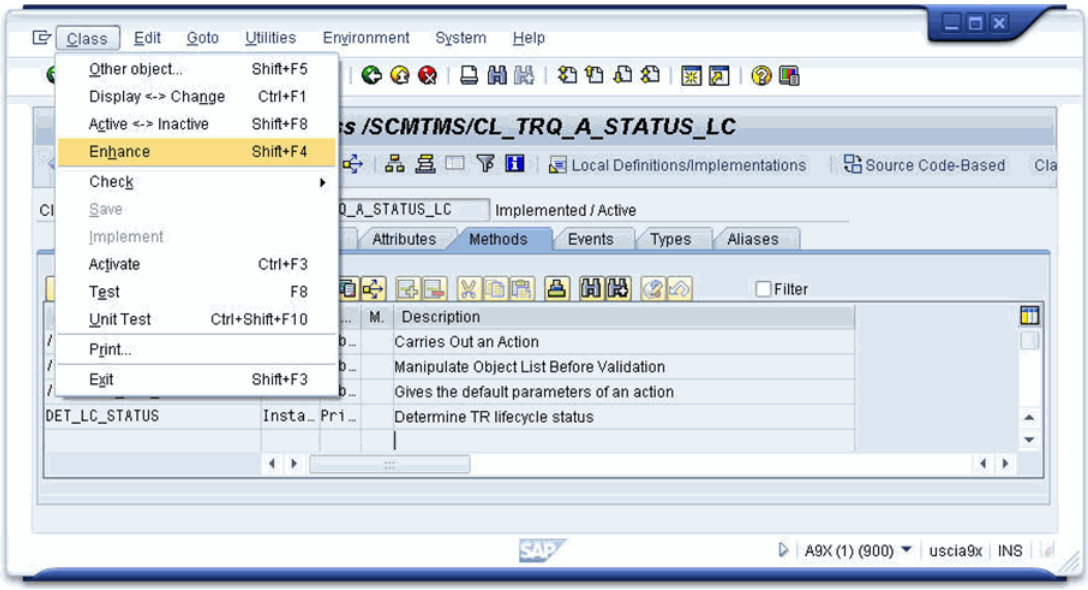
4.4.3 Overwrite-methods

Another implicit enhancement option for ABAP objects classes are overwrite-methods. They allow replacing standard method implementations by alternative implementations. As an example for realizing an overwrite-method let's assume that we have identified the right method of a class where a customer-specific behavior shall replace the standard behavior.

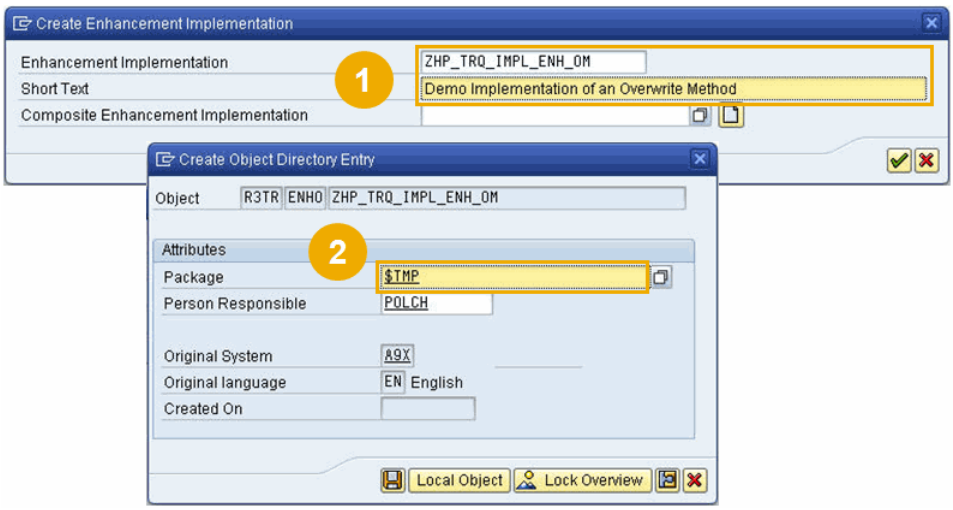
1) Navigate to the class that contains the method to be overwritten.

- Transaction SE24 can be used, in case the class is already known.
- Transaction SE80 can be used to navigate to the class.
- Transactions /BOBF/CONF_UI and/or /BOBF/CUST_UI can be used to navigate to the implementing class of BO node elements like Actions, Determinations or Validations of the BO to be enhanced.

2) Follow the menu path *Class → Enhance (Ctrl + F4)* to set the class into the enhancement mode. Then follow the menu path *Edit → Enhancement Operations → Show Implicit Enhancement Options* to display the pre- and post-method area for the selected method.

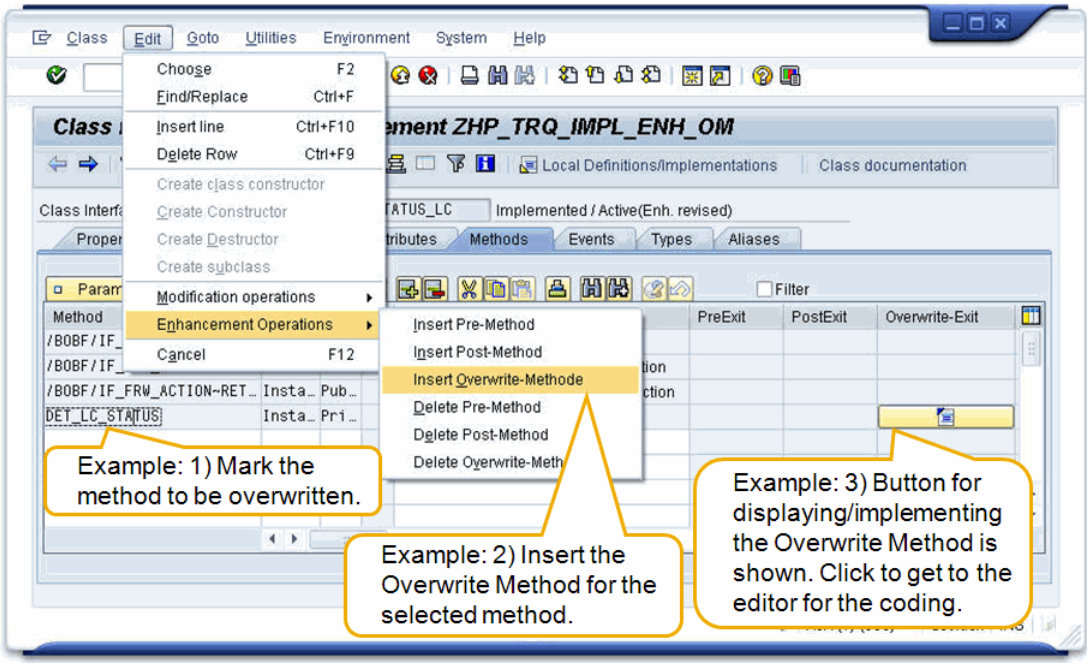


Picture 28: Set the class into the Enhancement mode.



Picture 29: Specifying an Enhancement Implementation and a package.

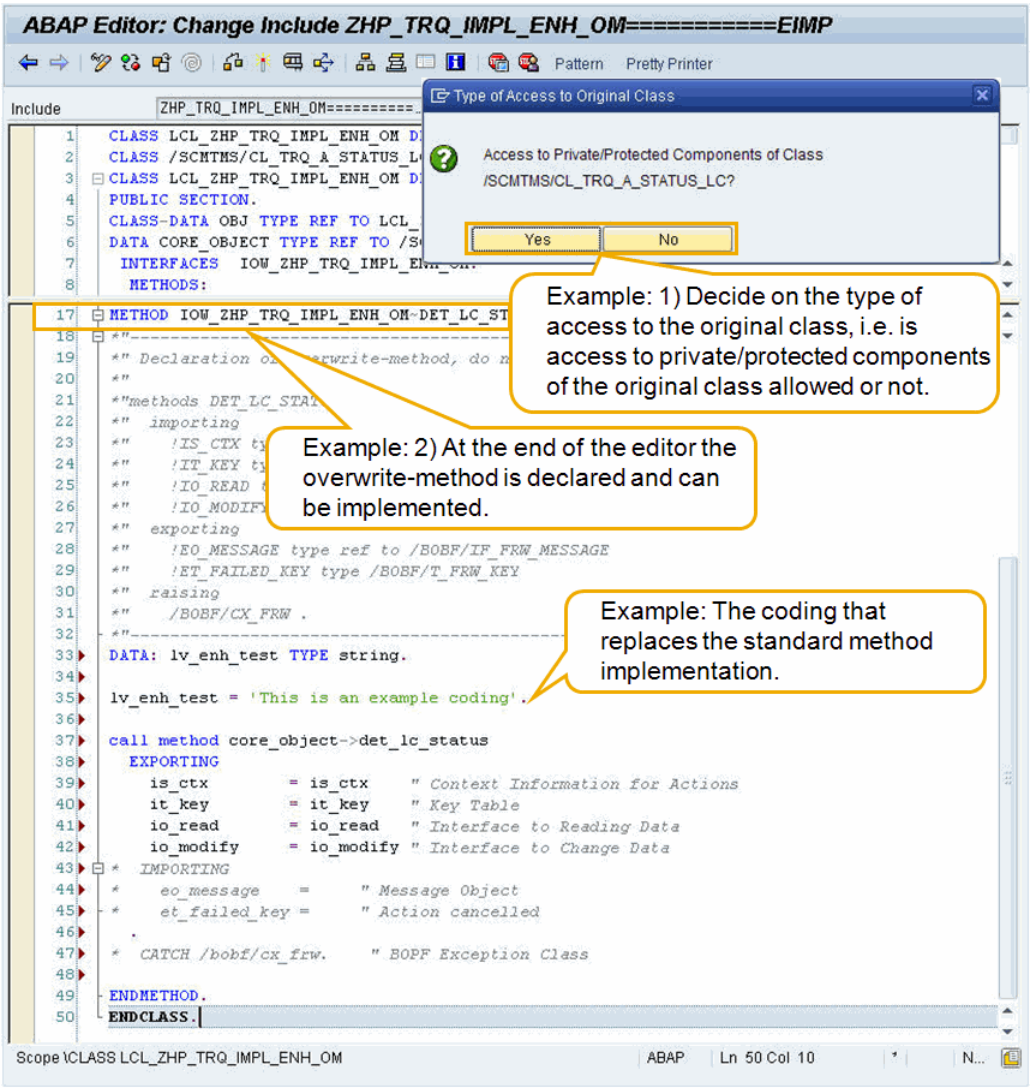
3) First mark the method to be overwritten. Then Follow the menu path *Edit → Enhancement Operations → Insert Overwrite-Method* to define the corresponding overwrite-method. For the selected method there will be a button displayed in the column Overwrite-Exit of the method list that allows navigating to the editor for the implementation of the alternative coding.



Picture 30: Specifying an Enhancement Implementation and a package.

As you can see in the picture above you can create all other available implicit enhancement operations, i.e. also pre- and post-methods. This represents an alternative way for the procedure of creating pre- and post-exits as described in 3.5.2.

4) Implement the overwrite-method with the coding that will replace the standard implementation during runtime. Before this, the system will ask whether you allow access from your implementation to private and protected components of the original class containing the standard implementation. At the end of the editor/include you can find the declaration of the overwrite-method and can implement the corresponding coding that will replace the standard implementation during runtime.



Picture 31: Implementation of the overwrite-method.

5) Finally, save and activate the Enhancement Implementation. Again, you should make sure to handle the depicted implicit enhancements (pre- and post-methods as well as overwrite-methods) with care. Keep in mind the potential problems and consequences mentioned at the beginning of this chapter.

Moreover, it is highly recommended, to implement such enhancement code in your own local class methods and just place the call of these methods into the enhancement implementation. This will provide more transparency for customers and partners as well as for SAP in case of problem analysis, etc.

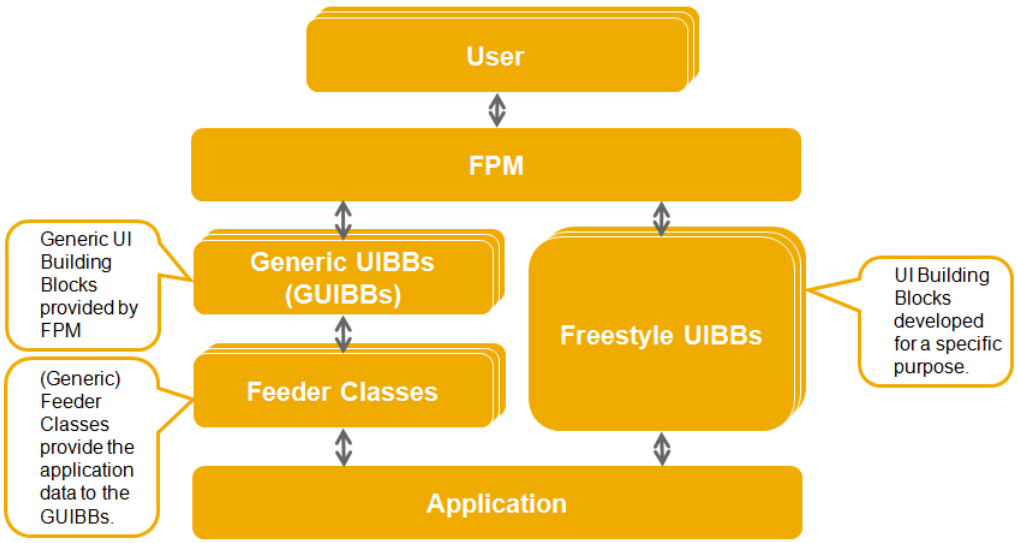
5 User Interface Enhancements

This chapter provides the basics on how to enhance the user interface of TM 8.0. As mentioned in sections 2.2 and 2.3 the user interface is build with the help of the Floor Plan Manager (FPM) and the Floor Plan Manager BOBF Integration (FBI). These two frameworks enable enhancing a user interface via configuration rather than having to implement additional code.

This document can for sure not cover a complete description of FPM and FBI. It therefore concentrates on the very basic things that customers and partners need to do basic and common enhancements of the UI by adjusting the standard configurations of the TM user interface. The examples used here are based on the Freight Order UI but the principles and techniques are valid for any other TM user interface too. For more complex user interface enhancements, it is recommended to build up more detailed FMP and FBI knowledge.

5.1 FPM – Floor Plan Manager

SAP Transportation Management 8.0 uses the Floor Plan Manager (FPM) to realize its User Interfaces. FPM is a Web Dynpro ABAP application that provides a framework for developing new Web Dynpro ABAP application interfaces consistent with the SAP UI guidelines. FPM allows a modification-free composition of discrete User Interface Building Blocks (UIBBs) which are compliant with the mentioned guidelines.



Picture: FPM Overview.

5.1.1 User Interface Building Blocks

The Web Dynpro ABAP Floorplan Manager (FPM) is a framework which composes application specific views (UIBBs) to an application. This allows a homogeneous high-level application structuring and interaction behavior. Instead of building the User Interface as an individual Web Dynpro Application, FPM centrally provides predefined UIBBs, so called Generic UI Building Blocks (GUIBBs) that can be reused to create UIBBs. GUIBBs used in the TM 8.0 User Interface are:

- **Overview Pages** (FPM_OVP_COMPONENT): Defines the general layout of the screens. It displays a title bar, a tool bar as well as one or more UIBBs.

- **Form GUIBB** (FPM_FORM_UIBB): A flat collection of input elements which displays the content of a (flat) structure → must use a form-compliant Feeder Class.

- **List GUIBB** (FPM_LIST_UIBB): Displays the content of an (internal) table → must use a list-compliant Feeder Class.

- **Tree GUIBB** (FPM_TREE_UIBB): Displays the content of an (internal) table in a hierarchically way → must use a tree-compliant Feeder Class.

- **Tabbed GUIBB** (FPM_TABBED_UIBB): Used to display a tab strip including further UIBBs with an optional master UIBB on top of it → does not require a Feeder Class (sometimes misused for layout purposes which it was not designed for).

The application only provides the data and a layout configuration to these GUIBBs. The rendering is handled by the framework itself. Generic UI Building Blocks provide a comprehensive way of creating or changing User Interface Compositions, without the necessity to change the underlying application code base and thereby offering a concept for modification free customer UI enhancements. The composition (configuration) of those building blocks takes place in a design time application (in this case a Web Application) where all the necessary field attribute, positioning and layout properties are assigned or composed.

GUIBBs are design templates for which, at design time, the application defines the data to be displayed along with a configuration. The concrete display of the data on the user interface is not determined and generated by the GUIBB until runtime. This is done automatically using the configuration provided.

5.1.2 Feeder Classes

Necessary or mandatory application specific information will be supplied by the application itself via a so called Feeder Class implementation. Feeder Classes are based on a predefined interface definition providing all necessary methods and corresponding signatures for standardizing the communication between the application and the GUIBB. With these Feeder Classes the application

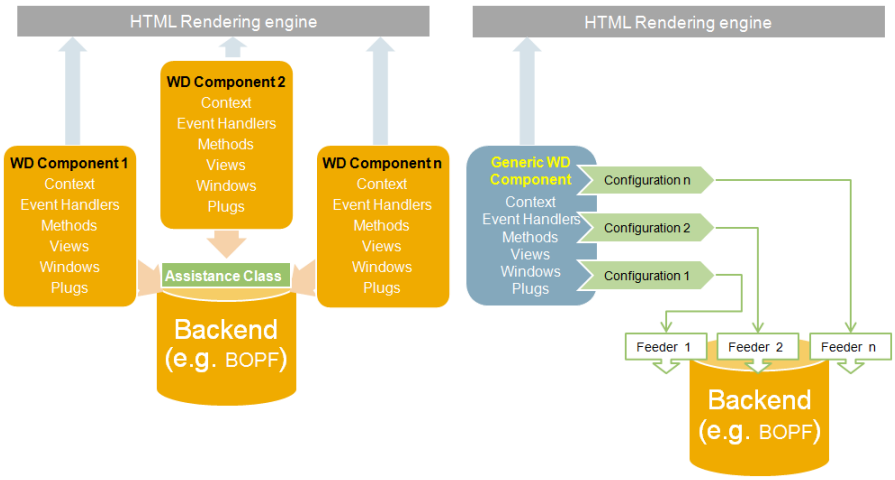
- Provides a field catalogue to the GUIBB design and runtime.
- Provides the data at runtime.
- Accepts UI changes at runtime by calling application middle ware.
- Handles user interactions (events) at runtime by calling application middle ware.
- Provides field control data to control visibility and changeability of UI elements.

The UI Administrator or Designer can

- Create UI layouts as a Web Dynpro Configuration for the standard GUIBBs.
- Put together such discrete GUIBB configurations in an application configuration.

In the traditional approach, the UI developer develops multiple Web Dynpro Components with fixed view layouts and delivers a fully assembled application. With this approach, realizing customer-installation specific UI variants requires modification of such applications.

With the FPM approach, it is possible to enhance application user interfaces and fit them to your business needs, based on configuration instead of modifications. Besides the GUIBBs, FPM still allows the implementation and usage of freestyle UIBBs that can be realized individually to serve specific purposes that cannot be handled via GUIBBs.



Picture: Traditional and FPM UI development approach.

At runtime, user interactions are handled by FPM events that pass an FPM phase model (Event Loop). Within the FPM event loop specific methods are called that are based on a predefined interface definition and corresponding signatures in order to standardize the communication between the application and the GUIBB. A Feeder Class implements such a predefined interface for a specific GUIBB, e.g. the interface IF_FPM_GUIBB_FORM for Form components. Important methods are:

- **INITIALIZE**: Called at runtime when the form is created. It is the first feeder method which is called from FPM.
- **GET_DEFINITION**: Allows the feeder to provide all necessary information for configuring a form: the list of available fields and their properties and the list of actions (FPM events).
- **FLUSH**: The first feeder method which is called during an event loop. Whenever an FPM event is triggered (this includes all round trips caused by the form itself) this method is called. Use it to forward changed data from the form to other components in the same application.
- **PROCESS_EVENT**: Called within the FPM event loop. The FPM PROCESS_EVENT is forwarded to the feeder class. Here the event processing can take place and this is where the event can be canceled or deferred.
- **GET_DATA**: Called within the FPM event loop. The FPM PROCESS_BEFORE_OUTPUT event is forwarded to the feeder class. Here you specify the form data after the event has been processed.

There are two options when building an FPM-based application. First option: Individual Feeder Classes. Each GUIBB has its own individually implemented feeder class. Second option: Usage of Generic Feeder Classes that are provided with the contextual information via feeder parameters. In SAP Transportation Management, the second option was chosen. The advantage is that the feeders need to be implemented only once (high reuse) and enhancements in the feeder logic are implemented in less feeder classes.

5.1.3 Wire Model

The wire model is used to create a running FPM application by pure configuration (or at least with a minimal coding effort). The runtime interdependencies between UIBBs are defined by configuration entities called “wires” which are based on reusable “connector” classes

implementing the dependency semantics. The primary use cases for the wire model are object models with generic access interfaces like BOPF.

A wire controls the runtime interdependencies between two UIBBs, i.e. they determine the data content of the target UIBB depending on user interaction changing the “outport” of the source UIBB. Outports can be of type lead selection, selection or collection. For example, changing the lead selection in a list of Forwarding Order Items may change the data content of another list displaying the associated Item Details.

Application areas or object models define their own namespaces for which their connector classes, feeder model classes can be reused. Moreover, they typically need to provide a transaction handler class which manages transaction events like “save”, “modify” or “check” and global message handling.

Wires are defined on the level of the Floorplan Configuration. For each model UIBB contained in the Floorplan Configuration, a source UIBB with specified outport can be defined. Furthermore, a connector class and, potentially, connector parameters must be maintained. If the Floorplan contains composite components (tabbed components), the model UIBBs contained in the tabbed components can also be wired. However, in order to provide better reusability of composite components, it is also possible to define intrinsic wiring for tabbed components. A tabbed component can define a model UIBB as a “wire plug” (this is usually a master UIBB), which serves as an entry point for the wiring of the tabbed component from the enveloping Floorplan component. If a wire plug is configured for a tabbed UIBB, only the wire plug UIBB can be wired from outside.

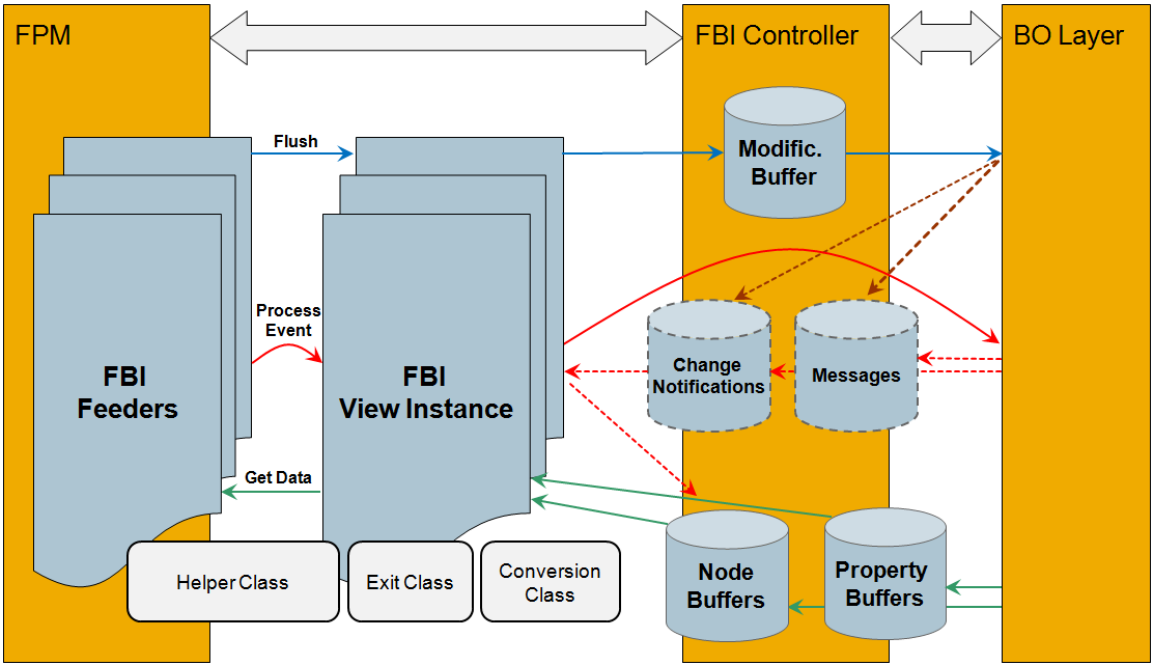
An example for using a wire is provided in section 5.4.3 where a new tab is added, based on an extension sub node.

5.2 FBI – Floor Plan Manager BOPF Integration

The Floor Plan Manager BOPF Integration (FBI) is used in SAP Transportation Management 8.0 to integrate FPM with the BOPF-based Business Objects. FBI provides generic FPM application feeder classes together with the relevant application configuration that allows consuming services of Business Objects modeled in BOPF. These BOPF services can be used seamlessly in a modification-free UI environment.

FBI provides the following functionalities that support the communication and corporation between FPM applications and BOPF-bases Business Objects:

- Editing data of BO node instances in the standard GUIBBs FORM and LIST.
- Accepting action parameter values and invoking corresponding actions on BO node instances.
- Overview Search (OVS) based on BO node queries.
- Input of external IDs on initial screens and subsequent conversion of these external IDs into internal (technical) IDs (Alternative Key Conversion).
- UI-specific services are supported:
  - Navigation to multiple targets.
  - Calling dialog boxes and editing application data in these dialog boxes.
  - Support of UI-specific non-BOPF actions.



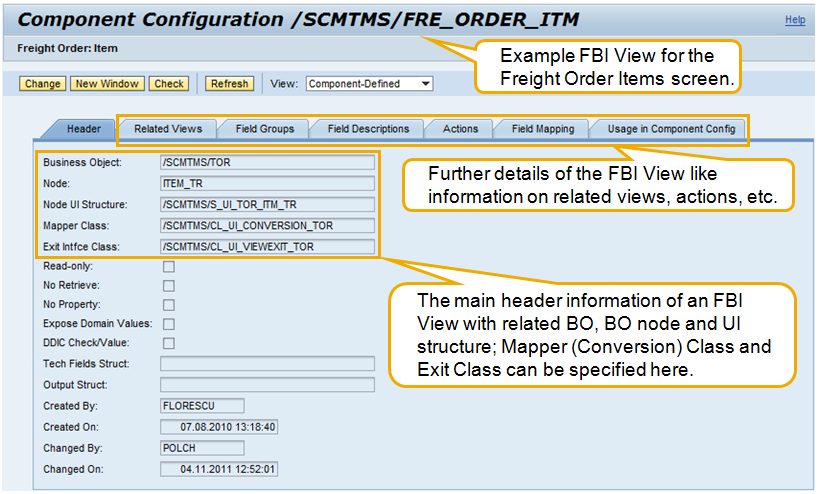
Picture: Technical relation between FPM, FBI and the BO layer.

Some concepts/entities of FBI that will be relevant for the UI enhancement topic described later in this document:

5.2.1 FBI View (design time)

FBI Views are the place where the design time UI structure of a building block is defined. Moreover, it contains the classes for conversion/mapping of BOBF BO data to this UI structure. An FBI View is closely related to a single BO node. But “Related Views” are also supported. They allow extracting data from multiple BO nodes into a single UI structure. Actions that are not

related to the BO are also defined in the FBI View (FBI views are stored as a configuration of Web Dynpro Component /BOFU/FBI_VIEW).



Picture: Example FBI View.

- **Header:**
  - Contains the mandatory part: Business Object and Node.
  - Optional UI Structure (if not specified, then node structure is used).
  - Optional Mapper Class (if not specified, MOVE-CORRESPONDING is used).
  - Optional Exit Interface Implementation Class (details later).
  - Additional settings, like Read-Only, etc.

- **Related Views (optional):**
  - Allows the definition of a chain of Views to read data from more nodes (e.g. when information coming from several nodes shall be combined into on flat UI structure to be displayed in a list).
  - Each related view is included with a mandatory suffix.

- **Field Descriptions (optional):**
  - Can be used to specify additional properties for structure attributes.
  - These settings are passed to the FPM field catalogue.
  - E.g. Sorting Allowed, Allow Filter, Domain Fixed Values, Fixed Values, F4-Values from Code Value List etc.

- **Actions (optional):**
  - Allows definition of new Event IDs.
  - For the new Event IDs, as well as for the existing ones (Standard FBI and BO Actions, which are taken into account automatically), you can specify additional settings:

    - Set specific Name and Tooltip (via OTR aliases) – they will be passed to the FPM action catalogue.
    - Specify another Event ID, whose enable/disable properties are to be inherited.
    - Specify whether the action is allowed to be triggered in read only mode.
    - Specify whether the action is allowed to be executed only when a record is selected.
    - Specify navigation target (in this case, FBI calls Navigation Class instead of Standard handling).

5.2.2 FBI View Instance (runtime)

The instances of an FBI View hold the keys of the displayed instances (coming from the wires that UIBBs are connected with). An instance e.g. prepares modifications, executes actions and posts change notification to the controller. It reacts to the FBI-specific SYNCUP Event, i.e. it evaluates change notifications and determines which of the keys must be refreshed.

Moreover it reads the data from node buffers or from the BO layer in case of modified keys. Where required it also calls conversion classes for the modified records (e.g. to convert a document ID into its corresponding technical key). A view instance calls available Exit methods at the appropriate places.

5.2.3 FBI Controller (runtime)

The FBI controller is responsible to do the orchestration between FBI View instances and the BO layer. It does not contain any application logic but only provides the technical framework for the orchestration. It provides a Modification Buffer for changes done on the UI that are then forwarded from there to the BO layer, i.e. it centralizes the BO Layer responses. It also collects the change notifications coming from the BO layer that then need to trigger updates on the UI.

Further buffers hold the information on the nodes read from the BO layer and the properties of nodes and their attributes. The properties determine e.g. whether an attribute is a mandatory field or is ready for input. Moreover, these buffers help to avoid redundant BOPF service calls-

5.2.4 Conversion Classes

When data is send from the BO layer to the UI, the conversion class is called to convert technical attributes into their clear text representation. The same conversion class is also called when data is send from the UI back to the BO layer, i.e. it converts clear text information in to its technical representation.

Conversions are done immediately after retrieval of data and shortly before sending modifications to the buffer. A conversion class is specified in the FBI View definition. Implementations of Conversion Classes do always inherit from TM super class /SCMTMS/CL_UI_CONVERSION. Each redefinition of the super class must define its own mapping table in method BUILD_MAP_TABLE. The super class already contains a few generic (bidirectional) mapping rules which are based on field naming conversions:

- **Mapping rule for Date-Time Conversion:** The conversion rule maps a field of type TIMESTAMP into its Date, Time and Time Zone part. A BO node attribute FIELD of type TIMESTAMP is automatically converted with this rule if the UI structure contains the attributes FIELD_D (Date), FIELD_T (Time) and FIELD_TZ (Time Zone).

- **Mapping rule for Date-Time Conversion into String:** The conversion rule maps a field of type TIMESTAMP into a String. A BO node attribute FIELD of type TIMESTAMP is automatically converted with this rule if the UI structure contains the attribute FIELD_TTT (Formatted Date).

- **Mapping Rule for Alternative Key Conversion:** The conversion rule maps a BO node foreign instance key into its corresponding foreign readable ID. For this, it uses e.g. the BO key, the BO node name and the alternative key for this node defined in the node Meta Data.

- **Mapping Rule for Code List Conversion:** The conversion rule maps a BO code into a readable UI code value. A BO attribute FIELD with its code value X is converted into its readable UI code value if the UI structure contains the attribute FIELD_TXT.

5.2.5 Exit Classes

The generic feeder classes usually take care of all communication aspects between the corresponding GUIBB and the application. Nevertheless there might be use cases that require a more specific implementation. For this, an Exit Class can be specified in the FBI View definition. Exit Classes provide many extension options and are the recommended means for adapting the standard FBI processing to customers and partner's needs.

Exit Class implementations inherit from TM super class /SCMTMS/CL_UI_VIEWEXIT_CMN. An Exit Class implements the following FBI Exit Interfaces:

- **Core Interface /BOFU/IF_FBI_VIEW_EXIT_INTF:** The interface does not have any interface methods but the Exit Class implements it for enabling FBI to instantiate an object from this class.

- **Definition Interface /BOFU/IF_FBI_VIEW_EXITINTF_DEF:** The methods of this interface offer the possibility to influence the processing of FPM phases Initialization and Get Definition ("one time" phases). Its implementation is optional.

    - Method ADAPT_FIELDS: Modify the field catalogue.

    - Method ADAPT_ACTIONS: Modify the action catalogue.

    - Method ADAPT_DND_DEFINITON: Modify drag & drop definitions.

- **Definition Interface /BOFU/IF_FBI_VIEW_EXITINTF_RUN:** The methods of this interface offer the possibility to influence the processing of User Interactions (at each round trip). Its implementation is also optional.

    - Method ADAPT_CHANGE_LOG: Modify the list of screen changes before converting them into BO modification records.

    - Method ADAPT_EVENT: Intercept and process any event that arrives in the underlying FBI view. If custom event IDs were added to the FBI View, this is the place to implement the action handling for them.

    - Method ADAPT_MESSAGES: Modify the returned messages from the Modify and DO_ACTION service calls.

    - Method ADAPT_DATA: Modify the data before it is passed to FPM. The data is in the concatenated format (all related views in the chain plus the reference fields). Thus, the component of the UI structure must be accessed with ASSIGN COMPONENT...

    - Method ADAPT_FIELD_PROPERTIES: Modify the field properties of this view (at column level, these values are merged with the properties from the reference fields of data structure).

    - Method ADAPT_ACTION_PROPERTIES: Modify the enabled/disable properties of this view's actions.

    - Method ADAPT_SELECTION: Modify the selected lines (in list and tree).

5.3 General remarks on user interface enhancements

Some general remarks for creating user interface enhancements:

- Basic enhancements ideally can be done without any coding. For more complex user interfaces and enhancements, coding might be required. In focus of this document version are enhancements that can be done with configuration only.

- Each TM user interface is build up from so called **User Interface Building Blocks** (**UIBBs**) as already described in sections 5.1 and 5.2. Each of these building blocks has a configuration that can be adapted by partners and customers.

- The standard configurations will remain untouched. When adapting a configuration, the system will create a corresponding so called customizing record which contains your enhancements. Adapted configurations can be created e.g. in a development system and get transported to a test or production system. The client of the system where you do the UI enhancements must be set up in a way that it allows transporting configurations.

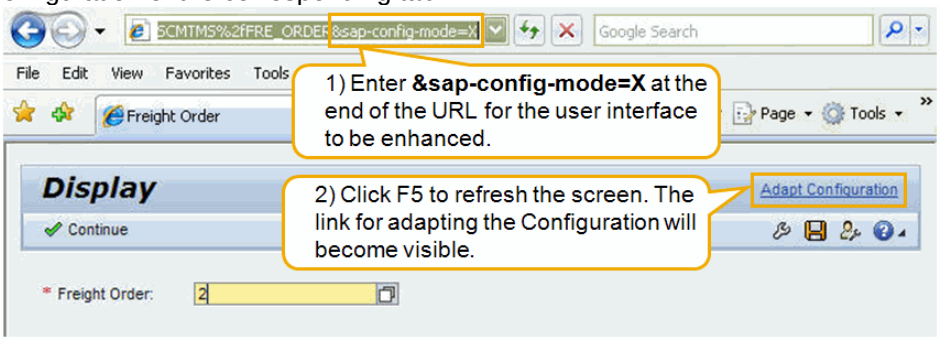
- The adaptations can also be deleted again. After deleting e.g. an adapted configuration which was maintained, the original standard configuration is used again for processing the corresponding user interface.

- **Before you can adapt any user interface configuration, you need to set the parameter sap-config-mode = X in the URL of the user interface to be enhanced.** Example: Assume we want to enhance the user interface of business object Freight Order.

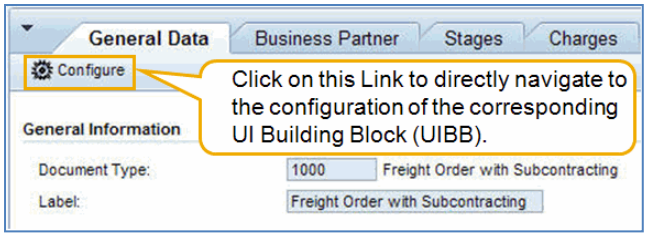
  a) Start the user interface to be enhanced from your user menu to use it in your browser.

  b) At the end of the URL enter the following additional parameter: “&sap-config-mode=X” to enable the adaptation of configurations related to this user interface. On the screens you will now find a link “Adapt Configuration” that you can follow to get to the Configuration Editor for the corresponding UI configuration. Within the configuration Editor you need then to navigate to the configuration of the UIBB that shall be enhanced.

  c) Within the UI the system displays a button “Configure” for each UI Building Block that allows a direct navigation to the configuration of the UIBB. Example: On the tab *General Data* of the Freight Order UI you find the mentioned link. It will lead you directly to the configuration of this tab. Clicking this link on a different tab will lead you to the configuration of the corresponding tab.



Picture: Switching on the configuration mode.

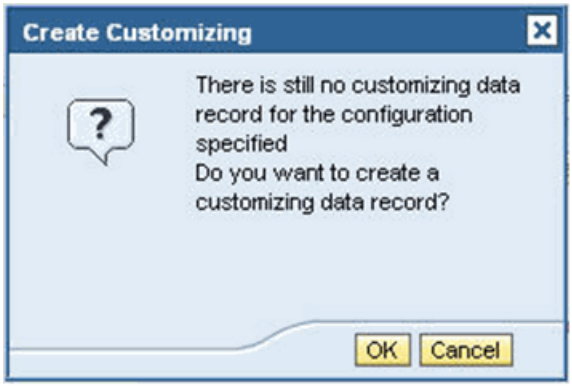


Picture: Direct navigation to UIBB configuration.

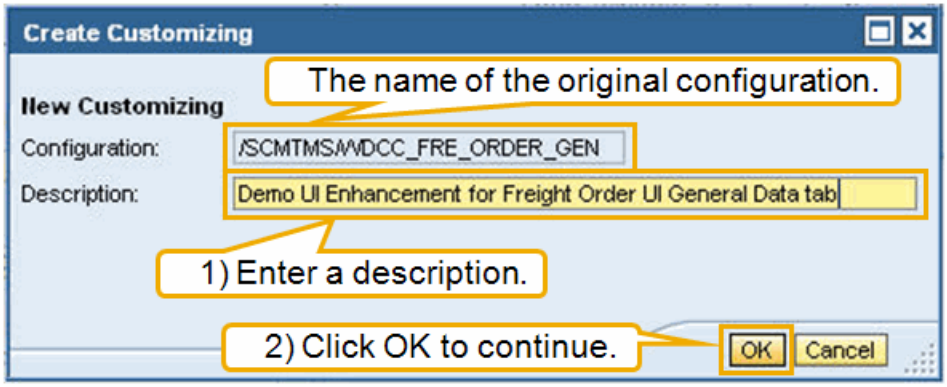
- To create enhancements, you need to start the corresponding user interface from the SAP user menu. Currently, it is not possible to trigger the configuration mode from within NWBC.

- A UIBB might in turn include other UIBBs. So when entering the configuration of a UIBB, in the configuration editor you may have to navigate to further configurations to get to the specific UIBB's configuration that shall carry the enhancements.

- When starting the configuration editor for a specific UIBB configuration that has not yet been enhanced, the system will always ask you to create a so called customizing data record. On the first popup, just click on button OK. On the second popup that comes up, enter a description for the customizing data record and click on button OK.



Picture: Create a customizing data record.



Picture: Creating a customizing data record

- Enhancement configurations can be transported e.g. from the development system to the test system and further to the production environment after successful test. If you create the

enhancements e.g. in a client of the development system, the client must be configured correspondingly to allow transports of enhancement configurations / customizing records.

- Transporting as well as deleting created customizing records is possible via a corresponding Web Dynpro application that can be started with the following general link which has to be enhanced with information on server and port, depending on where you want to start the tool.

  http://**[server]**:**[port]**/sap/bc/webdynpro/sap/wd_analyze_config_comp

  Example:
  http://ukwtr9x.wdf.sap.corp:80089/sap/bc/webdynpro/sap/wd_analyze_config_comp

  Here you can select the enhancement configuration/customizing record to either transport it through the system landscape or if required to delete it. Details on this tool and its usage are provided in section 4.3.

In the following sections the Freight Order UI will be the example UI to be enhanced. As mentioned, the principles and techniques used in the following examples are can also be applied for any other TM UI too. The next section describes how to do field extensions on the UI. This section also describes some basic aspects of the configuration editor which will be used in general, i.e. the descriptions provided here also hold for other UI configuration enhancements.

5.4 Enhancing the User Interface

5.4.1 Field Extensions

A very basic and common example for extending the user interface is adding additional fields on an identified building block that shall carry this additional information. The following example shows how to get a group of extension fields onto the tab *General Data* of the Freight Order UI.

1) Start the Freight Order UI for displaying Freight Orders from the SAP user menu and set the configuration mode in the URL for the UI as described in section 4.1.

2) Display an existing Freight Order and click on tab ***General Data*** (a FORM UIBB). On the left side of the tab click on link/button ***Configure*** to start the UIBB configuration for this tab (see also last picture above). The name of the standard configuration of tab *General Data* is:

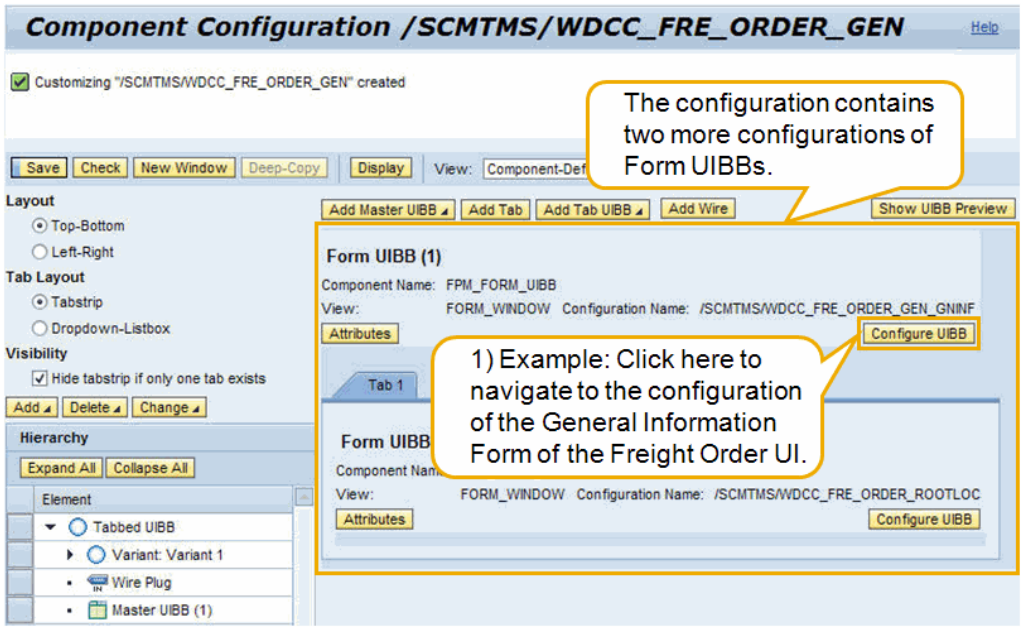
   /SCMTMS/WDCC_FRE_ORDER_GEN.

3) The system will start the configuration editor. If required create the customizing data record for this configuration as described in section 4.1.

4) Standard configuration /SCMTMS/WDCC_FRE_ORDER_GEN includes the configurations of two Form UIBBs.

Configuration	Comment
/SCMTMS/WDCC_FRE_ORDER_GEN_GNINF	Contains the configuration for the general information displayed on the General Data tab.
/SCMTMS/WDCC_FRE_ORDER_GEN_ROOTLOC	Contains the Source and Destination Location as well as pickup and delivery dates/times.

Navigate to the configuration /SCMTMS/WDCC_FRE_ORDER_GEN_GNINF by clicking on button Configure UIBB of this configuration. If required create the customizing data record for this configuration as described in section 4.1.

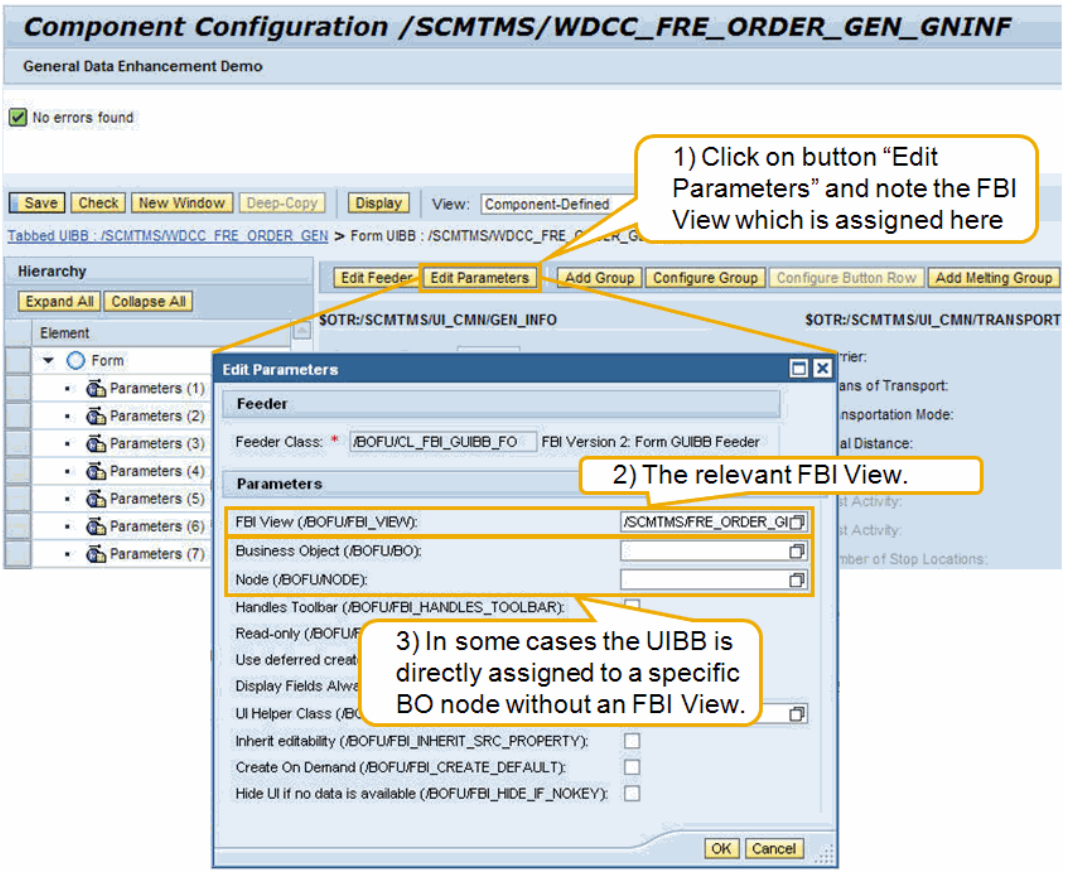


Picture: Navigation from a UUIB's configuration to the configuration of a sub UUIB.

5) In the configuration /SCMTMS/WDCC_FRE_ORDER_GEN_GNINF click on button *Edit Parameter*. Here you can find information which is relevant for the next steps:

- **FBI View**: The FBI view which is assigned to the current UI building block. As described in section 2.3, the FBI view besides other information holds the information on the UI structure of a building block as well as the related business object node.

- **Business Object & Node**: In some cases the UI building block is directly assigned or related to a specific business object node. If so, extension fields can directly be added to this node as described in section 3.4.3 and can afterwards directly get included in the UI layout. In this case, just continue with step 7.

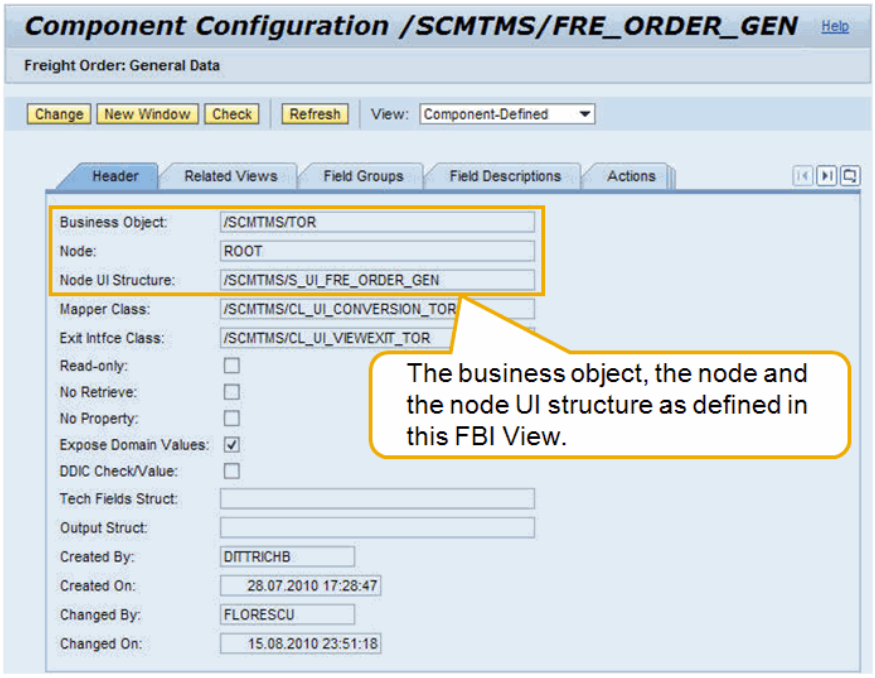


Picture: Feeder Parameters of the current UI building block configuration.

Example (see also picture above): FBI View /SCMTMS/FRE_ORDER_GEN is used, i.e. no direct relation to a business object node. In this case we need to display the FBI View to find out the business object node related to this UIBB (step 6).

6) Display the identified FBI View /SCMTMS/FRE_ORDER_GEN.
- Start transaction SE84 and follow the following path: Repository Information System → Web Dynpro → Component Configurations.
- On the selection screen enter /SCMTMS/FRE_ORDER_GEN in field Component Configuration. Press *F8*.
- In the following list mark the found entry. Press *F7*.

- Click on button *Start Configurator* and then on button *Display*.



Picture: Header details of the FBI View.

Example: Our FBI View /SCMTMS/FRE_ORDER_GEN is related to the business object /SCMTMS/TOR (Freight Order), ROOT node. The name of the corresponding Node UI structure is /SCMTMS/S_UI_FRE_ORDER_GEN.

7) Add your extension fields to the identified business object node as described in section 3.4.3, i.e. you create an append structure with the extension fields for the corresponding extension include.

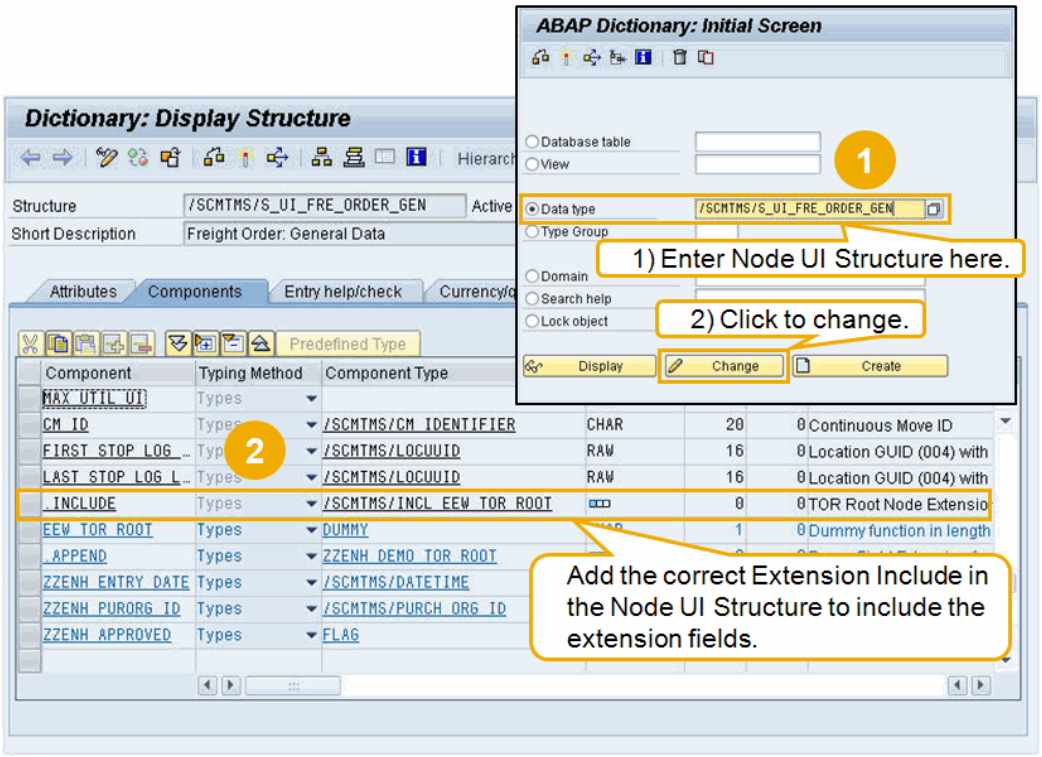
Example: Create extension fields for the ROOT node of business object /SCMTMS/TOR.

Business Object Information		Comment
Business Object	/SCMTMS/TOR	Technical name of the business object.
Extension Include	/SCMTMS/INCL_EEW_TOR_ROOT	The persistent Extension Include.
Append Structure		
Name	ZZENH_DEMO_TOR_ROOT	
Description	Demo Field Extension for Freight Order (TOR)	
Component	Typing Method	Component Type
ZZENH_ENTRY_DATE	Types	/SCMTMS/DATETIME
ZZENH_PURORG_ID	Types	/SCMTMS/PURCH_ORG_ID
ZZENH_APPROVED	Types	FLAG

In the easiest case the new fields are now already available in the field catalog of the required building block. This is only the case if the Node UI structure automatically includes the extension includes of the business object node. If so, you can continue with step 9.

8) Check and enhance the identified UI node structure if required.

Example: To display Node UI structure /SCMTMS/S_UI_FRE_ORDER_GEN, use transaction SE11. Check if your extension fields are already available there. The mentioned Node UI structure does not automatically include the required Extension Includes. To ensure that the extension fields are available in the field catalog of the required building block, add the Extension Include /SCMTMS/INCL_EEW_TOR_ROOT of the /SCMTMS/TOR, ROOT node to this UI structure.



Picture: Enhancing the Node UI Structure.

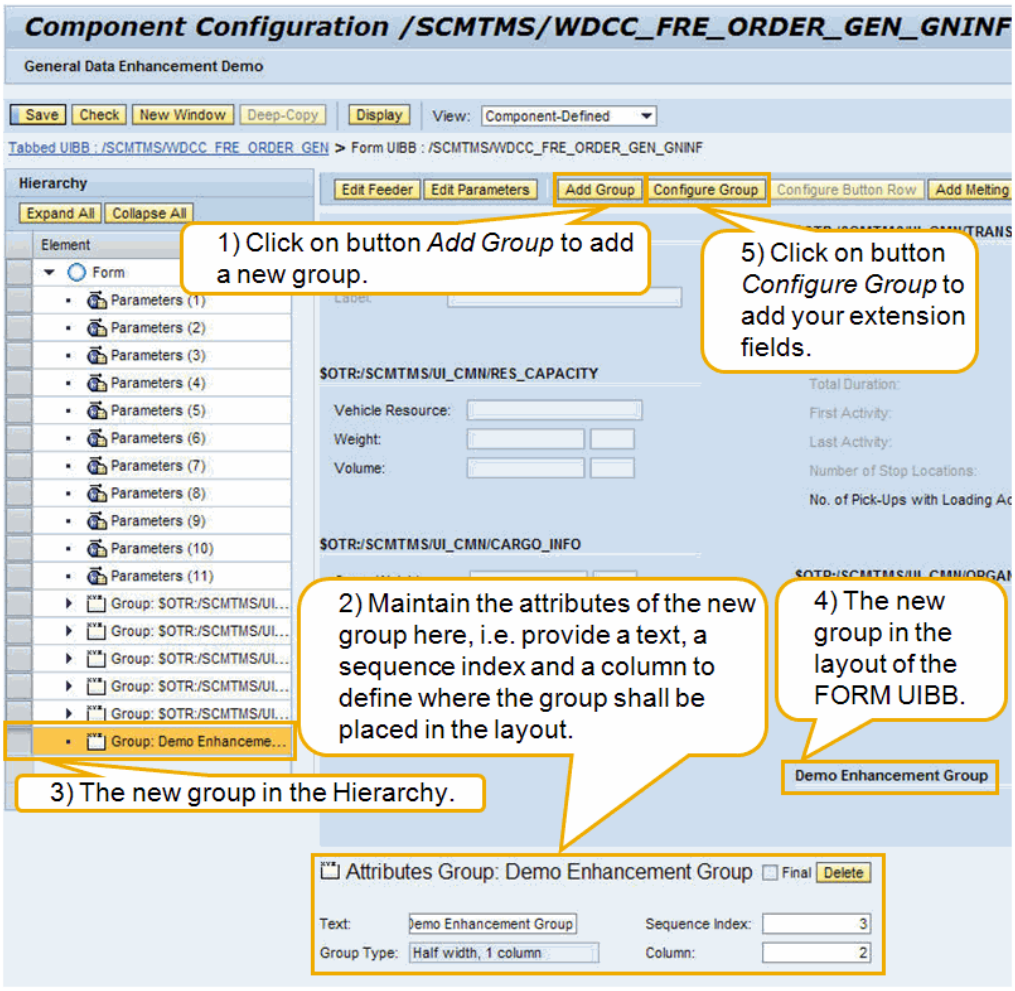
9) Use the extension fields to enhance the configuration of the UIBB.

The extension fields are now available in the field catalog of the UIBB to be enhanced. In this step, the configuration is enhanced by placing the new fields on the layout of the UIBB and defining the required field properties.

Example: a) On the General Data tab, we add a new group to carry the new extension fields. In the configuration /SCMTMS/WDCC_FRE_ORDER_GEN_GNINF click on button *Add Group*. For this group, provide the following information.

Field	Content	Comment
Text	Demo Enhancement Group	The header text to be displayed for the new group.
Sequence Index	3	The index of the new group in the relevant column. Here: The new group will be the third one to be displayed in column 2 (the example FORM UIBB is set up to have two columns).

Column	2	The new group is placed in column 2 of the FORM UIBB.

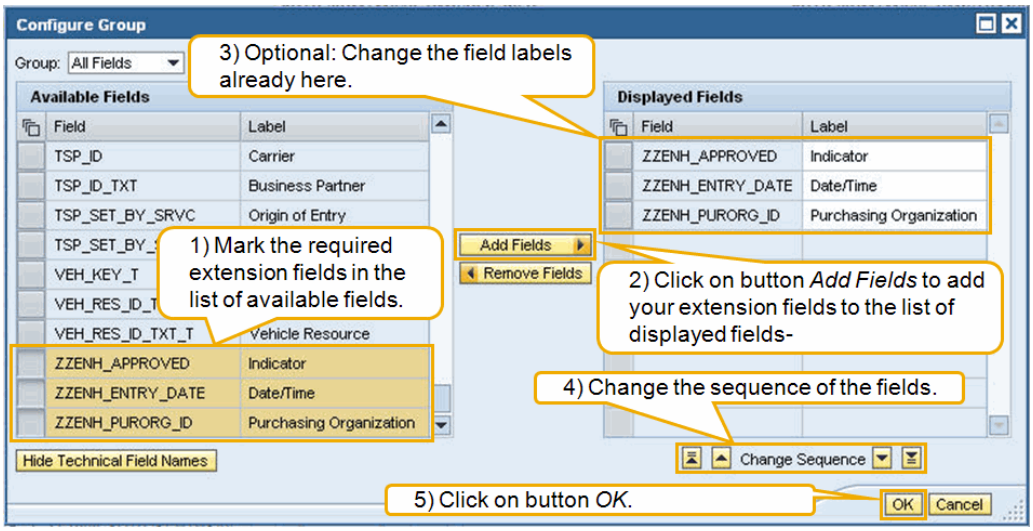


Picture: Adding a new field group to the FORM UIBB.

Example: b) Now we add the extension fields to the new group. In the configuration /SCMTMS/WDCC_FRE_ORDER_GEN_GNINF mark the new group in the hierarchy on the left side and then click on button *Configure Group*.

On the following popup screen you can find the list of available fields, including the extension fields that were added so far.

- Mark the extension fields required for the new group.
- Click on button *Add Fields* to take over the new fields in the groups list of displayed fields.
- Adjust the labels for each field in the list of displayed fields (optional; can be done also in the configuration).
- Adjust the sequence of the fields in the group if required (buttons below the list of displayed fields).
- Click button *OK* to finalize configuring the new group.

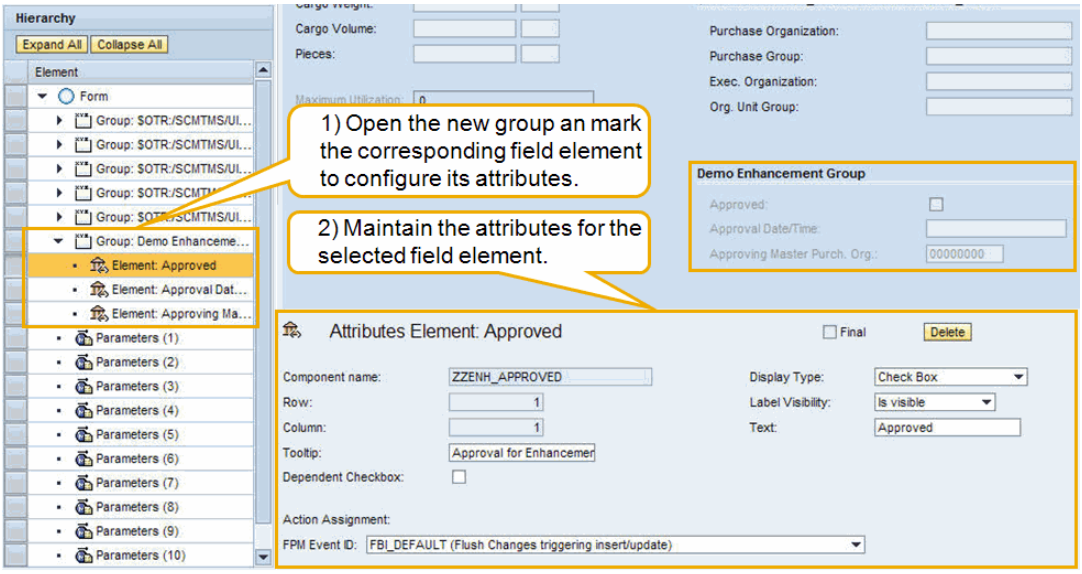


Picture: Assigning extension fields to the new group.

10) Maintain the attributes of the new extension fields.

The extension fields are now available in the layout of the FORM UIBB. Open the corresponding group in the hierarchy on the left side in the configuration tool. Now mark the field element whose attributes shall be maintained.

Example: The first field in the new group is a flag. Change the display type to *Check Box* to display the new field as a check box on the screen. In the field *Text*, enter the text for the label of the field (e.g. “Approved”). In field *Tooltip* add a tool tip for the field (e.g. “Approval for Enhancements”).

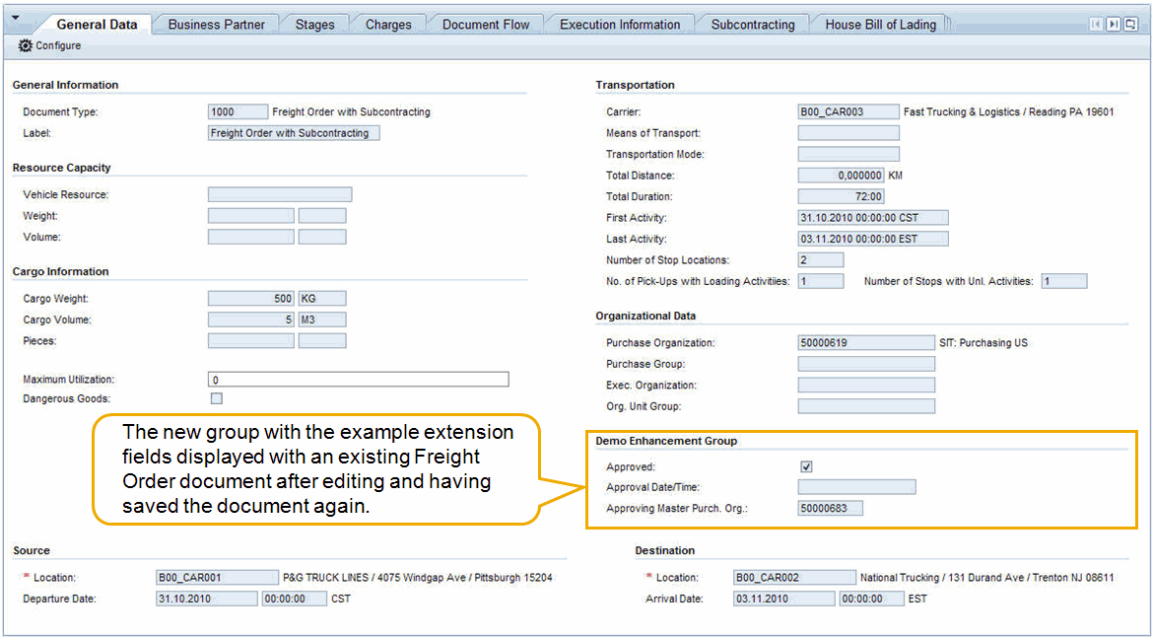


Picture: Maintain the attributes of the extension fields.

11) Finally, save the configuration by clicking on button *Save*. The enhancement can now be tested by restarting the UI.

Example: Display the same example Freight Order from step 2 again.

- Check if the new group is shown on the correct UIBB with the assigned fields.
- Bring the displayed document into edit mode and enter some data in the new fields.
- Save the document, close the UI and reopen it again by displaying the example Freight Order again to check that the content of the new extension fields get persisted.



Picture: The new group with the extension fields on the UI.

5.4.2 Adding a new action to a toolbar

A second example for extending the user interface is adding additional actions on a toolbar. The following example shows how to get a new action onto the toolbar of the tab *Items* of the Freight Order UI.

1) Start the Freight Order UI for displaying Freight Orders from the SAP user menu and set the configuration mode in the URL for the UI as described in section 5.1.

2) Display an existing Freight Order and click on tab ***Items*** (a FORM UIBB). On the left side of the tab click on link/button ***Configure*** to start the UIBB configuration for this tab (as described in 4.1). The name of the standard configuration of tab *Items* is:

   /SCMTMS/WDCC_FRE_ORDER_ITEMDET.

3) The system will start the configuration editor. If required create the customizing data record for this configuration as described in section 5.1.

4) Standard configuration /SCMTMS/WDCC_FRE_ORDER_ITEMDET includes the configurations of further UIBBs.

Configuration	Comment
/SCMTMS/WDCC_FRE_ORDER_ITM	Contains the configuration for the item hierarchy realized as a tree component.
/SCMTMS/WDCC_TOR_ITMTABXT	Contains configuration for further sub tabs on the item tab.

   Navigate to the configuration /SCMTMS/WDCC_FRE_ORDER_ITM by clicking on button Configure UIBB of this configuration. If required create the customizing data record for this configuration as described in section 5.1.

5) In the configuration /SCMTMS/WDCC_FRE_ORDER_ITM click on button *Edit Parameter*. Here you can find information which is relevant for the next steps:

   FBI View: The FBI view which is assigned to the current UI building block. As described in section 2.3, the FBI view besides other information holds the information on the UI structure of a building block as well as the related business object node.

   For our example the relevant FBI View is **/SCMTMS/FRE_ORDER_ITM**.

6) Take a look at the found FBI View (as described in section 5.2, step 6) to identify the BO and its node that it is related to.

   For our example, the BO is **/SCMTMS/TOR** (i.e. the Freight Order) and the node is **ITEM_TR** (the item node of the Freight Order).

7) Now use the BOPF Enhancement Workbench to create a new enhancement action as described in section 3.4.5. Example: Action ZENH_ITEM_ACTION with the following implementation for method EXECUTE of the action class ZCL_ENH_A_ITEM_ACTION:

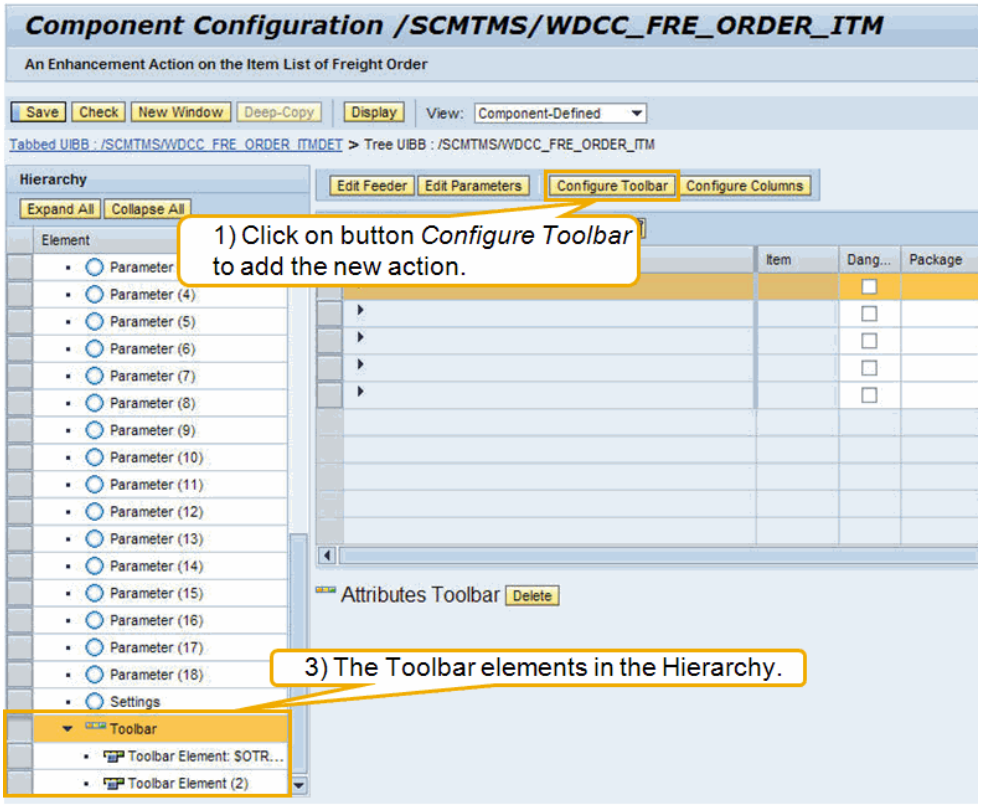
```
METHOD /bobf/if_frw_action~execute.
  DATA: lv_temp TYPE c.
  MESSAGE i008(/scmtms/ui_messages) INTO lv_temp.
  CALL METHOD /scmtms/cl_common_helper=>msg_helper_add_symsg
    EXPORTING
```

```
      iv_key      = /scmtms/if_tor_c=>sc_bo_key     " Instance Key
      iv_node_key = /scmtms/if_tor_c=>sc_node-root " BO Key
    CHANGING
      co_message  = eo_message.                     " Current message
 object
ENDMETHOD.
```

This very simple example action implementation takes a simple info message from message class /SCMTMS/UI_MESSAGES and puts it into the BOPF message object EO_MESSAGE. When you execute the new enhancement action the issued message will also be shown on the User Interface.

8) Use the new action to enhance the configuration of the toolbar.

The action is now available in the action catalog for the toolbar to be enhanced. In this step, the configuration is enhanced by adding the new action to the toolbar and defining the required action properties.



Picture: Adding a new action to the toolbar of a UIBB.

Example: Add the new action toolbar.
In the configuration /SCMTMS/WDCC_FRE_ORDER_ITEMDET click on button *Configure Toolbar*.

On the following popup screen you can find the list of available actions, including our new example action.

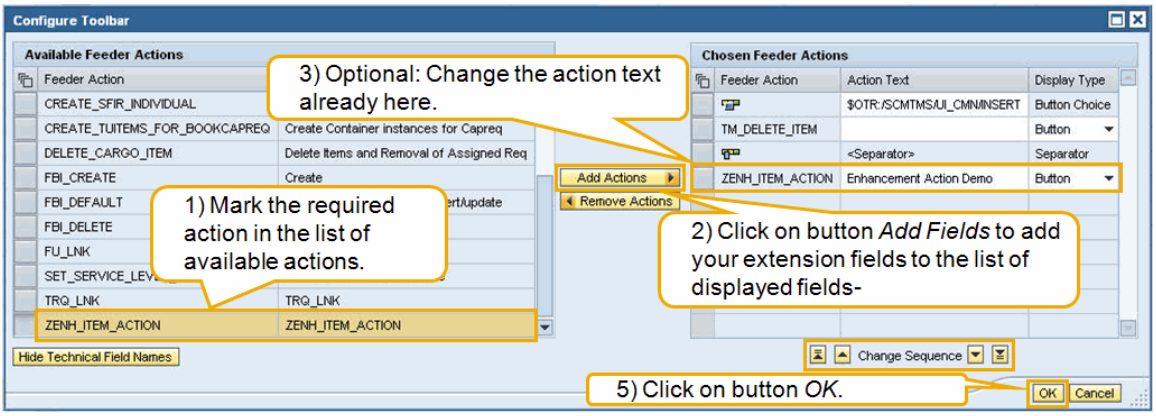
- Mark the action to be added (i.e. ZENH_ITEM_ACTION).
- Click on button *Add Actions* to take over the new action to the toolbar.

- Adjust the action text in the list of displayed actions (optional; can be done also in the configuration).

- Adjust the sequence of the actions in the list of actions if required (use the corresponding buttons below the list of displayed fields).

  Tipp: At the beginning of the list of available feeder actions on the left side of the popup, you can also add separators if you would like to separate the enhancement action from the other actions on the toolbar (as done in the example shown in the picture below).

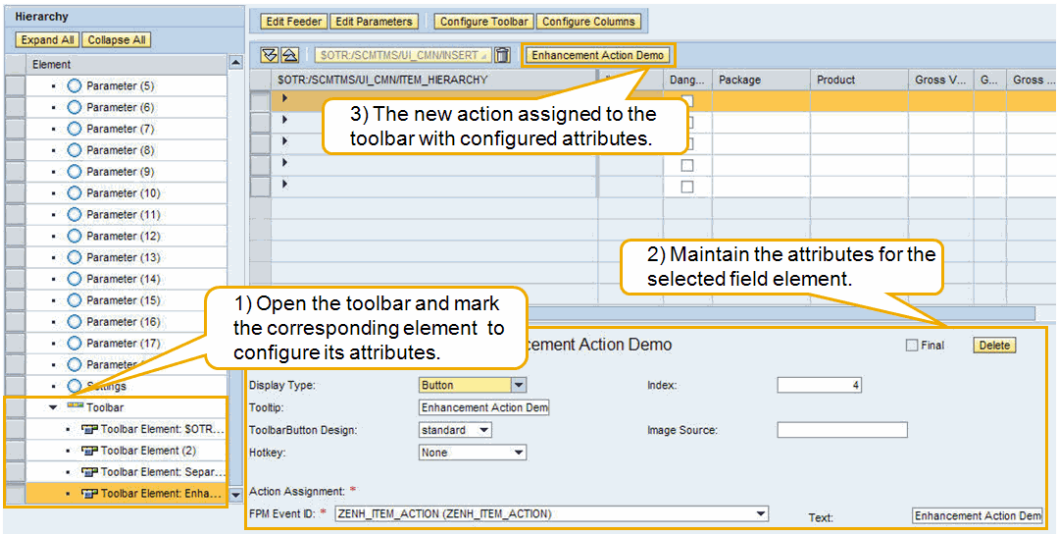
- Click button *OK* to finalize configuring the toolbar.



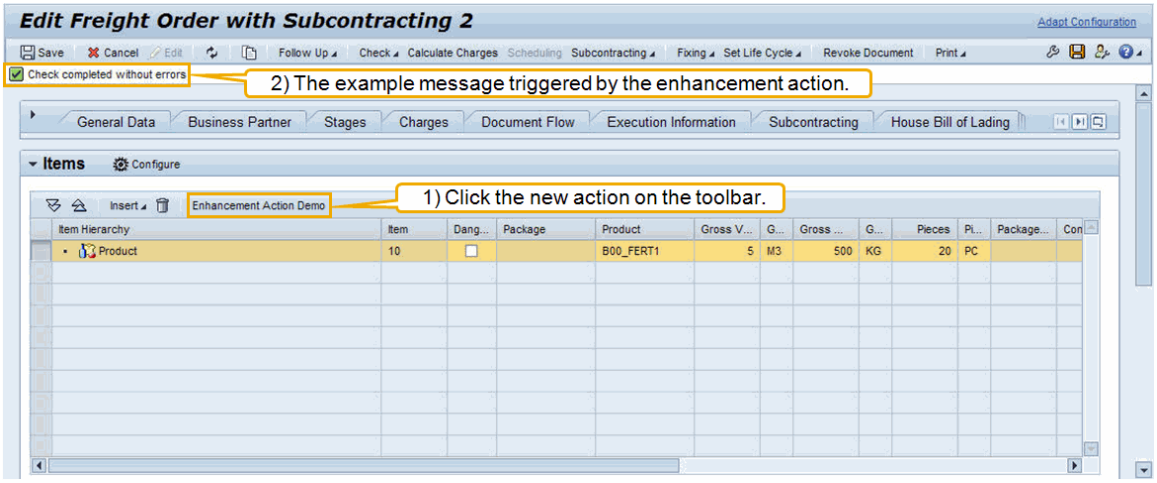
Picture: Configuring the toolbar.

9) Maintain the attributes of the new action: The action is now available on the layout for the toolbar of the TREE UIBB which displays the Freight Order items. Open the toolbar in the hierarchy on the left side in the configuration tool. Now mark the toolbar element whose attributes shall be maintained.

   Example: In the field *Text*, enter the text for the action (e.g. “Enhancement Action Demo”). In field *Tooltip* add a tool tip for the action. In field Image source you could specify an icon to be displayed with the action.



Picture: Maintain the attributes of the new action on the toolbar.



Picture: The new action on the toolbar.

5.4.3 Adding a new tab with data from a new BO subnode

The third example will show a more complex configuration enhancement. A new subnode for the Freight Order will be created. The data of this subnode shall be displayed as a list on a tab, including a toolbar with actions that can be executed on the available data.

1) Create a new subnode for the Freight Order as a subnode of its Root Node with a cardinality of 1:N. We will use the example subnode **ZENH_SUBNODE** as described in section 3.4.4 for the next steps.

2) Start the editor for the Web Dynpro ABAP Component Configuration to create a new configuration. The editor can be started via the following general link which has to be enhanced with information on server and port, depending on where you want to start the tool.

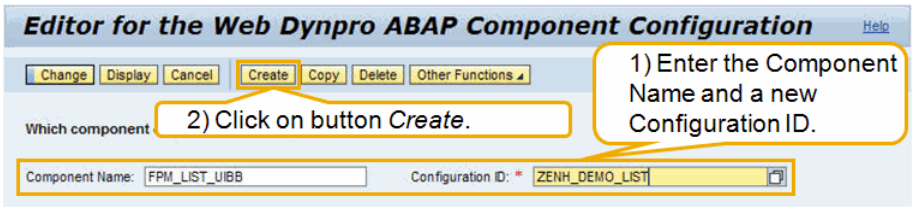
   https://**[server]**:**[port]**/sap/bc/webdynpro/sap/configure_component

   Example:
   https://uscia9x.wdf.sap.corp:44352/sap/bc/webdynpro/sap/configure_component

   Here you can enter a component name and a new Configuration ID.

Component Name	**FPM_LIST_UIBB**	The new configuration shall represent a list which will contain data from a new sub node
Configuration ID	**ZENH_DEMO_LIST**	This will be the new configuration to be integrated in the Freight Order UI.

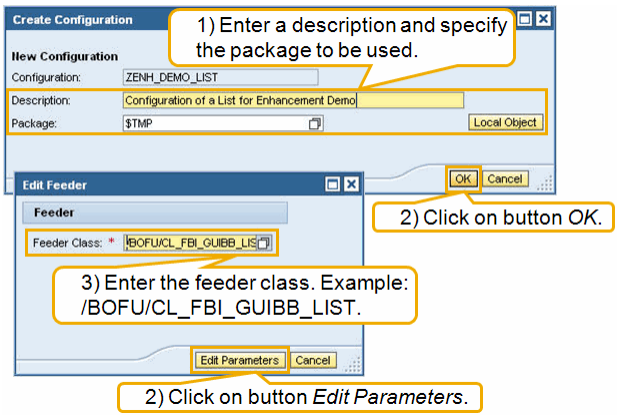
   Click on button *Create* to create the new configuration.



Picture: The initial screen of the Component Configuration Editor

3) On the first popup, specify a description for the new configuration as well as a package where to store it (e.g. as a local object in case of just testing).

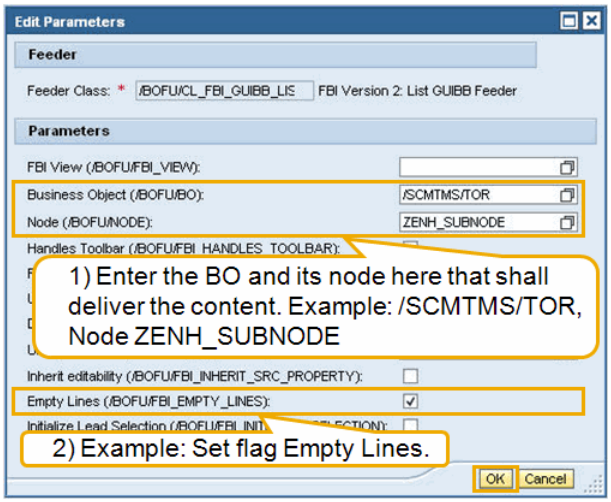
   On the second popup specify the feeder class that shall be used for the new configuration and the UIBB represented by it. For this example, we use a predefined feeder class for our new configuration: Class **/BOFU/CL_FBI_GUIBB_LIST**.



Picture: Create the configuration and define its feeder class.

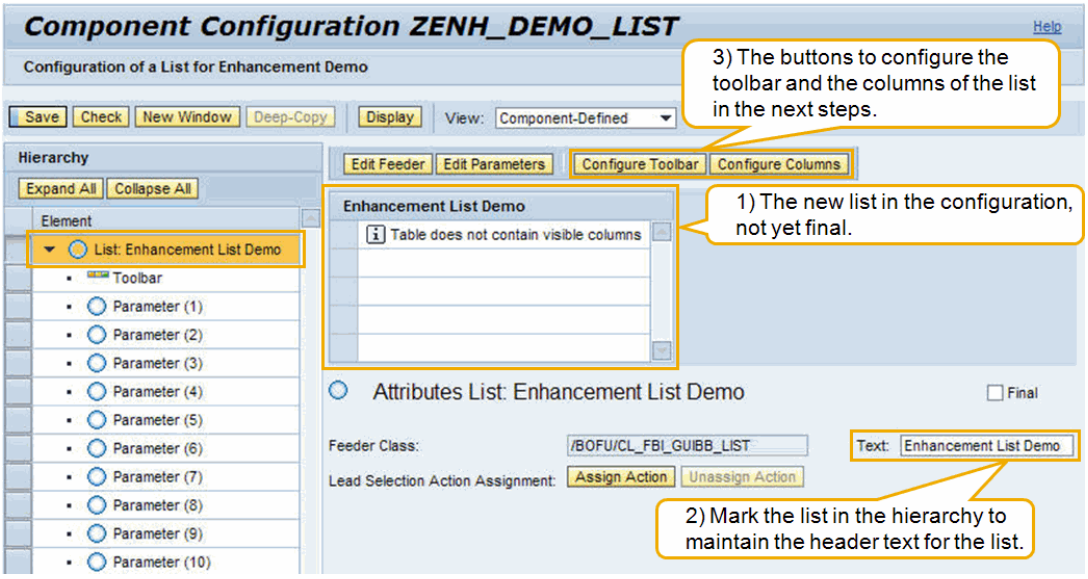
4) On the same popup click on button ***Edit Parameters*** to configure further parameters of the configuration. The following parameters define the data source from where our new list configuration will take the information to be displayed. They define the parameters that will be used by the feeder class in this configuration.

Business Object	**/SCMTMS/TOR**	The Freight Order BO.
Node	**ZENH_SUBNODE**	Our new subnode that was assigned to the Freight Order Root Node in step 1.
Empty Lines	**Yes**	In case this flag is set, the intended List will be displayed with a number of empty lines, i.e. a new entry in the list will not have to be created explicitly.



Picture: Parameters to be used by the feeder class.

Click on button ***OK*** to get to the next configuration step.

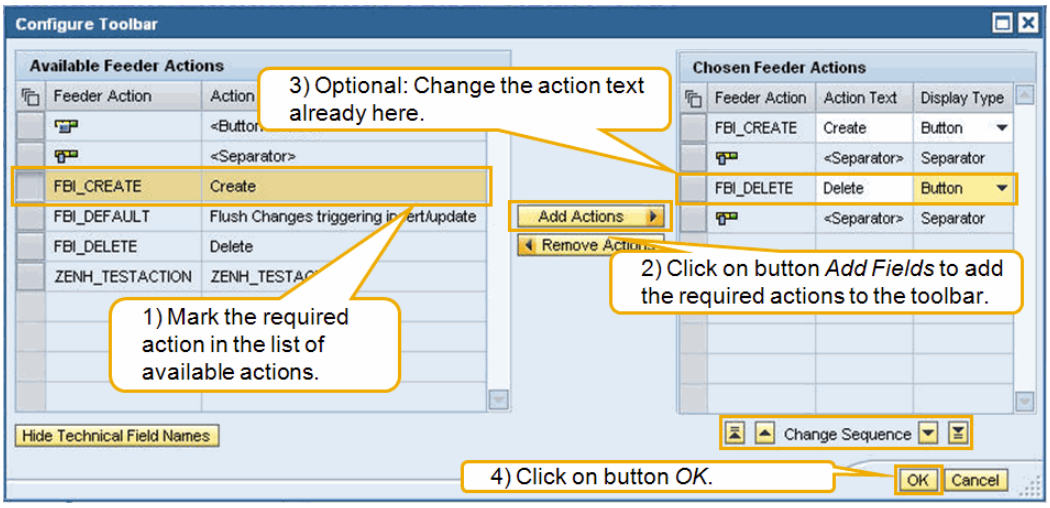


Picture: The list after the first configuration steps

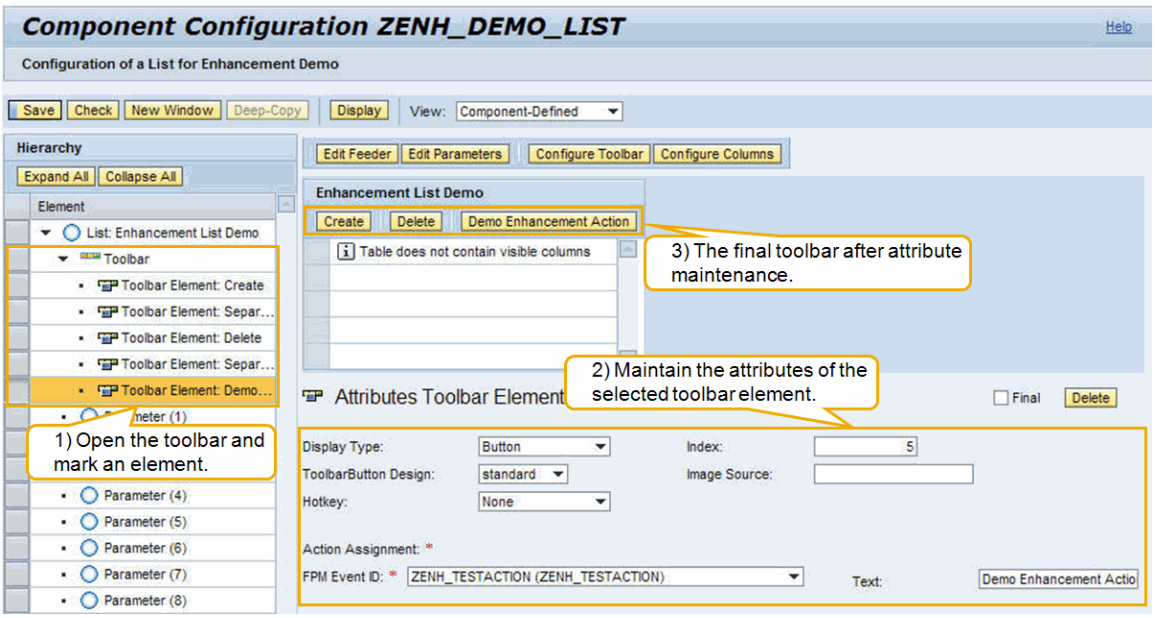
5) The next step is to further configure the list attributes, i.e. specifying a list text, defining the actions to be available on the list toolbar and most important the columns to be displayed in the list.

- Mark the List in the hierarchy (i.e. the topmost component) on the left side of the configuration editor (see picture above) and maintain the text for the list. Example: “Enhancement Demo List”.

- Click on button *Configure Toolbar* to add actions and separators to the list toolbar. Afterwards, open the toolbar in the element hierarchy on the left side of the configuration editor and maintain the attributes for each toolbar element, e.g. button texts, image source for an action icon, etc.

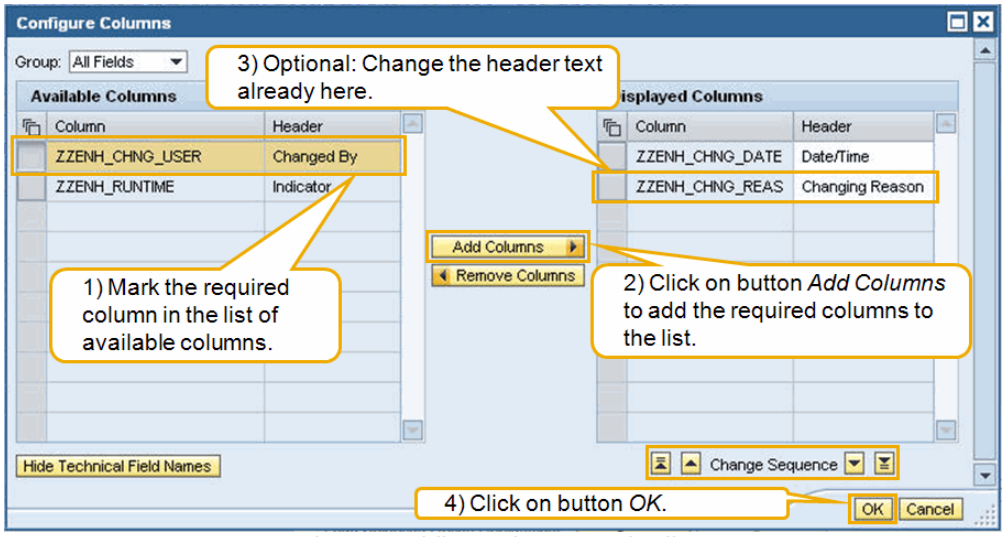


Picture: Adding actions to the toolbar.



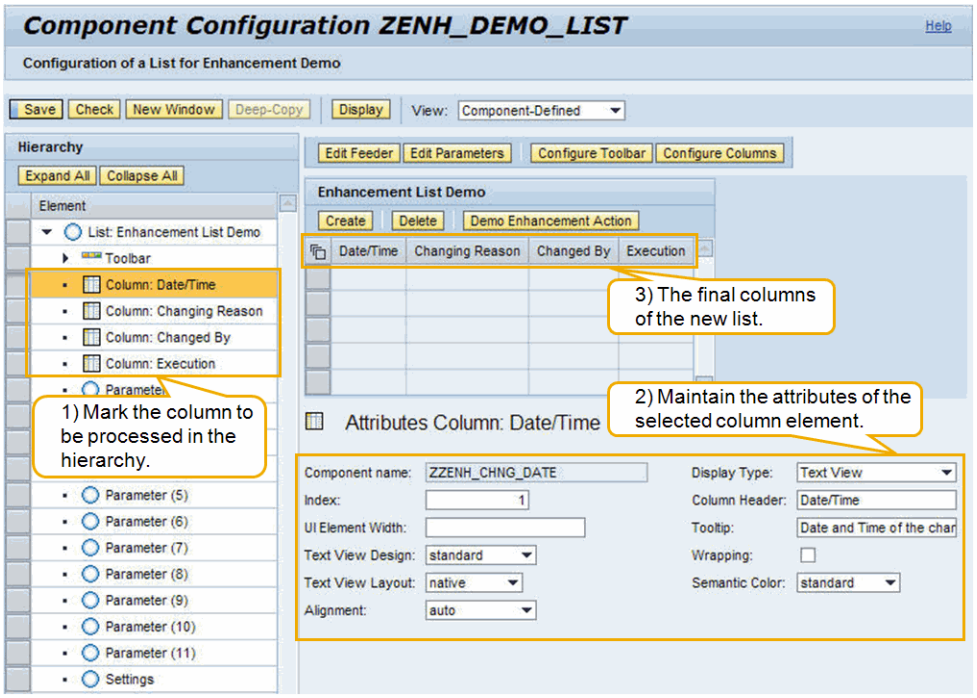
Picture: Maintaining toolbar element attributes.

- Click on button *Configure Columns* to add columns to the list. Afterwards, open the toolbar in the element hierarchy on the left side of the configuration editor and maintain the attributes for each toolbar element, e.g. button texts, image source for an action icon, etc.



Picture: Adding columns to the list.

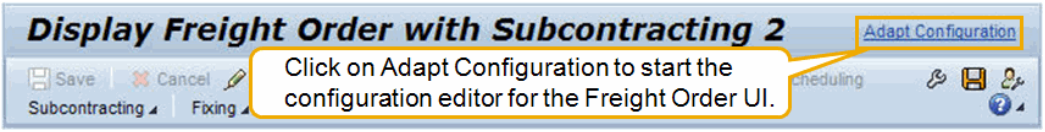
- After having selected the required columns for the new list, the attributes for each column can be maintained as shown in the next picture. Here you can e.g. define columns to be ready for input and the corresponding display type. The example column Execution is based on a Boolean data type which can be represented on the UI as a checkbox. You can select the display type from the available list box.



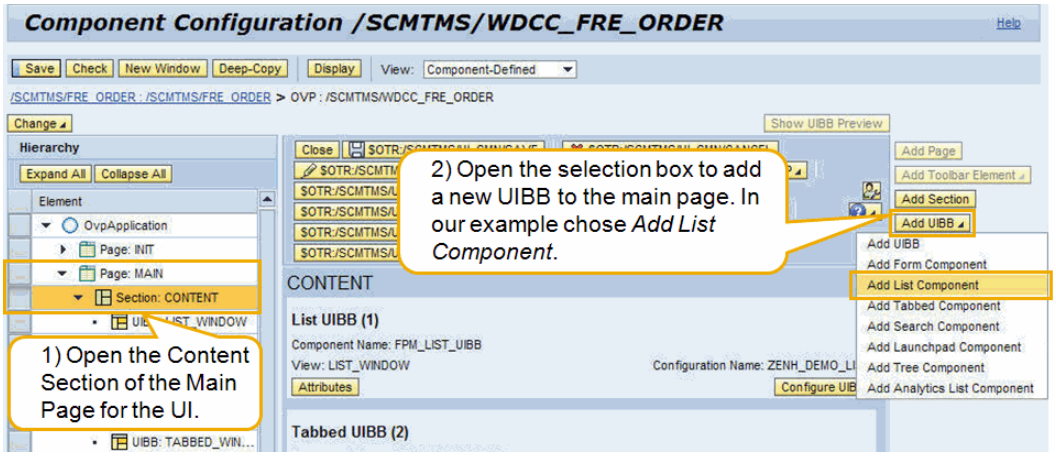
Picture: Maintaining list column attributes.

6) Save your configuration. In general you can execute a save for the configuration after each step. In case of problems with the configuration UI or the browser, you do not lose any work that was already done correctly and consistent.

7) The new configured UIBB will now integrated into the User Interface. Start the Freight Order UI for displaying Freight Orders from the SAP user menu and set the configuration mode in the URL for the UI as described in section 4.1.



Picture: Start the configuration Editor for the Freight Order UI.



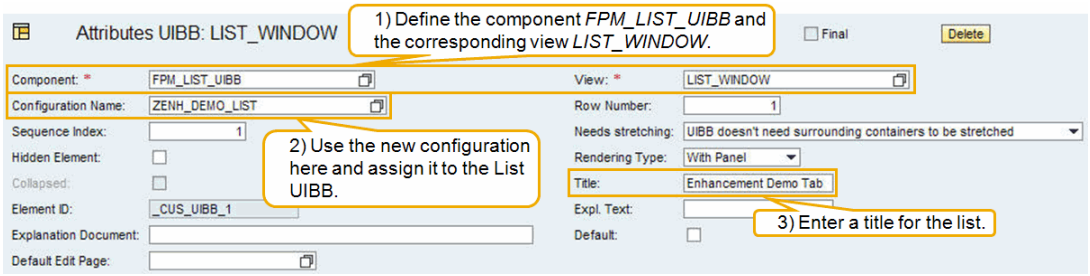
Picture: Adding a new UIBB to the main page.

- As shown in the picture above, open the main page of the OvpApplication and then mark the content section in the hierarchy of elements on the left side of the configuration editor.

- On the right side open the selection button *Add UIBB* and add a new List Component by choosing *Add List Component*.

8) Maintain the attributes of the new List Component (UIBB). First enter values for the following mandatory attributes. Choose *FPM_LIST_UIBB* as the component and *LIST_WINDOW* as the view for this UIBB.

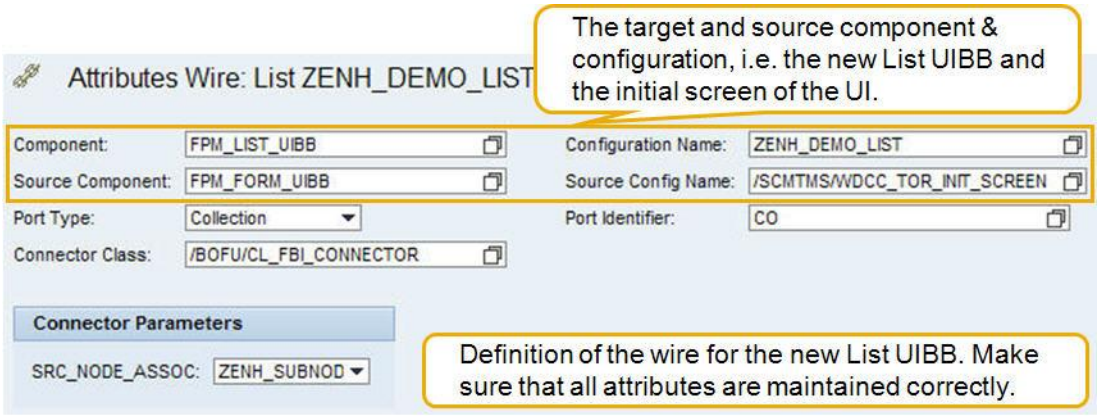
   In the field Configuration Name now enter the name of the new configuration we created with the previous steps: *ZENH_DEMO_LIST*.



Picture: Maintain the attributes of the new List Component.

9) Add a wire for the new UIBB: In the final step, we need to define where our new UIBB gets the data to be displayed from. This is done by declaring a so called wire which connects the new UIBB with the UI parts which already carry information on the current BO instance that is displayed. In our example, the new UIBB needs to know from which instance and which node of the Freight Order BO the data to be displayed is taken.

   Click on button Add Wire on the upper right side of the configuration editor. Then maintain the attributes for the new wire (note: the correct wiring is essential to make the new UIBB work).



Picture: Maintaining the wire attributes.

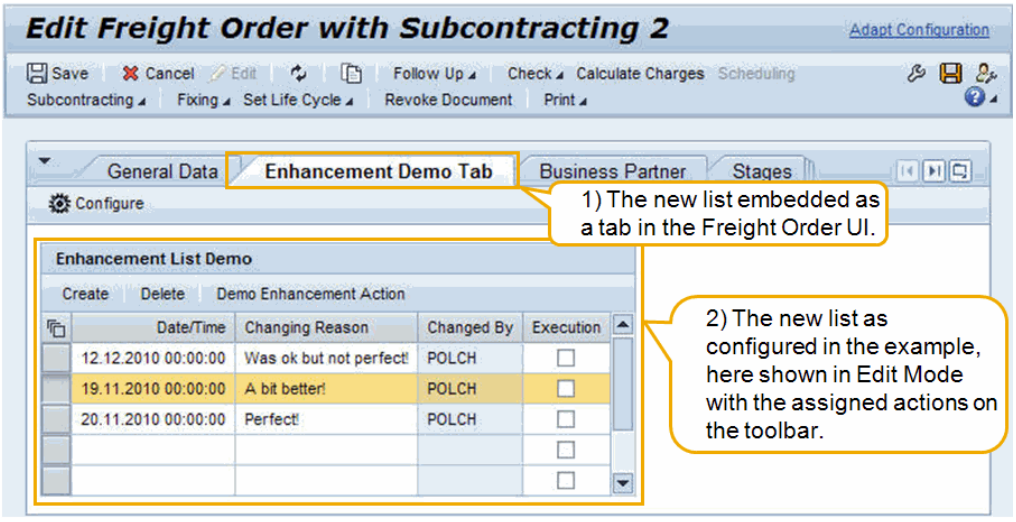
The following table contains the wire attributes with their corresponding values for the given example. In general, a wire has a target as well as source component and configuration. The target is our new List UIBB with its configuration that is based on the new sub node *ZENH_SUBNODE*. The source in this example is the initial screen of the Freight Order UI which carries the Freight Order number as the initial information. This source is based on the Root node of the Freight Order BO. At runtime the Root node contains the instance of the Freight Order which is processed. Based on this instance, the wire allows navigation to the corresponding sub node defined in the target. For this the BOBF association between the

Root node and sub node ZENH_SUBNODE is used. With this, the new List UIBB can now get the corresponding data from the sub node of the Freight Order instance.

Attribute	Value	Comment
Component	FPM_LIST_UIBB	The generic List UIBB provided by FPM, i.e. the target component of the wire.
Configuration Name	ZENH_DEMO_LIST	Our example configuration for the new List UIBB, i.e. the target configuration of the wire.
Source Component	FPM_FORM_UIBB	The source component of the wire. In this example it is a FORM_UIBB.
Source Config. Name	/SCMTMS/WDCC_TOR_INIT_SCREEN	The source configuration of the wire. In this example it is the configuration for the initial screen form of the Freight Order UI.
Port Type	Collection	(clarify detailed semantics)
Port Identifier	CO	(clarify detailed semantics)
Connector Class	/BOFU/CL_FBI_CONNECTOR	Provides basic functions to connect FPM, FBI and BOBF.
SRC_NODE_ASSOC	ZENH_SUBNODE	This is the association that is defined between the node of the wire source and the node of the wire target. In this example it is the composition association between the Freight Order (TOR) Root node and our new subnode ZENH_SUBNODE.

As mentioned in the introduction of this section 4, it is recommended to build up more detailed knowledge on FPM and FBI via separate trainings if required. This document cannot replace such trainings nor can it cover all aspects in detail.

10) Save your configuration. The new List UIBB with its configuration is now ready to be used on the Freight Order UI. The list is shown as a tab and allows displaying as well as editing instances of sub node ZENH_SUBNODE for a given Freight Order instance.



Picture: The final List UIBB embedded in the Freight Order UI.

5.4.4 Adding a new Action to the main tool bar

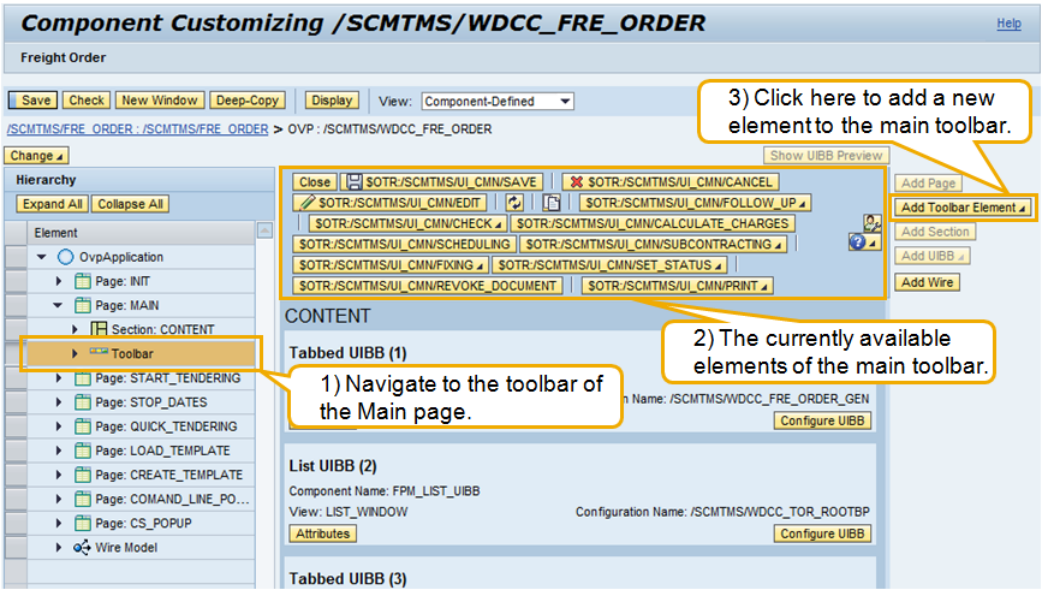
Adding a new action to the main tool bar of an FPM application works slightly different than adding an action to a component tool bar as shown in section 5.4.2.

For the following first example let's assume we have already added an enhancement action ZENH_MAINTOOLBAR_ACTION on the Root node of the Freight Order BO (TOR) that we would like to trigger from the main tool bar of the Freight Order UI. The coding for the action implementation shall look as follows:

```
METHOD /bobf/if_frw_action~execute.
  DATA: lv_temp TYPE c.
  MESSAGE i008(/scmtms/ui_messages) INTO lv_temp.
  CALL METHOD /scmtms/cl_common_helper=>msg_helper_add_symsg
    EXPORTING
      iv_key      = /scmtms/if_tor_c=>sc_bo_key     " Instance Key
      iv_node_key = /scmtms/if_tor_c=>sc_node-root " BO Key
    CHANGING
      co_message  = eo_message.                     " Current message ob
ject
ENDMETHOD.
```

1) Start the Freight Order UI for displaying Freight Orders from the SAP user menu and set the configuration mode in the URL for the UI as described in section 5.1.

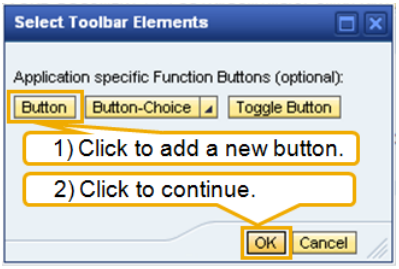
2) On the initial screen click on the link *Adapt Configuration* in the upper left corner to get to the component configuration /SCMTMS/WDCC_FRE_ORDER of the Freight Order UI. In the hierarchy tree on the left side of the configuration editor follow the path *OvpApplication → Page: MAIN → Toolbar* and then double click on entry *Toolbar*.



Picture: The main tool bar of the FOR UI in the Conf. Editor.

Click on button *Add Toolbar Element* on the right side of the configuration editor and then choose option *Add to Page*.

3) On the following popup click on *Button* to add a new button to the main tool bar. Then click on button *OK* to continue.



Picture: Add a new button.

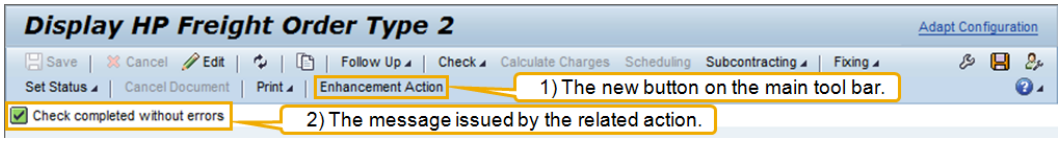
4) A new button will appear in the list of tool bar elements. The attributes of this button can now be maintained as follows:

Attribute	Value
Text	Enh. Main Toolbar Action
Tool Tip	An Enhancement Action on the main toolbar
FPM Event ID	ZENH_MAINTOOLBAR_ACTION
Action Type	Standard

Moreover maintain the following Event Parameter:

Parameter Name	Parameter Value
FBI_RAISED_BY_TOOLBAR	X

5) Save your configuration. The new button is now ready to be used on the Freight Order UI via its main tool bar.



Picture: The new button on the main tool bar.

With this first example the enhancement action will be triggered by the additional button on the main tool bar. As we have chosen the FPM Event ID to be identical with the action name, the execution of the action will be handled generically without any further coding required.

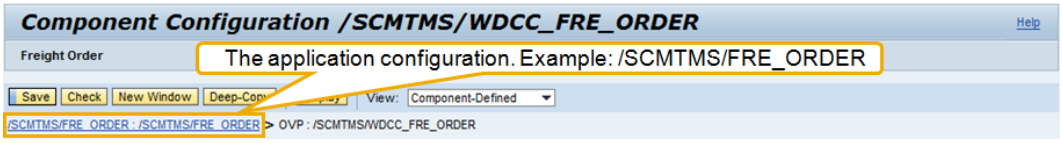
In case you don't want to relate the button to a BO action as shown in the first example, you can follow the second approach which allows you to implement arbitrary coding to be executed when clicking the related button on the UI. This works as follows:

For each application configuration (e.g. /SCMTMS/FRE_ORDER) there is a FBI View available that follows the naming convention [application configuration name]_HTLB. For the example this is FBI View /SCMTMS/FRE_ORDER_HTLB. It is defined to handle the tool bar of the application and the Exit Class defined there is called automatically.

Instead of providing an action name as the FPM Event ID (see step 4 above) you can provide an arbitrary FPM Event ID (e.g. *MyEventID*) that will be handled by the Exit Class of the HTLB FBI View. In the Exit Class you can add coding to method ADAPT_EVENT to react on and handle the event. You can identify the corresponding Exit Class as follows:

1) Start the Freight Order UI for displaying Freight Orders from the SAP user menu and set the configuration mode in the URL for the UI as described in section 5.1.

2) On the initial screen click on the link *Adapt Configuration* in the upper left corner to get to the component configuration /SCMTMS/WDCC_FRE_ORDER of the Freight Order UI. In the upper left corner of the configuration editor you can see a link that points to the application configuration /SCMTMS/FRE_ORDER.



Picture: Link to the application configuration.

3) Start transaction *SE84* and follow the path *Repository Information System → Web Dynpro → Component Configuration*. On the right side enter /SCMTMS/FRE_ORDER_HTLB in the input field Component Configuration

4) Press *F8* to start the selection and then double click on the found entry. On the right side you can now see the general attributes of FBI View /SCMTMS/FRE_ORDER_HTLB. Now click on button *Start Configurator* to start the Configurator for the FBI View.

5) On the next screen click on button *Display* to show the details of the FBI View.

6) On tab strip *Header* you can see the name of the relevant exit class in field *Exit Interface Class*. For the example this is class /SCMTMS/CL_UI_VIEWEXIT_TOR.

In the standard implementation of the identified Exit Class method ADAPT_EVENT you can see how to react on your own FPM Event IDs. The FPM Event ID that was configured for the new button on the main tool bar will be available in method parameter IV_EVENTID. The coding can then e.g. look as follows:

```
 CASE iv_eventid.

    WHEN /scmtms/if_ui_cmn_c=>sc_action-cmn-show_plan_blkdet OR
         /scmtms/if_ui_cmn_c=>sc_action-cmn-show_exec_blkdet OR
         /scmtms/if_ui_cmn_c=>sc_action-cmn-show_inv_blkdet.
      handle_show_blkdet(
        EXPORTING
          iv_eventid          = iv_eventid
          ir_event_data       = ir_event_data
          it_selected_rows    = it_selected_rows
        CHANGING
          cv_failed           = cv_failed ).

* React on your own Event ID here.
    WHEN MyEventId.
      " The coding that handles the event should be placed in a separate
      " method of e.g. a local class (in case of customer extensions).
       CALL METHOD MyEventIdHandler().

    WHEN OTHERS.

  ENDCASE.
```

5.4.5 Adding a new Parameter Action with a Popup

In the last section we added an action to the main tool bar of an FPM application. In the following example, a parameter action is added that invokes a popup to enter the action's parameter before executing the action. Moreover the example indicates how a Confirmation Popup for actions can be realized by configuring an OK and a Cancel button.

Execute the following steps to create this example:

1) Start the BOBF Enhancement Workbench (transaction /BOBF/CUST_UI) and create the following enhancement action on the Root node of the Freight Order BO (TOR) (see also section 3.3.6):

Attribute	Value
Action Name	ZENH_POPUP_PARAM_ACT
Description	Enh. Parameter Action for UI Popup Demo
Implementing Class	ZCL_ENH_A_POPUP_PARAM_ACT
Parameter Structure	ZENH_S_A_POPUP_PARAM_ACT
Action Cardinality	Multiple Node Instances
Extensible	Yes

The example action parameter structure ZENH_S_A_POPUP_PARAM_ACT shall look as follows:

Append Structure		
Name	ZENH_S_A_POPUP_PARAM_ACT	
Description	Enhancement Action Parameters	
Component	**Typing Method**	**Component Type**
ZZENH_COMMENT	Types	/SCMTMS/STRING
ZZENH_WORKS_IND	Types	Boolean

Make sure that you have defined an enhancement category for the new structure. Then save and activate the action parameter structure.

The attributes of this structure will later be available to be placed on the popup. When executing the action via the UI, the popup will be displayed where you can enter corresponding values. In the example, we will configure an OK and a Cancel button that lets you execute or abort the execution of the action.

Use transaction SE91 to create message class ZENH_MESS with the following messages:

Message	Message Short Text
001	Yes, it works! &1
002	No, it doesn't work! &1

The coding for the action implementation shall look as follows (in method EXECUTE of implementing class ZCL_ENH_A_POPUP_PARAM_ACT):

```
METHOD /bobf/if_frw_action~execute.

  FIELD-SYMBOLS: <fs_parameters> TYPE zenh_s_a_popup_param_act.

  DATA: ls_msg       TYPE symsg,
        lr_act_param TYPE REF TO /scmtms/s_tor_a_conf,
        lv_temp      TYPE c.
```

```
* take over action parameters
  ASSIGN is_parameters->* TO <fs_parameters>.

* prepare message text parameter
  CLEAR ls_msg.
  ls_msg-msgv1 = <fs_parameters>-zzenh_comment.

* use parameter Z_FLAG
  IF <fs_parameters>-z_works_ind = abap_true.
    MESSAGE s001(zenh_mess) WITH ls_msg-msgv1 INTO lv_temp.
  ELSE.
    MESSAGE e002(zenh_mess) WITH ls_msg-msgv1 INTO lv_temp.
  ENDIF.

  CALL METHOD /scmtms/cl_common_helper=>msg_helper_add_symsg(
    EXPORTING
      iv_key      = /scmtms/if_tor_c=>sc_bo_key
      iv_node_key = /scmtms/if_tor_c=>sc_node-root
    CHANGING
      co_message  = eo_message ).

ENDMETHOD.
```

2) Start the editor for the Web Dynpro ABAP Component Configuration to create a new configuration. As mentioned already in section 5.4.3, the editor can be started via the following general link which has to be enhanced with information on server and port, depending on where you want to start the tool.

https://**[server]**:**[port]**/sap/bc/webdynpro/sap/configure_component

Example:
https://uscia9x.wdf.sap.corp:44352/sap/bc/webdynpro/sap/configure_component

Here you can enter a component name and a new Configuration ID. This new configuration will define a From UIBB that will contain the action parameters as available input fields.

Field	Value	Comment
Component Name	**FPM_FORM_UIBB**	The new configuration shall represent a form which will contain data of the action parameter structure.
Configuration ID	**ZENH_WDCC_POPUP_ACTION**	This will be the new configuration to be integrated in the Freight Order UI.

Click on button *Create* to create the new configuration.

3) On the following popup provide a description and a package where to store the new configuration. Then click on button *OK* to continue.

Field	Value
Description	**FPM_FORM_UIBB**
Package	**$TMP** (or your own customer/partner specific package)

4) The next popup requests to specify the FBI Feeder Class that shall be used for providing the data to the Form UIBB displayed on the intended popup.

   For this the Feeder Class /BOFU/CL_FBI_GUIBB_ACTPRM_FDR which represents a generic Action Parameter Feeder class provided by the FBI framework. It makes use of the parameters defined for the action that will be assigned to trigger the new popup. The Assignment of the action created in step 1 to the new configuration is described in one of the next steps.

5) In the next step you specify the parameters that the Feeder Class shall take into consideration at runtime. Enter the following values in the mentioned fields and then click on button *OK*.

Field	Value	Comment
Business Object	/SCMTMS/TOR	The Business Object that the action is assigned to.
Node	ROOT	The node of the Business Object that the action is assigned to.
Action	ZENH_POPUP_PARAM_ACT	The name of the action that will be executed and delivers the fields to be provided on the popup based on its action parameter structure.

6) On the configuration screen click on button Add Group to specify a new group that shall contain the fields to be entered on the popup. In the attributes of the group enter the following value in field text:

Field	Value
Text	Enhancement Parameter Action

7) In our example we now create a Melting Group to allow the 2 fields of the action parameter structure to be displayed in one single line. Mark the created Group from step 6 in the Element Hierarchy on the left side of the configuration editor and click on button *Add Melting Group*.

   This step is optional if you don't need the fields in one single line, i.e. you could also click on button *Configure Group* directly and assign the fields directly to the group instead of the Melting Group which works exactly as described in the next step.

8) Mark the created Melting Group in the Element Hierarchy on the left side of the configuration editor and click on button *Configure Melting Group*.

   Here you can now take over the fields from the action parameter structure into the layout of the new Form UIBB and specify a label as well as a display type for each field:

Field	Text	Display Type
ZZENH_COMMENT	Comment	Input Field
ZZENH_WORKS_IND	Works?	Check Box

9) Save the configuration for the Form UIBB.

10) Start the editor for the Web Dynpro ABAP Component Configuration to add a new page to the Freight Order UI configuration /SCMTMS/WDCC_FRE_ORDER. As mentioned already in section 5.4.3, the editor can be started via the following general link which has to be

enhanced with information on server and port, depending on where you want to start the tool. In this case we customize an already existing standard component configuration, i.e. we use the following link to start the component customizing for /SCMTMS/WDCC_FRE_ORDER.

https://**[server]**:**[port]**/sap/bc/webdynpro/sap/customize_component

Example:
https://uscia9x.wdf.sap.corp:44352/sap/bc/webdynpro/sap/customize_component

Here you can enter a component name and a new Configuration ID. This new configuration will define a From UIBB that will contain the action parameters as available input fields.

Field	Value	Comment
Component Name	**FPM_OVP_COMPONENT**	
Configuration ID	**/SCMTMS/WDCC_FRE_ORDER**	The standard Web Dynpro Component Configuration of the Freight Order UI.

Click on button *Change* to enhance the existing standard component configuration.

11) A new page is now added to component configuration /SCMTMS/WDCC_FREE_ORDER. Click on button *Add Page* on the upper right side of the editor and specify the page attributes as follows:

Attribute	Value
Page ID	ENH_POPUP_ACTION
Page Type	Dialog
Title	Enhancement Popup
Dialog buttons	OK and CANCEL (OK is default button)

In the element hierarchy on the left side of the editor further drill down by following the path Page: *ENH_POPUP_ACTION → Section: SECTION_1 → UIBB_XXX* and specify the attributes of the UIBB listed there as follows:

Attribute	Value
Component	FPM_FORM_UIBB
Configuration Name	ZENH_WDCC_POPUP_ACTION
View	FORM_WINDOW
Title	Enhancement Popup

With these settings we have assigned our configuration of the Form UIBB to represent the popup to the newly created page. This new page represents now the complete definition of the popup that shall come up when executing the action from the UI.

12) Click on button *Save* in the Editor Tool Bar to save the component customizing.

13) In the next step, start the editor for the Web Dynpro ABAP Component Configuration /SCMTMS/WDCC_APPCC which represents the application controller configuration. Here, the Action is finally assigned to the popup that was configured in the previous steps.

14) Click on button *Change* and on the next screen navigate to tab strip *Component-Defined*. In section Configuration Context click on button Add and add a new Action Parameter Configuration. Specify the following attributes:

Attribute	Value
cfgIndex	A valid number representing the latest entry in the list, Final flag set.
Business Object	/SCMTMS/TOR, Final flag not set.
Node	ROOT, Final flag not set.
Action	ZENH_POPUP_PARAM_ACTION, Final flag not set.
Dialog window id	ENH_POPUP_ACTION, Final flag not set.

15) Click on button *Save* in the Component Configuration Tool bar.

The resulting popup that comes up when executing the new action can be seen on the following picture. The popup comes up after clicking on the corresponding button. You can then enter values in the input fields and click on button *Ok* to start the execution of the action with the entered values or click on button *Cancel* to abort the execution.

5.4.6 Accessing and displaying data from external sources

The following use case is based on a real world scenario where a customer wanted to display external data on the TM UI, i.e. the data to be displayed does comes from a data source outside the TM application / system.

Use Case:
On the *Document Reference* tab of the Freight Order UI shipment numbers (originally coming from ERP) related to the displayed Freight Order are shown. For these shipments some details shall be read from ERP and displayed with the related Freight Order on the Freight Order UI. In the specific customer example the serial numbers for the products assigned to the shipments shall be displayed. The serial numbers are not known on TM side but need to be read from the shipments in ERP.

1) To “simulate” an external data source and simplify this example, we simply create the following database table that serves as our external data source and can be populated with example data: Start transaction *SE11* and create data base table *ZENH_D_SERNUM* as follows:

    a. On the initial screen of transaction SE11 enter the table name *ZENH_D_SERNUM* in field Database Table and click on button *Create*.
    b. On the next screen enter the following short description for the new table: *Database Table to simulate external data access*.
    c. On tab strip Delivery and Maintenance specify *Delivery Class A (Application Table – master and transactional data)* and specify *Display Maintenance Allowed* in field *Data Browser / Table View Maint*enance.
    d. On tab strip *Fields* enter the following fields that make up our “external data source”:

Field	Key	Initial Values	Data Type	Short Description
MANDT	Yes	Yes	MANDT	Client
BTD_ID	Yes	Yes	/SCMTMS/BTD_ID	Bus. Trans. Document ID
SERNUM_IDX	Yes	Yes	/SCMTMS/INTEGER_VALUE	Integer Value
SERNUM			/SCMTMS/STRING	String
INUSE			BOOLEAN	Boolean Variable (X=True, -=False, Space=Unknown)
WEIGHT			/SCMTMS/QUANTITY	Quantity
WEIGHT_UOM			/SCMTMS/DIM_WEIGHT_WT_UOM	Weight Unit of Measure for Dimensional Weight

e. On tab strip *Currency / Quantity Fields* specify for field *WEIGHT* the reference table *ZENH_D_SERNUM*, reference field *WEIGHT_UOM*.
f. Maintain enhancement category *Can Be Enhanced (deep)* under *Extras → Enhancement Category*.
g. Click on button *Technical Settings* and maintain the technical settings of the new database table as follows:
    i. Data class : APPL1
    ii. Size Category : 4
    iii. Buffering not allowed : Yes
h. Finally save and activate the new database table.

The following steps illustrate how to realize an additional tab strip on the standard Freight Order UI that contains a list with the shipments and related serial numbers.

2) Display FBI View */SCMTMS/TOR_DOCREF* as follows:

a. Start transaction *SE84* and choose Web Dynpro.
b. Double click on Component Configuration.
c. Enter */SCMTMS/TOR_DOCREF* in field *Component Configuration* and press *F8*.
d. Double click on the found entry on the next screen and here click on button *Start Configurator*.
e. Click on button *Display*.

3) On the FBI View you can find the defined UI Structure, Mapper Class and Exit Interface class used for the tab strip *Document Reference* tab of the Freight Order UI. Create a copy of all three objects as follows:

a. Create a copy of Mapper Class */SCMTMS/CL_UI_CONVERSION_TOR* with transaction *SE24* and name it *ZCL_ENH_UI_CONVERSION_SERNUM*. Save and activate the copy.

b. Create a copy of Exit Interface Class */SCMTMS/CL_UI_VIEWEXIT_TOR* with transaction *SE24* and name it *ZCL_ENH_UI_VIEWEXIT_SERNUM*. Save and activate the copy.

c. Create a copy of Node UI structure */SCMTMS/S_UI_CMN_DOCREF* with transaction *SE11* and name it *ZENH_S_UI_SERNUM*. Save and activate the copy.

4) Add all external fields to the Node UI structure ZENH_S_UI_SERNUM that shall be read and displayed from the external data source, i.e. in the example this would be all fields that we have already used to define the database table in step 1, except field MANDT.

5) Create a new FBI View ZENH_SERNUM: Display FBI View */SCMTMS/TOR_DOCREF* as described in step 2.

a. On the first screen make sure that you specify the Component Name as */BOFU/FBI_VIEW* (already specified after displaying the mentioned standard FBI View)
b. Clear field *Configuration ID* and enter *ZENH_SERNUM* as the name for the new FBI View.
c. Click on button *Create*. On the Header tab of the following screen enter the following data:

Field	Value
Business Object	/SCMTMS/TOR
Node	DOCREFERENCE

Node UI Structure	ZENH_S_UI_SERNUM
Mapper Class	ZCL_ENH_UI_CONVERSION_SERNUM
Exit Interface Class	ZCL_ENH_UI_VIEWEXIT_SERNUM

d. Click on button *Save*.

6) In section 5.4.3 we described how to add a new List Component. We now add a new List Component that will carry the external data. Add it to section *Content* of page *Main* in Component Configuration */SCMTMS/WDCC_FRE_ORDER* (you can access this Component Configuration just like described for the FBI View in step 2).

   a. Add a new UIBB at the mentioned place by choosing *Add List Component* from selection button *Add UIBB*.

   b. Create a new UIBB configuration *ZENH_WDCC_SERNUM* for the new List Component. As Feeder Class assign */BOFU/CL_FBI_GUIBB_LIST*.

   c. In the Feeder Class Parameters assign FBI View *ZENH_SERNUM* that was created in step 5.

   d. Configure the columns etc. of the List UIBB. The fields of the new Node UI Structure *ZENH_S_UI_SERNUM* are all available for representing columns in the new list. Configure them all correspondingly and save the List UIBB configuration.

7) Now go back to Component Configuration */SCMTMS/WDCC_FRE_ORDER* and add a new wire that connects the initial screen of the Freight Order UI with the new List UIBB. On the right side of the Component Configuration Editor click on button *Add Wire*. Maintain the wire attributes as follows:

Field	Value
Component	FPM_LIST_UIBB
Configuration Name	ZENH_WDCC_SERNUM
Source Component	FPM_FORM_UIBB
Source Configuration Name	/SCMTMS/WDCC_TOR_INIT_SCREEN
Port Type	Collection
Port Identifier	CO
Connector Class	/BOFU/CL_FBI_CONNECTOR

8) Save Component Configuration /SCMTMS/WDCC_FRE_ORDER by clicking on button *Save*.

In the configuration of the Freight Order UI we have now added everything to display the external data. Now coding is required to read, prepare and get the external data displayed correctly on the new List UIBB.

1) In class *ZCL_ENH_UI_CONVERSION_SERNUM* method *BUILD_MAP_TABLE* add the following lines of code at the beginning of the method implementation. The member variable *MV_CALL_EXIT* is set to true. At runtime this setting will force the application to call method *CALL_EXIT_METHOD*.

```
METHOD build_map_table.

  DATA:
    ls_map_data_ext TYPE ts_map_data_ext.

  SET EXTENDED CHECK OFF.
```

```
* call exit method where the extraction of the external data
* will take place.
  mv_call_exit = abap_true.

  CASE iv_ui_struct.
  …
  ENDCASE.

ENDMETHOD.
```

2) In class *ZCL_ENH_UI_CONVERSION_SERNUM* method *CALL_EXIT_METHOD* add the place the following lines of code at the beginning of the CASE statement:

```
METHOD call_exit_meth.

  CASE mv_ui_struct.

    WHEN 'ZENH_S_UI_SERNUM'.
      CALL METHOD zcl_enh_sernum_ext_access=>read_serial_numbers
        CHANGING
          ct_ui_data = ct_ui_data.

    WHEN '/SCMTMS/S_UI_TOR_ITEM'          OR
    …
  ENDCASE.

ENDMETHOD.
```

At runtime, when the new UI structure *ZENH_S_UI_SERNUM* is used, a method of an external class is called that contains the coding to read data from the external data source.

When the method is called, the changing parameter *CT_UI_DATA* contains first of all the data of the Document Reference Tab of the Freight Order UI (remember that we have assigned */SCMTMS/TOR* as the “source” BO and *DOCREFERENCE* as the “source” node in the used FBI View *ZENH_SERNUM*.

3) Use transaction SE24 to create a simple static class ZCL_ENH_SERNUM_EXT_ACCESS with a method READ_SERIAL_NUMBERS. The method shall have a changing parameter CT_UI_DATA of type ANY_TABLE. Within this method, the data from the external data source is read and used to rebuild and redefine the content of the initial data in CT_UI_DATA that will then displayed in the new List UIBB that was added. The coding could look as follows:

```
METHOD read_serial_numbers.

* declarations
  TYPES: BEGIN OF ls_btd_id_range,
           sign   TYPE ddsign,
           option TYPE ddoption,
           low    TYPE /scmtms/btd_id,
           high   TYPE /scmtms/btd_id.
  TYPES: END OF ls_btd_id_range.
  TYPES: lt_btd_id_range TYPE TABLE OF ls_btd_id_range.

  DATA: lv_component_bo            TYPE string,
```

```
        lv_component_ui            TYPE string,
        ls_sernum                  TYPE zenh_s_sernum,
        lt_sernum                  TYPE TABLE OF zenh_s_sernum,
        ls_btd_id                  TYPE ls_btd_id_range,
        lt_btd_id                  TYPE lt_btd_id_range,
        ls_sernum_ui               TYPE zenh_s_ui_sernum,
        lt_sernum_ui               TYPE TABLE OF zenh_s_ui_sernum,
        ls_sernum_data             TYPE REF TO data.

  FIELD-SYMBOLS: <fs_ui_data>      TYPE any,
                 <fs_btd_tco>      TYPE /scmtms/btd_type_code,
                 <fs_btd_id>       TYPE /scmtms/btd_id,
                 <fs_sernum>       TYPE zenh_s_sernum,
                 <fs_sernum_ui>    TYPE zenh_s_ui_sernum,
                 <fs_key>          TYPE /bobf/conf_key.

  CLEAR: ls_btd_id,
         lt_btd_id.

* collect all relevant BTD IDs to be used for
* accessing external data
  LOOP AT ct_ui_data ASSIGNING <fs_ui_data>.
    ASSIGN COMPONENT 'BTD_TCO' OF STRUCTURE <fs_ui_data>
                               TO <fs_btd_tco>.
    IF <fs_btd_tco> = 'T57'.
      ASSIGN COMPONENT 'BTD_ID' OF STRUCTURE <fs_ui_data>
                                TO <fs_btd_id>.
      ls_btd_id-option = 'EQ'.
      ls_btd_id-sign   = 'I'.
      ls_btd_id-low    = <fs_btd_id>.
      APPEND ls_btd_id TO lt_btd_id.
    ENDIF.
  ENDLOOP.

* read the data from the external source
* Example: A Select statement to access our "Simulation Table"
  SELECT btd_id
         sernum_idx
         sernum
         inuse
         weight
         weight_uom
    FROM zenh_d_sernum
    INTO CORRESPONDING FIELDS OF TABLE lt_sernum
   WHERE btd_id IN lt_btd_id.

* take over the data into the TM UI structure
  IF sy-subrc = 0.
    CLEAR: ls_sernum_ui,
           lt_sernum_ui.

* create a table with the complete UI information, including the
* keys of the original entries from DOCREF.
    LOOP AT ct_ui_data ASSIGNING <fs_ui_data>.
      ASSIGN COMPONENT 'KEY' OF STRUCTURE <fs_ui_data>
                                      TO <fs_key>.
      ASSIGN COMPONENT 'BTD_ID' OF STRUCTURE <fs_ui_data>
```

```
                                TO <fs_btd_id>.
      ASSIGN COMPONENT 'BTD_TCO' OF STRUCTURE <fs_ui_data>
                                 TO <fs_btd_tco>.
      LOOP AT lt_sernum ASSIGNING <fs_sernum>
        WHERE btd_id = <fs_btd_id>.
        ls_sernum_ui-key        = <fs_key>.
        ls_sernum_ui-btd_id     = <fs_btd_id>.
        ls_sernum_ui-btd_tco    = <fs_btd_tco>.
        ls_sernum_ui-sernum_idx = <fs_sernum>-sernum_idx.
        ls_sernum_ui-sernum     = <fs_sernum>-sernum.
        ls_sernum_ui-inuse      = <fs_sernum>-inuse.
        ls_sernum_ui-weight     = <fs_sernum>-weight.
        ls_sernum_ui-weight_uom = <fs_sernum>-weight_uom.
        APPEND ls_sernum_ui TO lt_sernum_ui.
      ENDLOOP.
    ENDLOOP.

* transfer the UI data to be passed to the List UIBB into CT_UI_DATA
    IF NOT lt_sernum IS INITIAL.
      CLEAR ct_ui_data.
      CREATE DATA ls_sernum_data TYPE zenh_s_ui_sernum.
      ASSIGN ls_sernum_data->* TO <fs_ui_data>.
      LOOP AT lt_sernum_ui ASSIGNING <fs_sernum_ui>.
        MOVE-CORRESPONDING <fs_sernum_ui> TO <fs_ui_data>.
        INSERT <fs_ui_data> INTO TABLE ct_ui_data.
      ENDLOOP.
    ENDIF.

  ENDIF.

ENDMETHOD.
```

Basically, the coding does the following. From the UI data in *CT_UI_DATA* that in the first place contains just the same data as the Document Reference tab the entries are filtered out for which serial numbers shall be read from the external data source. In the example, this shall only happen for those document references that represent a Shipment, i.e. *BTD_TCO = T57*.

For the relevant documents a *SELECT* statement reads the serial number from the external data source which is in the example case the database table that we created in step 1. The result of this *SELECT* statement will then be used to rebuild the content of changing parameter *CT_UI_DATA* to then contain the list of relevant documents with their related serial numbers. This “modified data” will then be provided to the new List UIBB that was added to contain the serial number information.

4) If data from external data sources shall be displayed within the TM UI, please make sure that the access to the external data source is implemented with the highest performance possible. In the implementation you should also consider a buffer mechanism for the external data that only reads data again from the external data source if really necessary.

5.4.7 Building a simple new User Interface

SAP Transportation Management uses the Floor Plan Manager for Web Dynpro ABAP to build the user interface. So building such a user interface is based on a standard technology which is available in SAP NetWeaver.

For details on FPM and how to build user interfaces with it, please refer to the corresponding SAP NetWeaver documentation under the following link:

http://help.sap.com/saphelp_nw73/helpdata/en/fc/182711c34a4684a7c0214b42554514/frameset.htm

Further information can also be found in the SAP Developer Network under the following link (search there for FPM):

http://www.sdn.sap.com/irj/sdn/index

To connect a FPM build user interfaces with the application, so called feeder classes are used. Feeder class implementations are based on a predefined interface definition providing all necessary methods and corresponding signatures in order to standardize the communication between the application and the GUIBB.

Interface	Comment
IF_FPM_GUIBB_FORM	Interface for FORM components.
IF_FPM_GUIBB_LIST	Interface for LIST components
IF_FPM_GUIBB_SEARCH	Interface for SEARCH components
IF_FPM_GUIBB_TREE	Interface for TREE components

Method GET_DEFINITION of a feeder class defines the field catalog of the component (GUIBB). At runtime, method GET_DATA supplies the component with data from the application.

SAP Transportation Management uses FBI (Floor Plan Manager BOPF Integration) to connect the FPM user interface with the application which is build up by BOPF business objects and the corresponding business logic. Instead of having to implement individual feeder classes, FBI provides a list of already implemented (generic) Feeder Classes that can be reused to connect a FPM user interface with the BOPF based application.

These available, generic FBI feeder classes allow creating a new UI on an existing BOPF business object without having to implement any own coding (of course there might be UIs with a high complexity that require own coding).

The following example shows how to build a small and simple UI for the Freight Order BO (TOR) from scratch (to be illustrated with corresponding screen shots). You should not be scared about the number of steps. The intention is to show a variety of different configuration aspects for realizing even specific and useful details. This will help to understand the configuration possibilities from scratch.

1) Start transaction *SE80*, navigate e.g. to your local objects (we will store the example in package *$TMP*) and create a new Web Dynpro Application with the following parameters:

Field	Value
Application	ZENH_TOR_UI
Description	Enhancement Demo UI
Component	FPM_OVP_COMPONENT
Interface View	FPM_WINDOW
Plug Name	DEFAULT

2) Create an Application Configuration with the following parameters:

Field	Value
Application Name	ZENH_TOR_UI
Configuration ID	ZENH_TOR_UI

Click on button *Create* to create the application configuration. A popup comes up where you can specify a description and a package where to store the application configuration.

Field	Value
Configuration	ZENH_TOR_UI
Description	Enhancement Demo UI for TOR BO
Package	$TMP (or other package)

3) On the following screen click on tab *Structure* where you can see the assignment of component configurations represented as a list (with one item). In column *Configuration* enter the following configuration name.

Field	Value
Component Usage	ZENH_TOR_UI (defaulted)
Component	FPM_OVP_COMPONENT (defaulted)
Implementation	FPM_OVP_COMPONENT (defaulted)
Configuration	ZENH_WDCC_TOR_UI

Click on button *Go to Component Configuration* to create the application configuration. On the following screen, the system will issue an error message stating that configuration *ZENH_WDCC_TOR_UI* does not yet exist. Click again on button *Create* to create the configuration. On the next popup enter the following data:

Field	Value
Configuration	ZENH_WDCC_TOR_UI
Description	Enhancement Demo UI Application Configuration
Package	$TMP (or other package)

4) You can now see the Component Configuration Editor. Click on button *Change* and select option *Global Settings*. On the following popup enter the following settings and click on button *Ok*:

Field	Value
Web Dynpro Component	/BOFU/WDC_FBI_CONTROLLER
Configuration Name	/SCMTMS/WDCC_APPCC

5) On the right side of the Component Configuration Editor click on button *Add Page*. Maintain the following parameters for the new page:

Field	Value
Page ID	INIT
Page Type	Initial Screen
Title	Enhancement Demo UI Initial Screen

6) On the left side of the Component Configuration Editor you can see the hierarchy of elements. Open the sub tree for page *INIT* and click on section *SECTION_1*. Maintain the following attributes for the section:

Field	Value
Section ID	SECTION_1
Layout Type	One Column Layout (Standard Layout)

7) Mark section *SECTION_1* of page *INIT* in the hierarchy and click on button *Add UIBB* on the right side. Select Add *Form Component* and maintain the following attributes for the new form:

Field	Value
Component	FPM_FORM_UIBB
View	FORM_WINDOW
Configuration Name	ZENH_WDCC_TOR_UI_ALTKEY

The new UIBB will be listed in the middle part of the Component Configuration Editor. Click on the corresponding button *Configure UIBB* to create the configuration and configure the UIBB.

8) On the following popup specify a description and a package for the new configuration:

Field	Value
Configuration	ZENH_WDCC_TOR_UI_ALTKEY
Description	Enhancement Demo UI Alternative Key Configuration
Package	$TMP (or other package)

Create configuration *ZENH_WDCC_TOR_UI_ALTKEY* and on the following popup enter class ***/BOFU/CL_FBI_GUIBB_ALTKEY_FDR*** as the feeder class. Click on button *Edit Parameters* and maintain the following attributes. Afterwards click on button *Ok*.

Field	Value
Business Object	/SCMTMS/TOR
Node	ROOT
Alternative Key	TOR_ID

Click on button *Add Group* to add a new Group. Then click on button *Configure Group* and from the list of available fields add field *TOR_ID* to the group. Maintain the following attributes for the field:

Field	Value
Component Name	TOR_ID
Display Type	Input Field
Label Visibility	Is visible
Text	Document
FPM Event ID	FPM_LEAVE_INITIAL_SCREEN(). (This will allow hitting ENTER in the field instead of clicking on button Continue to get to the main screen).

Check and save this configuration. Then navigate back to component configuration *ZENH_WDCC_TOR_UI*.

9) Add a new Form UIBB as already described in step 7.

Field	Value
Component	FPM_FORM_UIBB

View	FORM_WINDOW
Configuration Name	ZENH_WDCC_TOR_UI_INIT
Sequence Index	1

The new UIBB will be listed in the middle part of the Component Configuration Editor. Click on the corresponding button *Configure UIBB* to create the configuration and configure the UIBB. On the first popup enter the following data:

Field	Value
Configuration	ZENH_WDCC_TOR_UI_ALTKEY
Description	Enhancement Demo UI Alternative Key Configuration
Package	$TMP (or other package)

10) Create configuration *ZENH_WDCC_TOR_UI_INIT* and on the following popup enter class ***/BOFU/CL_FBI_GUIBB_BOOTSTRAP*** as the feeder class. Click on button *Edit Parameters* and maintain the following attributes. Afterwards click on button *Ok*.

Field	Value
Business Object	/SCMTMS/TOR
Node	ROOT
URL Key Provider	/BOFU/CL_FBI_URL_KEYPROVIDER
Preselection Key Provider	/BOFU/CL_FBI_PRSEL_KEYPROVIDER

Check and save this configuration. Then navigate back to component configuration *ZENH_WDCC_TOR_UI*.

11) On the right side of the Component Configuration Editor click on button *Add Wire*. Maintain the wire attributes as follows:

Field	Value
Component	FPM_FORM_UIBB
Configuration Name	ZENH_WDCC_TOR_UI_INIT
Source Component	FPM_FORM_UIBB
Source Configuration Name	ZENH_WDCC_TOR_UI_ALTKEY
Port Type	Collection
Port Identifier	CO
Connector Class	/BOFU/CL_FBI_CONNECTOR

Click again on button *Add Wire* to maintain a second required wire:

Field	Value
Component	/BOFU/WDC_FBI_CONTROLLER
Configuration Name	/SCMTMS/WDCC_APPCC
Source Component	FPM_FORM_UIBB
Source Configuration Name	ZENH_WDCC_TOR_UI_INIT
Port Type	Collection
Port Identifier	CO
Connector Class	/BOFU/CL_FBI_CONNECTOR

12) Click on button *Add Page* and add a second page in configuration *ZENH_WDCC_TOR_UI*. Maintain the attributes of the new page as follows:

Field	Value
Page ID	MAIN

Page Type	Main Screen
Title	TOR Document Main Screen

13) Mark section *SECTION_1* of page *MAIN* in the hierarchy and maintain the following attributes:

Field	Value
Section ID	SECTION_1
Stacked	Yes (ensures that any form, list, etc. of the section appears as a separate tab strip).

Click on button *ADD UIBB* on the right side. Select *Add Form Component* and maintain the following attributes for the new form:

Field	Value
Component	FPM_FORM_UIBB
View	FORM_WINDOW
Configuration Name	ZENH_WDCC_TOR_UI_ROOT
Sequence Index	1
Title	Root Node Information

The new UIBB will be listed in the middle part of the Component Configuration Editor. Click on the corresponding button *Configure UIBB* to create the configuration and configure the UIBB.

14) Create configuration *ZENH_WDCC_TOR_UI_ROOT* and on the following popup enter class ***/BOFU/CL_FBI_GUIBB_FORM*** as the feeder class. Click on button *Edit Parameters* and maintain the following attributes. Afterwards click on button *Ok*.

Field	Value
Business Object	/SCMTMS/TOR
Node	ROOT
Handles Toolbar	Yes

Click on button *Add Group* to add a new Group. Maintain the following attributes for the new group:

Field	Value
Text	Document Data
Sequence Index	1
Group Type	Half width, 1 column

Click on button *Configure Group*. From the list of available fields add the following fields to the group: *TOR_ID*, *TOR_CAT* and *TOR_TYPE*.

Click again on button *Add Group* to add a new group with the following attributes:

Field	Value
Text	Administrative Data
Sequence Index	2
Group Type	Half width, 1 column

Then click on button *Configure Group* and from the list of available fields add the following fields to the group: *CREATED_BY*, *CREATED_ON*, *CHANGED_BY* and *CHANGED_ON*.

Check and save this configuration. Then navigate back to component configuration *ZENH_WDCC_TOR_UI*.

15) On the right side of the Component Configuration Editor click on button *Add Wire*. Maintain the wire attributes as follows:

Field	Value
Component	FPM_FORM_UIBB
Configuration Name	ZENH_WDCC_TOR_UI_ROOT
Source Component	FPM_FORM_UIBB
Source Configuration Name	ZENH_WDCC_TOR_UI_INIT
Port Type	Collection
Port Identifier	CO
Connector Class	/BOFU/CL_FBI_CONNECTOR

Check and save component configuration *ZENH_WDCC_TOR_UI* and navigate to Application Configuration *ZENH_TOR_UI*.

16) Now the UI is ready for a first test. On the Application Configuration screen click on button *Test* to test your new user interface. Enter an existing TOR ID and click non button Continue. You should now see a screen like this:

You can now add further UIBBs with corresponding configurations and wires between them to add more functionality to your user interface. The steps 1 – 16 show the very basics on how to make use of the FBI feeder classes that are already implemented and available. In the next steps we will add further functionality.

17) The next step is to create a button in the toolbar of the main screen that allows switching a document into Edit Mode. Go back to component configuration ZENH_WDCC_TOR_UI and open the path *OvpApplication – Page: MAIN – Toolbar*. On the right side of the editor click on button *Add Toolbar Element* and choose *Add to Page*.

On the following popup click on *Button. A*dd a new button to the toolbar and maintain the following attributes for it:

Field	Value
Element ID	EDIT
Sequence Index	1
Text	Edit
Add Separator	Yes
FPM Event ID	FPM_EDIT

Add another button with the following attributes:

Field	Value
Element ID	SAVE
Sequence Index	2
Text	Save
Add Separator	Yes
FPM Event ID	FPM_SAVE

When data is displayed on the main screen, you can now click on button *Edit* to switch into Edit Mode. Fields allowed to be changed can now be entered. Click on button *Save* to save the changed data.

18) We add a second form UIBB to display Business Partner Data coming from the TOR Root node. Mark page *MAIN* in the hierarchy and click on button *ADD UIBB* on the right side. Select *Add Form Component* and maintain the following attributes for the new form:

Field	Value
Component	FPM_FORM_UIBB
View	FORM_WINDOW
Configuration Name	ZENH_WDCC_TOR_UI_BUPA
Sequence Index	1
Title	Root Node Business Partners

The new UIBB will be listed in the middle part of the Component Configuration Editor. Click on the corresponding button *Configure UIBB* to create the configuration and configure the UIBB.

Create configuration *ZENH_WDCC_TOR_UI_BUPA* and on the following popup enter class ***/BOFU/CL_FBI_GUIBB_FORM*** as the feeder class. Click on button *Edit Parameters* and maintain the following attributes. Afterwards click on button *Ok*.

Field	Value
Business Object	/SCMTMS/TOR
Node	ROOT
Handles Toolbar	Yes

Click on button *Add Group* to add a new Group. Maintain the following attributes for the new group:

Field	Value
Text	Business Partner Data
Sequence Index	1
Group Type	Half width, 1 column

Click on button *Configure Group*. From the list of available fields add the following fields to the group: *CONSIGNEEID*, *SHIPPERID* and *TSPID*.

Check and save this configuration. Then navigate back to component configuration *ZENH_WDCC_TOR_UI*.

19) On the right side of the Component Configuration Editor click on button *Add Wire*. Maintain the wire attributes as follows:

Field	Value
Component	FPM_FORM_UIBB
Configuration Name	ZENH_WDCC_TOR_UI_BUPA
Source Component	FPM_FORM_UIBB
Source Configuration Name	ZENH_WDCC_TOR_UI_INIT
Port Type	Collection
Port Identifier	CO
Connector Class	/BOFU/CL_FBI_CONNECTOR

Check and save component configuration *ZENH_WDCC_TOR_UI*. For testing the UI again navigate to Application Configuration *ZENH_TOR_UI* and click on button *Test*. You should now see the second Form UIBB represented as a tab strip containing Business Partner Data that is stored on the TOR Root node.

20) Navigate back to component configuration *ZENH_WDCC_TOR_UI* and mark page *MAIN* in the hierarchy on the left side of the editor.

Click button *Add Section* on the right side to add a new section and maintain the following attributes for the new section:

Field	Value
Section ID	SECTION_2
Stacked	Yes (ensures that any form, list, etc. of the section appears as a separate tab strip).

Click on button *ADD UIBB* on the right side. Select *Add Form Component* and maintain the following attributes for the new form:

Field	Value
Component	FPM_LIST_UIBB
View	LIST_WINDOW
Configuration Name	ZENH_WDCC_TOR_UI_ITEM
Sequence Index	1
Title	Item Node Information

The new UIBB will be listed in the middle part of the Component Configuration Editor. Click on the corresponding button *Configure UIBB* to create the configuration and configure the UIBB.

21) Create configuration *ZENH_WDCC_TOR_UI_ITEM* and on the following popup enter class ***/BOFU/CL_FBI_GUIBB_LIST*** as the feeder class. Click on button *Edit Parameters* and maintain the following attributes. Afterwards click on button *Ok*.

Field	Value
Business Object	/SCMTMS/TOR
Node	ITEM_TR
Handles Toolbar	Yes

Click on button *Configure Columns* and add the following fields to represent the columns of the item list: ITEM_ID, ITEM_DESCR, PRODUCT_ID, GRO_VOL_VAL, GRO_VOL_UNI, GRO_WEI_VAL and GRO_WEI_UNI.

Check the attributes for each of these fields. Initially all added fields are defined to be *Text Views* in attribute *Display Type*, i.e. they are defined to be display only fields. If you want any of the listed fields to be input fields were data can be entered or adjusted in Edit Mode, change the attribute *Display Type* of the field to *Input Field*.

Now click on button Configure Toolbar to add the following actions to the tool bar of the item list: FBI_CREATE and FBI_DELETE (you can of course add any other action from the list of available feeder actions).

Check and save this configuration. Then navigate back to component configuration *ZENH_WDCC_TOR_UI*.

22) On the right side of the Component Configuration Editor click on button *Add Wire*. Maintain the wire attributes as follows:

Field	Value

Component	FPM_LIST_UIBB
Configuration Name	ZENH_WDCC_TOR_UI_ITEM
Source Component	FPM_FORM_UIBB
Source Configuration Name	ZENH_WDCC_TOR_UI_INIT
Port Type	Collection
Port Identifier	CO
Connector Class	/BOFU/CL_FBI_CONNECTOR

Check and save component configuration *ZENH_WDCC_TOR_UI*. For testing the UI again navigate to Application Configuration *ZENH_TOR_UI* and click on button *Test*. You should now see the second section with the configured List UIBB represented as a tab strip containing Business Partner Data that is stored on the TOR Root node.

5.5 Transporting or removing UI enhancements.

Transporting as well as deleting created customizing records is possible via a corresponding Web Dynpro application that can be started with the following general link which has to be enhanced with information on server and port, depending on where you want to start the tool.

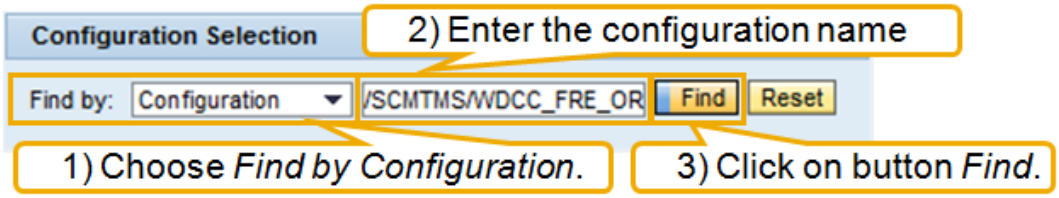
http://**[server]**:**[port]**/sap/bc/webdynpro/sap/wd_analyze_config_comp

Example: http://ukwtr9x.wdf.sap.corp:80089/sap/bc/webdynpro/sap/wd_analyze_config_comp

Here you can select the enhancement configuration/customizing record to either transport it through the system landscape or if required to delete it.

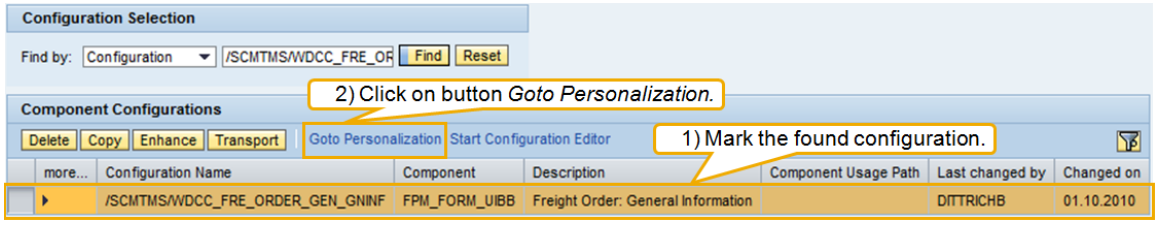
1) Start the tool as mentioned above. In field ***Find by*** select ***Configuration*** and in the next field enter the name of a configuration that you want to take a look at.

   Example: /SCMTMS/WDCC_FRE_ORDER_GEN_GNINF



Picture: The initial screen of the tool.

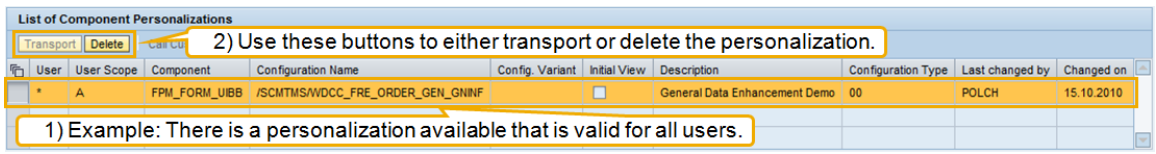
2) On the next screen mark the found configuration and click on button *Goto Personalization*.



Picture: Navigating to the Personalization of the configuration.

Moreover, the buttons Copy or Enhance allow creating a copy of a selected configuration that can be reused when building a new user interface, e.g. for an existing BO. Or such a copy is created, adjusted and replaces corresponding standard configurations in an existing user interface.

3) The following screen shows the list of Component Personalizations. Here you can find buttons to either transport an enhanced configuration (i.e. the corresponding customizing records) or delete the enhancements again.



Picture: Transporting or deleting a Component Personalization (customizing record).

In the above mentioned example, you can see a customizing record for the standard configuration /SCMTMS/WDCC_FRE_ORDER_GEN_GNINF which is valid for all users (*).

6 Enhancing Queries and POWL

6.1 Queries

6.1.1 General concept

As described in section 3.4.10, the BOBF Enhancement Workbench does not support enhancing existing standard BO queries. It is for example not possible to assign a query to the ROOT node, which returns instances or the keys of the related ITEM node. The only way to extend queries in the standard BOPF environment is to add further query node attributes to the query structure.

This section describes how to enhance also existing standard queries.

All queries of SAP TM are derived from super class /**SCMTMS/CL_Q_SUPERCLASS**. This super class contains an enhancement mechanism which makes SAP TM queries extensible and helps to make TM queries in a unified way. The mechanism is based on the query enhancement table (QET) **/SCMTMS/C_QENH** which has the following structure:

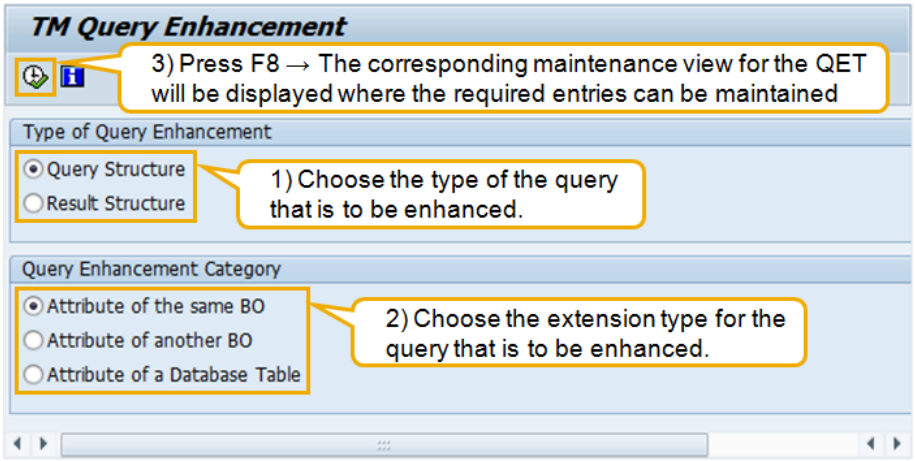
Attribute		Description
MANDT	Filled automatically	Client
QUERY_CAT	Mandatory	Value “space” = Standard Query, “G” = Generic Result Query
BO_NAME	Mandatory	Name of the Business Object
NODE_NAME	Mandatory	Name of the Business Object node.
QUERY_NAME	Mandatory	Name of the query assigned to the specified BO node. The first five components of the table identify the query to be enhanced.
QUERY_ATTRIBUTE	Mandatory	Name of the new query attribute.
ATTR_NODE_NAME	Mandatory	Name of the node to which the additional query attribute belongs to. If an external BO node or a database table (or database view) is used as the source of the additional query attribute, this field contains the name of the query BO node which contains the attribute used for the JOIN between the query BO and the external BO node or database table ("source node key of the Cross BO Association").
NODE_ATTRIBUTE	Mandatory	Name of the additional query attribute as it is named on its node.
EXT_BO_NAME	Optional	Name of Target Business Object in Cross BO Association
EXT_NODE_NAME	Optional	Name of Node Containing Cross BO Association: Together with EXT_BO_NAME this component describes the node of an external BO to which the additional query attribute belongs to.
EXT_DB_NAME	Optional	Table Name: Instead of an external BO node it is also possible to define a database table (or view) directly, to which the additional query attribute belongs to.
EXT_JOIN_ATTR	Optional	External Join Attribute (on Cross BO Assoc. Node or DB Table): This component is needed if an external BO node or a database table (or view) contains the additional query attribute. It specifies the attribute within this external BO node or database table (or view) which

		is used to join the ATTR_NODE_NAME node and the external BO node or database table (or view) together.
NODE_JOIN_ATTR	Optional	Source Join Attribute (on Cross BO Assoc. Node of Query BO). This component is needed if an external BO node or a database table (or view) contains the additional query attribute. It specifies the attribute of the ATTR_NODE_NAME node of the query BO which is used to join the ATTR_NODE_NAME node and the external BO node or database table (or view) together.
NODE_JOIN_ATTR2	Optional	Target Join Attribute (on Target DB Table, such as LANGU).
ND_JN_ATTR2_VAL	Optional	Target Node Join Attribute Value.
ND_JN_ATTR2_C	Optional	Target Node Join Attribute Value from Constant or Type.

The query super class provides an API for creating an optimized database SELECT statement to execute the query and returning the requested result table. In case of a standard query, the result table will be a list of keys for instances of the BO node that the query is assigned to. In case of a generic result query it will return the data directly in a table having a predefined result structure. At runtime the super class is creating the optimized database SELECT statement from the content of query structure and the query enhancement table.

6.1.2 Maintaining the standard query enhancement table

To enter and maintain the required entries in the query enhancement table (QET), the report **/SCMTMS/MAINT_EQUERY_ENH** can be used. It allows maintaining entries depending on the use case and the type of enhancement that you want to realize.



Picture: Report for QET maintenance.

The list below shows the specific QET views available for each use case. On the selection screen of the report you define the use case and then click or press F8. The corresponding maintenance view will open and allows specifying the required entries for the query enhancement.

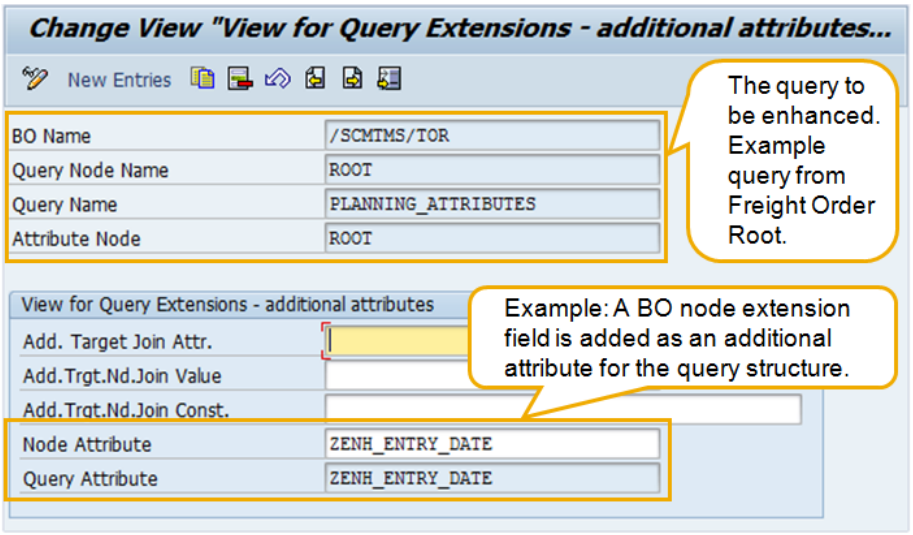
View	Function / Use Case
/SCMTMS/V_QENH1	View for Query Extensions - additional attributes
/SCMTMS/V_QENH2	View for Query Extensions - additional attributes XBO
/SCMTMS/V_QENH3	View for Query Extensions - additional attributes from table
/SCMTMS/V_QENH4	View for Generic Result Query Extensions - additional attributes
/SCMTMS/V_QENH5	View for Generic Result Query Extensions - additional attributes XBO
/SCMTMS/V_QENH6	View for Generic Result Query Extensions - additional attributes from

	table.

Some general remarks on how to use the report to maintain query extensions:

1) **Enhancing Standard Queries**: A Standard Query is always related to a specific node of the corresponding business object. As a result they just return the node instance keys of those records that match the search criteria specified in the request structure.

   - In the section *Type of Query Enhancement*, you only need to select option Query Structure to define/declare additional attributes that shall serve as selection criteria.
   - Chose a corresponding Query Enhancement Category and click/hit F8.
   - The corresponding view of the QET will open. Here you can maintain entries for the additional selection attributes. Maintain all required fields and save the new entry.
   - In this use case you just need to enhance the query data structure by your additional selection attributes.



Picture: An example entry for the QET, view /SCMTMS/V_QENH1.

2) Enhancing Generic Result Queries: A Generic Result Query (e.g. used for the POWLs) returns its results as a table with a specific result structure, containing the discrete data, not only node instance keys.

   - In the section *Type of Query Enhancement*, you first need to select option *Query Structure* to define/declare additional attributes that shall serve as selection criteria.
   - Chose a corresponding Query Enhancement Category and click/hit F8.
   - The corresponding view of the QET will open. Here you can maintain entries for the additional selection attributes. Maintain all required fields and save the new entry.
   - Finally, you need to add the additional result attributes in the corresponding DDIC object for the structure of the result table (see example 2 in section 5.1.5). This is done by defining an Append for the result structure with the new field included.

   In case of Generic Result Queries being used e.g. for the POWL selection, also the origin of the attributes of the result table needs to be specified. This is done the same way as shown for the attributes of the query structure with the following differences which should also be kept in mind when creating your very own Generic Result Queries from scratch:

   - Assumption is, that all attributes of the result table structure for which no origin and mapping was defined, belong to the query node.

- The result table structure must contain attribute DB_KEY (corresponding to the DB_KEY attribute of the query node database table). This is required to enable finding the link between the query node instances and the found result records.

- If for the result table only the mandatory attribute DB_KEY was defined, it is assumed that method GET_RESULT_DATA was overwritten. In this case only the DB_KEY attribute will be selected from database per default. All further attributes have to be selected within the GET_RESULT_DATA method.

- In general, it is always allowed and possible to overwrite the PROTECTED methods of the query super class to realize individual query logic. Nevertheless it is important to keep the query extensible. This can be accomplished if additional attributes are always defined within the query and result enhancement tables. The best place to do this is within method GET_QUERY_ENHANCE_TABLE. But as this is not always possible or feasible, there are further methods called during generating the query SELECT statement at runtime:

    - **EXTEND_SELECT_CLAUSES**: This method is called right before the database **SELECT** statement is executed. It provides the possibility to extend or modify all parts of the SELECT statement to realize any kind of possible selection on the TM backend.

    - **EXTEND_RESULT_DATA**: This method is called after the query was completely executed and the result data has been collected following the definitions from the result enhancement table. It provides the possibility to select further data to extend the result structure or to modify the result table in any way.

    - **SPLIT_SELECTION_PARAMETERS**: This method is called before the real query execution starts. It can be used to take parts of the selection parameters out into an extra selection parameters table which shall not be taken into account by the standard query. The selection parameters from the extra table can be processed in method POST_KEY_FILTERING.

    - **POST_KEY_FILTERING**: This method is called after database selection of the query has been done. It can be used to filter the selected instance keys before they are returned to the consumer. It is called with the selection parameters that were processed by the query so far, and with the table of extra selection parameters.

6.1.3 BAdI for creation of query enhancement table entries

Instead of using the mentioned report to provide entries for the query enhancement table, these entries can also get provided by an implementation of BAdI **/SCMTMS/FRW_QUERY**. While the report allows creation of the entries without coding, the use of the BAdI requires implementation of corresponding code that provides additional entries.

The BAdI allows a programmatic provisioning of Query Enhancement information. Customers and partners can implement the BAdI to provide corresponding information. With an implementation you can use other tables than the standard QET (e.g. your own customer specific tables) that contain the enhancement data. The default implementation of the BAdI takes the information from the mentioned table /SCMTMS/C_QENH whose records were created with report /SCMTMS/MAINT_EQUERY_ENH.

6.1.4 Example 1: Enhancing a standard query

The following first example shows how to enhance the standard query PLANNING_ATTRIBUTES defined for the Root node of the Freight Order business object. In this example the query shall be enhanced by an extension field ZZENH_ENTRY_DATE that was added to the Root node of Freight Order as described in section 4.2.1, step 7.

1) Start report /SCMTMS/MAINT_QUERY_ENH: Choose Query Type ***Standard Query***, Query *Extension Type* ***Attribute* of the same BO** and press F8.

2) On the next screen you can see the corresponding maintenance view (in this case it is /SCMTMS/V_QENH1). Click on button ***New Entries*** and enter the required data for the query extension field:

Field	Value	Comment
BO Name	/SCMTMS/TOR	The technical name for the Freight Order BO.
Query Node Name	ROOT	The node of the BO that the query to be enhanced is assigned to.
Query Name	PLANNING_ATTRIBUTES	The name of the query.
Attribute Node	ROOT	The node where the extension field can be found.
Node Attribute	ZZENH_ENTRY_DATE	The name of the extension field which will be available as a selection criterion.
Query Attribute	ZZENH_ENTRY_DATE	The name of the extension attribute as it shall be used in the query. This name can be different from the Node Attribute.

3) Save the new entry. The standard query has now an additional query attribute that can be used.

4) Test the enhanced query.

   Note that the query enhancements cannot be tested via the BOBF Test tool /BOBF/TEST_UI. As the query enhancement concept is not part of the BOBF framework itself, any query enhancements will not appear in the list of selection fields when testing with the test tool. Instead, the query can be tested with a simple test report that executes the query with the new query attribute. Code example:

```
*&---------------------------------------------------------------------*
*& Report ZREP_STANDARD_QUERY_TEST
*&---------------------------------------------------------------------*
*& Demonstration of a standard query enhancement
*&---------------------------------------------------------------------*
REPORT  zrep_standard_query_test.

DATA:  lo_srv          TYPE REF TO /bobf/if_tra_service_manager,
       lt_selpar       TYPE /bobf/t_frw_query_selparam,
       ls_selpar       TYPE /bobf/s_frw_query_selparam,
       lo_message      TYPE REF TO /bobf/if_frw_message,
       lt_data         TYPE /scmtms/t_tor_root_k,
       ls_key          TYPE /bobf/s_frw_key,
       lt_key          TYPE /bobf/t_frw_key,
       ls_query_inf    TYPE /bobf/s_frw_query_info.

CLEAR: ls_selpar,
```

```
       lt_selpar.

* Get instance of service manager for TRQ
lo_srv = /bobf/cl_tra_serv_mgr_factory=>get_service_manager( /scmtms
         /if_tor_c=>sc_bo_key ).

*Get instances of TOR via Query
ls_selpar-attribute_name = /scmtms/if_tor_c=>sc_query_attribute-
                           root-planning_attributes-created_by.
ls_selpar-option         = 'EQ'.
ls_selpar-sign           = 'I'.
ls_selpar-low            = 'POLCH'.
APPEND ls_selpar TO lt_selpar.

ls_selpar-attribute_name = 'ZZENH_ENTRY_DATE'.
ls_selpar-option         = 'EQ'.
ls_selpar-sign           = 'I'.
ls_selpar-low            = '20110428220000'.
APPEND ls_selpar TO lt_selpar.

BREAK-POINT.

* Execute the query
lo_srv->query(
  EXPORTING
    iv_query_key            = /scmtms/if_tor_c=>sc_query-root-
                              planning_attributes  " Query
    it_selection_parameters = lt_selpar " Query Selection Parameters
    iv_fill_data            = abap_true
  IMPORTING
    eo_message              = lo_message    " Message Object
    es_query_info           = ls_query_inf " Query Information
    et_data                 = lt_data
    et_key                  = lt_key ).

BREAK-POINT.
```

The query in this example should return just the keys of those instances of BO /SCMTMS/TOR which were created by user POLCH and ZZENH_ENTRY_DATE equal to 02.12.2010 23:00:00. You can of course also specify a range for the new extension field to be used for the query to e.g. search for all instances within a given time frame. So all additional selection fields can be handled just like the standard selection fields.

6.1.5 Example 2: Enhancing a generic result query

In the second example the generic result query QDB_PLANNING_ATTRIBUTES is extended. Again this query defined for the Root node of the Freight Order business object. The extension field ZEHN_ENTRY_DATE of the Root node shall be added to the query as a selection criterion and shall also be returned in the result table. So in this example a new field of the same business object node is added to the query.

1) Start report /SCMTMS/MAINT_QUERY_ENH: Choose Type of Query Enhancement ***Query Structure***, Query *Enhancement Category* ***Attribute* of the same BO** and press F8.

2) On the next screen you can see the corresponding maintenance view (in this case it is /SCMTMS/V_QENH4). Click on button ***New Entries*** and enter the required data for the query extension field:

Field	Value	Comment
BO Name	/SCMTMS/TOR	The technical name for the Freight Order BO.
Query Node Name	ROOT	The node of the BO that the query to be enhanced is assigned to.
Query Name	QDB_PLANNING_ATTRIBUTES	The name of the query.
Attribute Node	ROOT	The node where the extension field can be found.
Node Attribute	ZENH_ENTRY_DATE	The name of the extension field which will be available as a selection criterion.
Query Attribute	ZENH_ENTRY_DATE	The name of the extension attribute as it shall be used in the query. This name can be different from the Node Attribute.

With this entry in the Query Enhancement Table, the request structure is enhanced with an additional selection criterion.

3) The next step is to enhance the query result structure with the additional field that shall be returned by the query.

In transaction /BOBF/CONF_UI navigate to business object /SCMTMS/TOR (Freight Order) and then navigate to the query QDB_PLANNING_ATTRIBUTES under the node elements of the Root node. Double click on the query to display its details. Now double click on the displayed Result Type /SCMTMS/S_TOR_Q_RESULT of the query and create an append structure with the following information:

Append Structure	ZENH_TOR_Q_RESULT
Description	Generic Result Query Enhancement Test

Add the following component to the append structure.

Component	Typing Method	Component Type
ZENH_ENTRY_DATE	Types	/SCMTMS/DATETIME

Save and activate the append structure.

5) Test the enhanced query.

Note that the query enhancements cannot be tested via the BOBF Test tool */BOBF/TEST_UI*. As the query enhancement concept is not part of the BOBF framework itself, any query enhancements will not appear in the list of selection fields when testing with the test tool. Instead, the query can be tested with a simple test report that executes the query with the new query attribute. Code example:

```
*&---------------------------------------------------------------------*
*& Report  ZREP_GENRES_QUERY_TEST
*&---------------------------------------------------------------------*
*& Demonstartion of a generic result query enhancement
*&---------------------------------------------------------------------*
REPORT  zrep_genres_query_test.
```

```
DATA:  lo_srv           TYPE REF TO /bobf/if_tra_service_manager,
       lt_selpar        TYPE /bobf/t_frw_query_selparam,
       ls_selpar        TYPE /bobf/s_frw_query_selparam,
       lo_message       TYPE REF TO /bobf/if_frw_message,
       lt_data          TYPE /scmtms/t_tor_q_result,
       ls_key           TYPE /bobf/s_frw_key,
       lt_key           TYPE /bobf/t_frw_key,
       ls_query_inf     TYPE /bobf/s_frw_query_info.

CLEAR: ls_selpar,
       lt_selpar.

* Get instance of service manager for TOR
lo_srv = /bobf/cl_tra_serv_mgr_factory=>get_service_manager( /scmtms
/if_tor_c=>sc_bo_key ).

*Get instances of TOR via Query
ls_selpar-attribute_name = /scmtms/if_tor_c=>sc_query_attribute-
root-qdb_planning_attributes-created_by.
ls_selpar-option         = 'EQ'.
ls_selpar-sign           = 'I'.
ls_selpar-low            = 'POLCH'.
APPEND ls_selpar TO lt_selpar.

ls_selpar-attribute_name = 'ZENH_ENTRY_DATE'.
ls_selpar-option         = 'EQ'.
ls_selpar-sign           = 'I'.
ls_selpar-low            = '20110428220000'.
APPEND ls_selpar TO lt_selpar.

BREAK-POINT.

* Execute the query
lo_srv->query(
  EXPORTING
    iv_query_key            = /scmtms/if_tor_c=>sc_query-root-
                              qdb_planning_attributes   " Query
    it_selection_parameters = lt_selpar " Query Selection Parameters
    iv_fill_data            = abap_true " Data element for domain BO
                                        OLE: TRUE (='X') and
                                        FALSE =' ')
  IMPORTING
    eo_message              = lo_message    " Message Object
    es_query_info           = ls_query_inf " Query Information
    et_data                 = lt_data
    et_key                  = lt_key ).

BREAK-POINT.
```

6.2 Creating a new POWL

This section describes how to create a new TM specific Personal Object Work List (POWL) and how to enhance existing standard POWLs provided with the standard TM application. As a first step to learn about the basic technical concepts we will take a look at how to create a new POWL.

The provided example will use generic result query *QDB_PLANNING_ATTRIBUTES* that was already enhanced by an additional field *ZENH_ENTRY_DATE* in section 6.1.5. Generic Result Queries are the basic data source for any POWL. With this example enhancement all POWLs that make use of the mentioned query can make use of the additional field as a selection criteria as well as an attribute in the result list.

6.2.1 The POWL Feeder Class

The main access point for a POWL is the POWL Feeder Class. It contains the definition of the POWL's field catalog, the selection criteria and the actions that can be executed for a selected set of object instances from the POWL.

In TM, a POWL Feeder Class is based on a query of a Business Object. The relationship between a Business Object query (a generic result query) and a POWL Feeder class is always one to one. So whenever there is no POWL Feeder Class for an existing generic result query of a BO, you need a new POWL Feeder Class.

You should also keep this in mind when you create BO Queries for POWL usage. If you have two completely different requirements which lead to different BO Queries, of course two different POWL Feeder Classes are required.

If you have different business categories/usages for POWL which share a lot of common parts form a technical perspective, it makes sense to design one (technical) BO Query which has one technical POWL Feeder class in the end. Based on this feeder class, you can separate your different usages or categories with POWL types. An example is the TOR Feeder class, with separated POWL types for each BO Category.

In the following example a new POWL for Freight Orders is created to describe how POWLs are developed in general. The example POWL will make use of the enhanced Generic Result Query from chapter 6.1.5.

1) Create a new POWL Feeder Class with e.g. transaction SE24: The general naming convention followed in TM is */SCMTMS/CL_UI_POW_FD_[object name or abbreviation]*. Our example class will be: *ZCL_ENH_UI_POW_FD_TOR*.

   Make sure that the new Feeder class inherits from class */SCMTMS/CL_UI_POW_FD_BASE*. Save and activate the new class.

2) As you will see in the coding of the POWL Feeder Class Constructor, constants are used to specify the names or keys for all general attributes of a POWL. In the standard TM implementation, the constants interface */SCMTMS/IF_UI_POW_CONST* contains all the definitions of these constants for all TM standard POWLs.

   In the example a separate new constants interface is created to represent the constants used for this customer/partner specific POWL (with this it will not be necessary to use implicit enhancements to adjust the standard constants interface with your own customer/partner specific constants). Create the example constants interface as follows:

   - Start transaction *SE24*, enter the interface name *ZIF_ENH_UI_POW_CONST* in field *Object Type* and click on button *Create*.

- On tab strip *Attributes* enter the following constants:

Attribute	Level	Description
CO_OUTPUT_STRUCTURE_NAME	Constant	Output list Structure Names
CO_SELCRIT_STRUCTURE_NAME	Constant	Selection Criteria Structure names
CO_ACTION_CLASS_NAME	Constant	Action class names
CO_POWL_TYPE	Constant	POWL Types

- Switch to the *Source Code-based view* (toggle button in the Class Builder, transaction *SE24* tool bar) and make sure that the example constants interface is defined by the following code:

```
*"* components of interface ZIF_ENH_UI_POW_CONST
INTERFACE zif_enh_ui_pow_const
  PUBLIC .

  CONSTANTS:
    BEGIN OF co_output_structure_name,
      zc_tor_resp TYPE struname VALUE 'ZENH_S_UI_POW_R_TOR',
    END OF co_output_structure_name .
  CONSTANTS:
    BEGIN OF co_selcrit_structure_name,
      zc_tor_req TYPE  struname VALUE 'ZENH_S_UI_POW_S_TOR',
    END OF co_selcrit_structure_name .
  CONSTANTS:
    BEGIN OF co_action_class_name,
      zc_tor_act TYPE seoclsname VALUE 'ZCL_ENH_UI_ACTION_TOR',
    END OF co_action_class_name .
  CONSTANTS:
    BEGIN OF  co_powl_type,
      BEGIN OF enh_type,
        zenh_tor TYPE powl_type_ty VALUE 'ZENH_TOR',
      END OF enh_type,
    END OF co_powl_type.

ENDINTERFACE.                    "ZIF_ENH_UI_POW_CONST
```

3) In the next step, copy the following required structures from the standard TOR POWL and create a new action class (This helps to shortcut the effort and time for this example. In your own implementation, you can of course your very own corresponding objects).

- **Selection Criteria:** The structure will represent the POWL Search Structure for the new POWL, i.e. it contains the list of attributes that will be available as selection criteria for the POWL queries.

    - Start transaction *SE11* and enter */SCMTMS/S_UI_POW_S_TOR* in field *Data type* on the initial screen.
    - Copy (*Ctrl+F5*) this structure to *ZENH_R_UI_POW_S_TOR*.
    - Save and activate the new structure.

- **Result Structure:** The structure will represent the POWL Result Structure for the new POWL, i.e. it contains the list of attributes that will be available to be displayed in the result list of the POWL.

    - Start transaction *SE11* and enter */SCMTMS/S_UI_POW_R_TOR* in field *Data type* on the initial screen.
    - Copy (*Ctrl+F5*) this structure to *ZENH_R_UI_POW_R_TOR*.
    - Save and activate the new structure.

  Actions: The class will represent the POWL Action Class for the new POWL, i.e. it contains the coding to handle all actions that can be executed on selected entries in the POWL result list.

    - Start transaction *SE24* and enter class name *ZCL_ENH_UI_ACTION_TOR* in field *Object type* and click on button *Create* (*F5*) to create this class.
    - On tab Properties specify class */SCMTMS/CL_UI_ACTION_BASE* as the super class for the new class.
    - Save and activate the new class.

  Alternative: Copy standard action class /SCMTMS/CL_UI_ACTION_TOR to the new class ZCL_ENH_UI_ACTION_TOR. In the class you simple reuse the action handling as implemented in the standard. In section 6.2.2 you can find an implementation example that shows how to implement the action class yourself.

4) Go back to the POWL Feeder Class ZCL_ENH_UI_POW_FD_TOR and create a method *CONSTRUCTOR* as a public instance method. In the implementation of this POWL Feeder Class constructor, the following information is defined and provided:

Attribute	Description
BO_NAME	The business object that is to be processed with the POWL.
BO_QUERY_KEY	The key of the business object query that will provide the data for the POWL.
BO_ALTID_ATTRIBUTE_NAME	Describes the attribute name of the result structure which is the alternative identifier of the business object. This attribute will be displayed as the first column in the POWL result list. Moreover, this column is fixed and will be displayed as a link (for further object based navigation).
POW_OUTPUT_STRUCTURE_NAME	Represents the output structure for the field catalog (based on the result structure of the output query or the data structure of the root node). All Standard POWL result structures start with **/SCMTMS/S_UI_POW_R***
POW_SELCRIT_STRUCTURE_NAME	Represents the selection criteria structure for the selection criteria catalog (based on the query structure of the BO query). All Standard POWL query structures start with **/SCMTMS/S_UI_POW_S***
ACTION_CLASS_NAME	(Optional) The class can be specified in case you want to use your very own action class to handle the actions on the POWL.
BO_CATEGORY_ATTRIBUTE_NAME	(Optional) Describes the attribute name of the

	result structure which contains a BO category (e.g. required for TRQ and TOR as these objects are used for different purposes represented by a corresponding category → serves as a “filter”).
BO_KEY_ATTRIBUTE_NAME	Describes the attribute name of the result structure which is used for generic navigation. This starts after you clicked on the generic link which is based on BO_ALTID_ATTRIBUTE_NAME.
CONVERSION_CLASS_NAME	(Optional) The class can be specified in case you want to use your very own conversion class.

Use the following example code to implement the constructor method. Then save and activate the class. Within the coding you can see that it makes use of the constants defined in step 2 to specify the above listed attributes of the feeder class.

```
METHOD CONSTRUCTOR.
* call the constructor of the super class
  CALL METHOD super->constructor.

* define BO to be represented by the POWL
  ms_pow_profile-bo_name = /scmtms/if_tor_c=>sc_bo_name.

* define the Generic Result Query to be used with the POWL
  ms_pow_profile-bo_query_key = /scmtms/if_tor_c=>sc_query-root-
                                qdb_planning_attributes.

* define the attribute of the BO to represent the alternative id/key
 on the POWL
  ms_pow_profile-bo_altid_attribute_name = /scmtms/if_tor_c=>
                                sc_node_attribute-root-tor_id.

* define the attribute to represent the category of BO instances
* Use Case e.g.: Only TOR instances of category Booking shall be
* listed
  ms_pow_profile-bo_category_attribute_name = /scmtms/if_tor_c=>
                                sc_node_attribute-root-tor_cat.

* define the DDIC structure that represents the set of attributes to
* be listed in the POWL result list
  ms_pow_profile-pow_output_structure_name = zif_enh_ui_pow_const=>
                              co_output_structure_name-zc_tor_resp.

* define the DDIC structure that represents the set of selection
* criteria attributes to beused for the POWL Query
  ms_pow_profile-pow_selcrit_structure_name = zif_enh_ui_pow_const=>
                               co_selcrit_structure_name-zc_tor_req.

* define the class that represents the action class for the POWL,
* i.e. the operations that can be triggered from the POWL for
* selected Business Document in the POWL result list
  ms_pow_profile-action_class_name = zif_enh_ui_pow_const=>
                           co_action_class_name-zc_tor_act.

  CALL METHOD init( ).
```

```
ENDMETHOD.
```

5) Before we can redefine and implement some of the methods of the example feeder class, create the following methods. They encapsulate the coding for building the list of selection criteria and the field catalog for the POWL result list at runtime.

- Define a new method *GET_SEL_CRITERIA_FO* in class *ZCL_ENH_UI_POW_FD_TOR* with the following settings:

Method	Level	Visibility	Description
GET_SEL_CRITERIA_FO	Instance Method	Protected	Return selection criteria for category Freight Order.

Parameter	Type	Typing Method	Associated Type
C_SELCRIT_DEFS	Changing	Type Ref To	POWL_SELCRIT_TTY
C_DEFAULT_VALUES	Changing	Type	RSPARAMS_TT

Use the following example coding to implement it:

```
METHOD get_sel_criteria_fo.

  DATA: ls_selcrit_defs LIKE LINE OF c_selcrit_defs,
        ls_default_values LIKE LINE OF c_default_values,
        ls_selcrit_ddfields LIKE LINE OF mt_selcrit_ddfields,
        ls_pow_selcrit_mapp LIKE LINE OF mt_pow_selcrit_mapp.

  LOOP AT mt_selcrit_ddfields INTO ls_selcrit_ddfields.
*   define the general properties of each selection field
    CLEAR ls_selcrit_defs.
    ls_selcrit_defs-param_type = /scmtms/if_ui_pow_const=>
                                 co_param_type-input_field.
    ls_selcrit_defs-kind = 'S'.
*   P = Parameter, S = Select Option
    ls_selcrit_defs-allow_admin_change = abap_true.
    ls_selcrit_defs-ref_table = ms_pow_profile-
                                pow_selcrit_structure_name.
    ls_selcrit_defs-ref_field = ls_selcrit_ddfields-fieldname.
    ls_selcrit_defs-crittext = ls_selcrit_ddfields-scrtext_m.
    ls_selcrit_defs-tooltip  = ls_selcrit_ddfields-scrtext_l.
    ls_selcrit_defs-datatype = ls_selcrit_ddfields-rollname.
    ls_selcrit_defs-allow_admin_change = abap_true.

*   define specific properties for each field
    CASE ls_selcrit_ddfields-fieldname.
*     Fields for identifying the TOR instance
      WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                             qdb_planning_attributes-tor_id.
        ls_selcrit_defs-selname = 'P0001'.
        ls_selcrit_defs-header = cl_wd_utilities=>
          get_otr_text_by_alias( '/SCMTMS/UI_CMN/GENERAL_DATA' ).
        ls_selcrit_defs-quicksearch_crit = abap_true.
      WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                             qdb_planning_attributes-tor_type.
        ls_selcrit_defs-selname = 'P0002'.
        ls_selcrit_defs-header = cl_wd_utilities=>
```

```
            get_otr_text_by_alias( '/SCMTMS/UI_CMN/GENERAL_DATA' ).
          ls_selcrit_defs-quicksearch_crit = abap_true.
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                                qdb_planning_attributes-tor_cat.
          ls_default_values-selname = 'P0003'.
          ls_default_values-kind    = 'P'.
          ls_default_values-sign    = 'I'.
          ls_default_values-low = /scmtms/if_tor_const=>
                                  sc_tor_category-active.
          INSERT ls_default_values INTO TABLE c_default_values.
          ls_selcrit_defs-read_only = abap_true.
          ls_selcrit_defs-hidden    = abap_true.
          ls_selcrit_defs-selname = 'P0003'.
          ls_selcrit_defs-header = cl_wd_utilities=>
            get_otr_text_by_alias( '/SCMTMS/UI_CMN/GENERAL_DATA' ).
          ls_selcrit_defs-param_type = /scmtms/if_ui_pow_const=>
                                       co_param_type-input_field.

*     Organisational Data
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                                qdb_planning_attributes-exec_org_id.
          ls_selcrit_defs-selname = 'P0100'.
          ls_selcrit_defs-header = cl_wd_utilities=>
       get_otr_text_by_alias('/SCMTMS/UI_CMN/ORGANIZATIONAL_DATA').
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                                qdb_planning_attributes-exec_grp_id.
          ls_selcrit_defs-selname = 'P0101'.
          ls_selcrit_defs-header = cl_wd_utilities=>
     get_otr_text_by_alias('/SCMTMS/UI_CMN/ORGANIZATIONAL_DATA').
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                               qdb_planning_attributes-purch_org_id.
          ls_selcrit_defs-selname = 'P0102'.
          ls_selcrit_defs-header = cl_wd_utilities=>
       get_otr_text_by_alias('/SCMTMS/UI_CMN/ORGANIZATIONAL_DATA').
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                               qdb_planning_attributes-purch_grp_id.
          ls_selcrit_defs-selname = 'P0103'.
          ls_selcrit_defs-header = cl_wd_utilities=>
       get_otr_text_by_alias('/SCMTMS/UI_CMN/ORGANIZATIONAL_DATA').

*     Admin data
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                                qdb_planning_attributes-created_by.
          ls_selcrit_defs-selname = 'P2000'.
          ls_selcrit_defs-header = cl_wd_utilities=>
                  get_otr_text_by_alias('/SCMTMS/UI_CMN/ADM_INFO').
          ls_selcrit_defs-quicksearch_crit  = abap_true.
        WHEN 'CREATED_ON_D'.
          ls_selcrit_defs-selname = 'P2001'.
          ls_selcrit_defs-header = cl_wd_utilities=>
                  get_otr_text_by_alias('/SCMTMS/UI_CMN/ADM_INFO').
        WHEN /scmtms/if_tor_c=>sc_query_attribute-root-
                                qdb_planning_attributes-changed_by.
          ls_selcrit_defs-selname = 'P2002'.
          ls_selcrit_defs-header = cl_wd_utilities=>
                  get_otr_text_by_alias('/SCMTMS/UI_CMN/ADM_INFO').
        WHEN 'CHANGED_ON_D'.
```

```
        ls_selcrit_defs-selname = 'P2003'.
        ls_selcrit_defs-header = cl_wd_utilities=>
                get_otr_text_by_alias('/SCMTMS/UI_CMN/ADM_INFO').

*     Enhancement Selection Attribute
      WHEN 'ZENH_ENTRY_DATE'.
        ls_selcrit_defs-selname = 'P3003'.
        ls_selcrit_defs-header = 'Enh. Entry Date'.
        ls_selcrit_defs-quicksearch_crit = abap_true.

      WHEN OTHERS.
        CONTINUE.
    ENDCASE.

*   fill mapping table
    ls_pow_selcrit_mapp-selname   = ls_selcrit_defs-selname.
    ls_pow_selcrit_mapp-fieldname = ls_selcrit_ddfields-
                                    fieldname.
   APPEND ls_pow_selcrit_mapp TO mt_pow_selcrit_mapp.
   APPEND ls_selcrit_defs TO c_selcrit_defs.
  ENDLOOP.

ENDMETHOD.
```

In the coding you can see especially in the WHEN sections of the CASE instruction how to set the properties of the selection attributes.

- Define a new method *GET_FIELDCATALOG_FO* in class *ZCL_ENH_UI_POW_FD_TOR* with the following settings:

Method	Level	Visibility	Description
GET_FIELDCATALOG_FO	Instance Method	Protected	Return output list for category Freight Order

Parameter	Type	Typing Method	Associated Type
C_FIELDCAT	Changing	Type	POWL_FIELDCAT_TTY

Use the following example coding to implement it:

```
METHOD get_fieldcatalog_fo.
  DATA: ls_output_ddfields LIKE LINE OF mt_output_ddfields,
        ls_fieldcat  LIKE LINE OF c_fieldcat.

  LOOP AT mt_output_ddfields INTO ls_output_ddfields.
    CLEAR ls_fieldcat.
*   now set default layout for all other columns
    ls_fieldcat-colid             = ls_output_ddfields-fieldname.
    ls_fieldcat-col_visible       = abap_true.
    ls_fieldcat-header_by_ddic    = abap_true.
    ls_fieldcat-enabled           = abap_true.
    ls_fieldcat-allow_filter      = abap_true.
    ls_fieldcat-allow_sort        = abap_true.
    ls_fieldcat-display_type      = /scmtms/if_ui_pow_const=>
                                    co_display_type-textview.

    CASE ls_output_ddfields-fieldname.
```

```
      WHEN 'TOR_ID'.
        ls_fieldcat-colpos = 1.
        ls_fieldcat-col_visible = abap_true.
        ls_fieldcat-fixed = abap_true.
        ls_fieldcat-display_type = /scmtms/if_ui_pow_const=>
                                   co_display_type-link_to_action.
        ls_fieldcat-text_ref = ms_pow_profile-
                               bo_altid_attribute_name.
        ls_fieldcat-sort_order  =  '01'.
      WHEN 'TOR_TYPE'.
        ls_fieldcat-colpos = 2.
        ls_fieldcat-col_visible = abap_true.

*     Organizational Units
      WHEN 'PURCH_ORG_ID'.
        ls_fieldcat-colpos = 3.
        ls_fieldcat-col_visible = abap_true.
      WHEN 'PURCH_GRP_ID'.
        ls_fieldcat-colpos = 4.
        ls_fieldcat-col_visible = abap_true.
      WHEN 'EXEC_ORG_ID'.
        ls_fieldcat-colpos = 5.
        ls_fieldcat-display_type = /scmtms/if_ui_pow_const=>
                                   co_display_type-dropdown_by_key.
        ls_fieldcat-col_visible = abap_true.
      WHEN 'EXEC_GRP_ID'.
        ls_fieldcat-colpos = 6.
        ls_fieldcat-display_type = /scmtms/if_ui_pow_const=>
                                   co_display_type-dropdown_by_key.
        ls_fieldcat-col_visible = abap_true.

*     Administrative Data
      WHEN 'CREATED_BY'.
        ls_fieldcat-colpos = 7.
        ls_fieldcat-col_visible = abap_true.
      WHEN 'CREATED_ON'.
        ls_fieldcat-colpos = 8.
        ls_fieldcat-col_visible = abap_true.
      WHEN 'CHANGED_BY'.
        ls_fieldcat-colpos = 9.
        ls_fieldcat-col_visible = abap_true.
      WHEN 'CHANGED_ON'.
        ls_fieldcat-colpos = 10.
        ls_fieldcat-col_visible = abap_true.

*     Enhancement Field
      WHEN 'ZENH_ENTRY_DATE'.
        ls_fieldcat-colpos = 11.
        ls_fieldcat-col_visible = abap_true.

      WHEN OTHERS.
        ls_fieldcat-col_visible       = abap_false.

    ENDCASE.

    INSERT ls_fieldcat INTO TABLE c_fieldcat.
  ENDLOOP.
```

```
ENDMETHOD.
```

Analog to the method for the selection criteria, you can see in the WHEN section of the CASE instruction how to set the different properties of the fields that will be added to the field catalog at runtime.

6) The next steps are to redefine some of the methods of the feeder class:

- **Class method *IF_POWL_FEEDER~GET_SEL_CRITERIA*:** The coding of this POWL Feeder Class method specifies the set of selection criteria that will be available for defining POWL queries.

  The generic implementation provided in super class /SCMTMS/CL_UI_POW_FD_BASE will just take all fields from the structure *ZENH_S_UI_POW_S_TOR* to create the list of selection criteria at runtime.

  For the example POWL, redefine the method with the following coding which uses method *GET_SEL_CRITERIA_FO* created in step 5.

```
METHOD if_powl_feeder~get_sel_criteria.
* depending on the POWL type the corresponding selection
* criteria will be defined
  CASE i_type.

    WHEN zif_enh_ui_pow_const=>co_powl_type-enh_type-zenh_tor.
      get_sel_criteria_fo( CHANGING
                           c_selcrit_defs   = c_selcrit_defs
                           c_default_values = c_default_values ).
    WHEN OTHERS.
*     in case given powl type is not to be treated specifically
*     use the generic implementation of the super class, i.e.
*     take all attributes from the selection criteria structure
      CALL METHOD super->if_powl_feeder~get_sel_criteria
        EXPORTING
          i_username             = i_username
          i_applid               = i_applid
          i_type                 = i_type
          i_langu                = sy-langu
        IMPORTING
          e_selcrit_defs_changed = e_selcrit_defs_changed
          e_default_val_changed  = e_default_val_changed
        CHANGING
          c_selcrit_defs         = c_selcrit_defs
          c_default_values       = c_default_values.
  ENDCASE.

ENDMETHOD.
```

The CASE instruction in the above method implementation shows how you can reuse this method for different POWL types, i.e. depending on the POWL type the selection criteria is build up differently at runtime. This allows a reuse of one and the same POWL Feeder Class for different POWLs.

You will see in the later customizing steps that POWL Feeder Class can be assigned to different POWL Types. E.g. standard class /SCMTMS/CL_UI_POW_FD_TOR serves for

Freight Order, Bookings, Freight Units and others, i.e. all POWLs related to the technical BO TOR that is used to represent these kinds of business documents.

- **Class method *IF_POWL_FEEDER~GET_FIELD_CATALOG*:** The coding of this POWL Feeder Class method specifies the set of fields that will be available as columns in the POWL result list.

  The generic implementation provided in super class /SCMTMS/CL_UI_POW_FD_BASE will just take all fields from the structure *ZENH_S_UI_POW_R_TOR* to create the field catalog at runtime.

  For the example POWL, redefine the method with the following coding which uses method *GET_FIELDCATALOG_FO* created in step 5.

```
METHOD if_powl_feeder~get_field_catalog.
* depending on the POWL type the corresponding field
* catalog will be defined
  CASE i_type.
    WHEN /scmtms/if_ui_pow_const=>co_powl_type-tor-cat_fu.
      get_fieldcatalog_fo( CHANGING c_fieldcat = c_fieldcat ).

    WHEN OTHERS.
*     in case given powl type is not to be treated specifically
*     use the generic implementation of the super class, i.e.
*     take all attributes from the field catalog structure
      CALL METHOD super->if_powl_feeder~get_field_catalog
        EXPORTING
          i_username              = i_username
          i_applid                = i_applid
          i_type                  = i_type
          i_langu                 = i_langu
          i_selcrit_values        = i_selcrit_values
        IMPORTING
          e_fieldcat_changed      = e_fieldcat_changed
          e_visible_cols_count    = e_visible_cols_count
          e_visible_rows_count    = e_visible_rows_count
          e_default_technical_col = e_default_technical_col
        CHANGING
          c_fieldcat              = c_fieldcat.
  ENDCASE.

* add default Header for descriptions fields
  add_std_description_label( CHANGING c_fieldcat = c_fieldcat ).

* set default output values
  e_default_technical_col = abap_true.
  e_fieldcat_changed = abap_true.
  e_visible_cols_count = 10.
  e_visible_rows_count = 15.

ENDMETHOD.
```

  Analog to the previous method, the CASE instruction in the above methods implementation shows how you can reuse this method for different POWL types, i.e. depending on the POWL type the field catalog is build up differently at runtime.

- **Class method *IF_POWL_FEEDER~GET_ACTIONS*:** Within this method you place coding that defines the set of actions that will be available to be executed via the tool bar of the POWL result list.

  For the example POWL, redefine the method with the following coding.

```
METHOD if_powl_feeder~get_actions.

  DATA: ls_action_def  LIKE LINE OF c_action_defs,
        ls_act_choices TYPE powl_act_choice_sty,
        lv_index       TYPE int4.

* Define the availability of some standard actions. Their
* properties are finally defined in method GET_ACTIONS of
* the super class.
  mv_action_open    = abap_true.
  mv_action_display = abap_true.
  mv_action_copy    = abap_true.
  mv_action_create  = abap_true.
  mv_action_delete  = abap_true.
  mv_action_open_bd = abap_true.

* Disable or enable certain standard actions
  CASE i_type.
    WHEN zif_enh_ui_pow_const=>co_powl_type-enh_type-zenh_tor.
*     there shall be e.g. no DELETE action on this POWL
      mv_action_delete  = abap_false.

    WHEN OTHERS.

  ENDCASE.

* call super class to take over default actions
  CALL METHOD super->if_powl_feeder~get_actions
    EXPORTING
      i_username        = i_username
      i_applid          = i_applid
      i_type            = i_type
      i_selcrit_para    = i_selcrit_para
      i_langu           = i_langu
    IMPORTING
      e_actions_changed = e_actions_changed
    CHANGING
      c_action_defs     = c_action_defs.

* keep in mind, how many actions are alreday available
* at this point in time.
  lv_index = lines( c_action_defs ).

* Define further actions depending on the POWL Type
  CASE i_type.
    WHEN zif_enh_ui_pow_const=>co_powl_type-enh_type-zenh_tor.
*     add the action to claculate charges
      CLEAR ls_action_def.
      lv_index                       = lv_index + 1.
      ls_action_def-placementindx    = lv_index.
```

```
      ls_action_def-cardinality       = 'S'.
      ls_action_def-placement         = 'B'.
      ls_action_def-actionid          =
              /scmtms/if_ui_tor_c=>sc_action-calc_transp_charges.
      ls_action_def-text              = cl_wd_utilities=>
get_otr_text_by_alias( '/SCMTMS/UI_CMN/CALC_TRANSP_CHARGES' ).
      ls_action_def-tooltip           = cl_wd_utilities=>
get_otr_text_by_alias( '/SCMTMS/UI_CMN/CALC_TRANSP_CHARGES' ).
      ls_action_def-enabled           = abap_true.
      INSERT ls_action_def INTO TABLE c_action_defs.

*     add an enhancement action that was added to the TOR BO
      CLEAR ls_action_def.
      lv_index                        = lv_index + 1.
      ls_action_def-placementindx     = lv_index.
      ls_action_def-cardinality       = 'S'.
      ls_action_def-placement         = 'B'.
      ls_action_def-actionid          =
                                  'ZENH_MAINTOOLBAR_ACTION'.
      ls_action_def-text              = 'Enhancement Action'.
      ls_action_def-tooltip           =
                        'Tooltip for the Enhancement Action'.
      ls_action_def-enabled           = abap_true.
      INSERT ls_action_def INTO TABLE c_action_defs.

    WHEN OTHERS.

  ENDCASE.

ENDMETHOD.
```

6.2.2 The POWL Action Class

The POWL Action Class is used to handle the execution of the actions assigned to the tool bar of the POWL result list. The name of the class to be used is defined in the constructor of the related POWL feeder class (see step 2 & 4 in the last section 6.2.1).

In general, method *HANDLE_ACTION* is the only method to be implemented here. At runtime, the Action ID and the data of the objects selected on the POWL result list is available. This can be used to execute e.g. related BOBF actions that are either executed e.g. for all selected or only the first selected object on the POWL result list.

In section 6.2.1 Action Class *ZCL_ENH_UI_ACTION_TOR* was created which inherits from the Action Super Class */SCMTMS/CL_UI_ACTION_BASE*. While standard actions like New, Copy, Edit, Display, etc. are handled in method *START_POWL_ACTION* of the supper class, any other actions care handled directly in method *HANDLE_ACTION* of the Action Class.

The following lines of code provide an example on how to implement the method to handle the action *CALCULATE_TRANSPORTATION_CHARGES* and the Enhancement Action *ZENH_MAINTOOLBAR_ACTION* that was described in the UI Enhancements section of this document. Both actions have been also prepared in method *GET_ACTIONS* of the POWL Feeder Class.

```
METHOD handle_action.

  FIELD-SYMBOLS: <ls_tor_root_key> TYPE /bobf/s_frw_key.
```

```
  DATA: lv_error_exists TYPE boole_d,
        lv_do_save      TYPE boole_d,
        lo_message      TYPE REF TO /bobf/if_frw_message,
        lt_key          TYPE /bobf/t_frw_key.

  CASE iv_action_id.

    WHEN /scmtms/if_ui_tor_c=>sc_action-calc_transp_charges.
*     Action / Button: Calculate Transportation Charges
*     The calculation is executed for all documents marked
*     in the POWL result list
      IF it_keys IS INITIAL.
        RETURN.
      ENDIF.
*     Execute the TOR action CALCULATE TRANSPORTATION CHARGES
      do_action(
            EXPORTING
              iv_act_key    = /scmtms/if_tor_c=>sc_action-root-
                              calc_transportation_charges
              it_key        = it_keys
            IMPORTING
              ev_error      = lv_error_exists ).
*     If all calculations were successfull,
*     save the corresponding changes
      IF lv_error_exists IS INITIAL AND iv_source = co_source_powl.
        lv_do_save = abap_true.
      ENDIF.

    WHEN 'ZENH_MAINTOOLBAR_ACTION'.
*     Action / Button: Enhancement Action. The action is only
*     executed for the first document marked in the POWL result list
      READ TABLE it_keys ASSIGNING <ls_tor_root_key> INDEX 1.
      IF sy-subrc IS INITIAL.
        CLEAR lt_key.
        APPEND <ls_tor_root_key> TO lt_key.
*       Execute the TOR action CALCULATE TRANSPORTATION CHARGES
        do_action(
              EXPORTING
                iv_act_key    = zif_enh_tor_c=>sc_action-root-
                                zenh_maintoolbar_action
                it_key        = lt_key
              IMPORTING
                ev_error      = lv_error_exists ).
      ENDIF.

    WHEN OTHERS.

  ENDCASE.

* In case a SAVE is required
  IF lv_do_save IS NOT INITIAL.
    mo_tramgr->save( IMPORTING eo_message  = lo_message ).
    mo_tramgr->cleanup( ).
    add_message( io_message = lo_message ).
  ENDIF.
```

```
ENDMETHOD.
```

6.2.3 The basic POWL Customizing

In the previous sections, the coding foundation for a new POWL has been described and created. To really see and use the new POWL on the TM UI, customizing settings need to be done which will ensure that the POWL will be visible for users with a specific role and in the correct application area. The POWL created in section 6.2 handles Freight Orders. We will therefore assign it to the corresponding application area Freight Order Management.

1) **Transaction *POWL_TYPE*:** The transaction registers the POWL Feeder Class and adds a description that is used in the POWL dialog for creating user specific POWL query definitions.

   - Start transaction *POWL_TYPE* and create a new entry as follows:

Field	Value
Type	ZENH_TOR
Description	Enhancement TOR POWL Type
Feeder Class	ZCL_ENH_UI_POW_FD_TOR
Sync. Call	(not set)
No Msg. Wrapping	(not set)

   - Save the new entry.

2) **Transaction *POWL_TYPER*:** The transaction assigns the POWL Type (see step 1) to a PFCG Role, i.e. all users assigned to this role will be able to see the new POWL in the application area to be specified.

   - Start transaction *POWL_TYPER* and create a new entry as follows:

Field	Value
Application	SCMTMS_POWL_FO
Role	SAP_QAP_TRANSPORTATION_MANAGER
Type	ZENH_TOR
Description	Enhancement TOR POWL Type

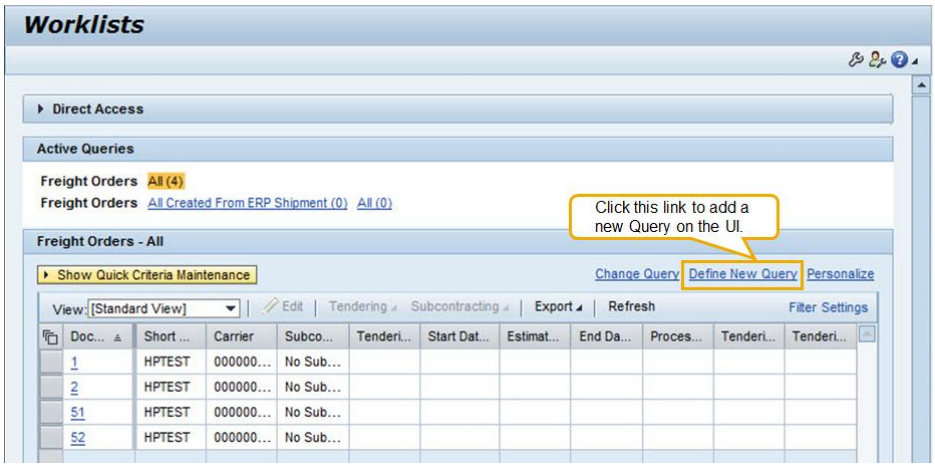
   - Save the new entry.

   You will only see the new POWL if your user is assigned to the role used in the above customizing entry. There is also transaction *POWL_TYPEU* available which allows assigning the POWL to a specific user, i.e. it allows further restricting the visibility of the POWL to a specific set of users.

With this two customizing entries in place you can now specify a new POWL query on the TM UI. How to do this is described in the next section.

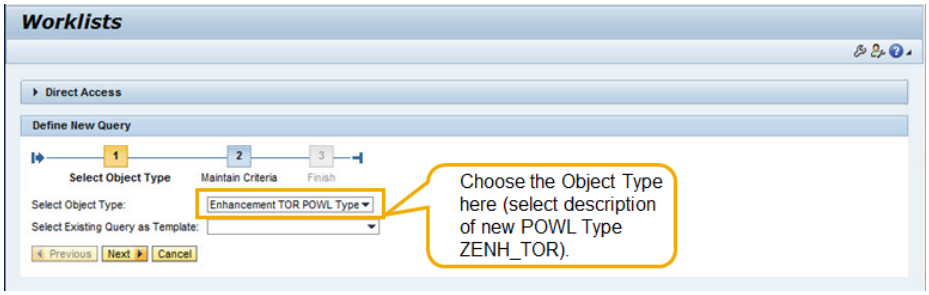
6.2.4 Creating POWL Queries

Start the NetWeaver Business Client (transaction *NWBC*) and navigate to *Freight Order Management → Overview Freight Orders*. In the POWL Result List section you can now click on the link *Define New Query*. The following guided procedure will request you to enter all relevant parameters for specifying a new POWL Query.



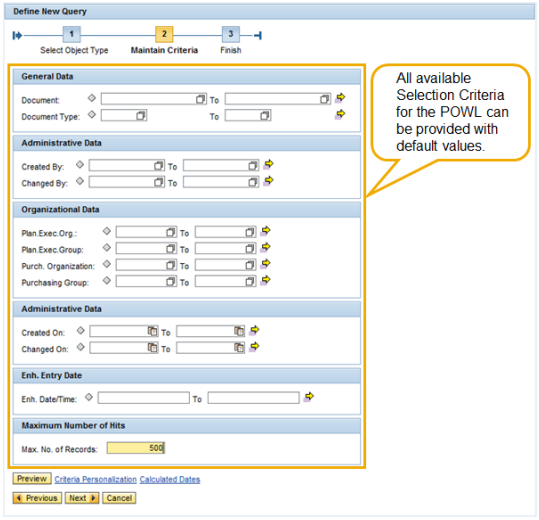
Picture: Define a new POWL Query.

1) **Select Object Type:** In field Select Object Type choose the entry *Enhancement TOR POWL Type* (which is nothing else but the description of the POWL type that was customized in section 6.2.3. Click on button *Next*.



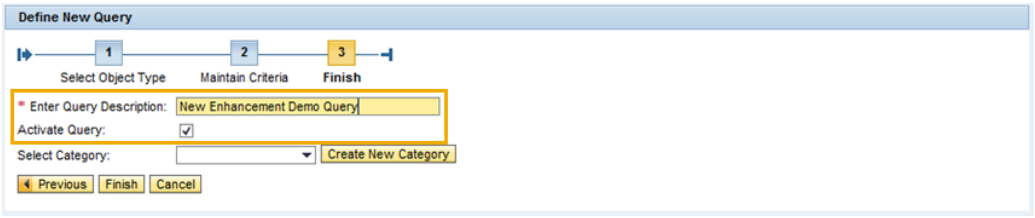
Picture: Select Object Type (POWL Type).

2) **Maintain Criteria:** On this screen of the guided procedure you can define default values for a set of selection criteria. Here, all selection criteria are visible that were specified in method *GET_SEL_CRITERIA* of the underlying POWL Feeder Class (in this example, we just leave all fields blank by default except the *Maximum Number of Hits* which is set to 500). When all required default / predefined values are specified, click on button *Next* again.



Picture: Maintain Criteria.

3) **Finish:** On the final screen you enter a Query Description, e.g. *New Enhancement Query* and set the flag *Activate Query*. Click on button *Finish* to get back to the POWL main screen. Here you can now see the new POWL Query.



Picture: Finish the new POWL Query.

6.2.5 Additional POWL Customizing

(To be completed in the next version).

6.3 Enhancing a standard POWL

(To be completed in the next version).

7 Enhancing Print Forms

SAP Transportation Management provides a number of standard print forms that can be printed out. The available forms can be found in transaction ***SFP*** (Form Builder) by using the F4-Help in field Form on the initial screen. Search for forms that start with */SCMTMS/**.

Form Name	Description
/SCMTMS/FP_CFI_PF	TM Pro Forma Customer Freight Invoice
/SCMTMS/FP_CMR	TM Road Waybill (Europe)
/SCMTMS/FP_FAG	TM Freight Agreement
/SCMTMS/FP_FBL	TM Multimodal Transport Bill of Lading
/SCMTMS/FP_FFC_IN	TM Confirmation of Forwarding Instructions
SCMTMS/FP_FFDOC	TM Forwarding Instructions
/SCMTMS/FP_FFI	TM Forwarding Instructions
/SCMTMS/FP_FFI_IN	TM Forwarding Instructions
/SCMTMS/FP_HAWB	TM House Air Waybill
/SCMTMS/FP_HBL	TM House Sea Bill of Lading
/SCMTMS/FP_LABELS	TM Label for Packaging
/SCMTMS/FP_MANIFEST	TM Shipping Manifest
/SCMTMS/FP_MAWB	TM Master Air Waybill
/SCMTMS/FP_MBL	TM Master Sea Bill of Lading
/SCMTMS/FP_PACKLIST	TM IATA Packing List
/SCMTMS/FP_SFI_PF	TM Pro Forma Supplier Freight Invoice
/SCMTMS/FP_VICS	TM Road Waybill (U.S.)

The provided standard forms may not contain all information required by customers or the layout might not match the requirements. For example there are extension fields (customer specific) on business object level that shall be also printed with a form or the layout needs to be adjusted, e.g. changing the sequence of fields or adding a company logo.

It is recommended to copy the standard form to be extended so that the standard form layout and configuration remains untouched and can still serve as a “template”. This copy can still have the same Interface as the standard form, i.e. the print structure, etc. will be the same.

In the following sections we will use standard form */SCMTMS/FP_FFDOC* (TM Forwarding Instructions) as an example how to enhance print forms. Assuming that the corresponding business object */SCMTMS/TRQ* (Forwarding Order) has been enhanced by customer specific fields, the example shows how to get these additional fields on the form and how to provide the content of the fields for printing.

We will also see how to create form completely from scratch, i.e. how to create completely new print forms. This will also include a description of how to set up the *Post Processing Framework* (PPF) in customizing to get the form displayed in the preview and printed via a connected printer.

7.1 Enhancing the backend part of a form

7.1.1 Enhancing the involved BO(s)

There might be additional standard fields on a business object that shall be printed but have not yet been included in the form or customers / partners have added customer-specific fields to a business object that shall be printed with a related form. In our example the BO */SCMTMS/TRQ* (Forwarding Order) is the source of data where the form will get the content to be printed from.

Add the following fields to the Root node of the BO (review section 3.3.4 to get an overview on how to create extension fields on a business object):

Component	Typing Method	Component Type
ZENH_ENTRY_DATE	Types	/SCMTMS/DATETIME
ZENH_SALESORG_ID	Types	/SCMTMS/SALES_ORG_ID
ZENH_APPROVED	Types	FLAG

In the following steps we will bring these customer / partner specific field onto the mentioned print form. In the described example, we follow a bottom-up approach, i.e. we start with some additional fields on a BO to get them to the print form. Of course it is also possible to follow a top-down approach by first of all placing additional fields on a form and add these fields to underlying BOs in the second step.

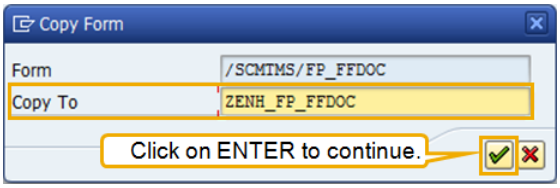
7.1.2 Copying the standard form

First of all we create a copy of the standard form */SCMTMS/FP_FFDOC* as follows:

1) Start transaction *SFP*, select radio button *Form* and enter the form to be copied in the corresponding input field (or use the F4-Help of the field to find the form).

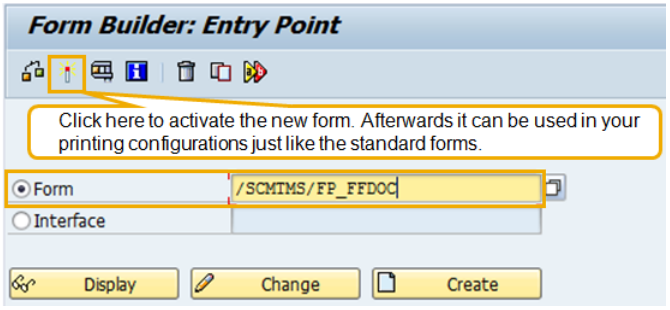
2) In the menu bar select *Form Object → Copy…* or press *CTRL+F5*.

3) On the following popup screen, enter the new name for your copy of the form. Example: *ZENH_FP_FFDOC*.



Picture: Creating a copy of a standard form.

4) On the following popup, define a package where to store the new copy. Then save the form. Back on the initial screen of transaction *SFP*, activate the new form.



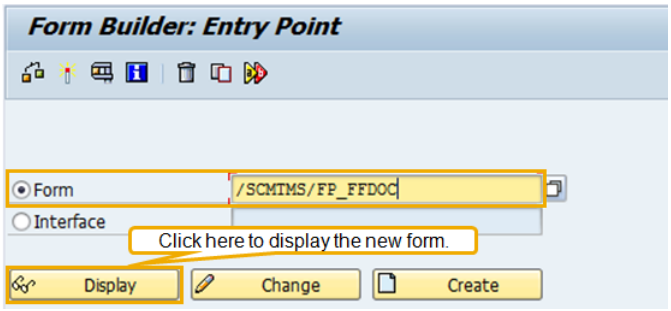
Picture: Activating the new form.

5) The new form can now be used in the printing configuration (Output Management / PPF) just like the original standard form (see also last sections for more details on this).

7.1.3 Enhancing the Print Structure of a Form

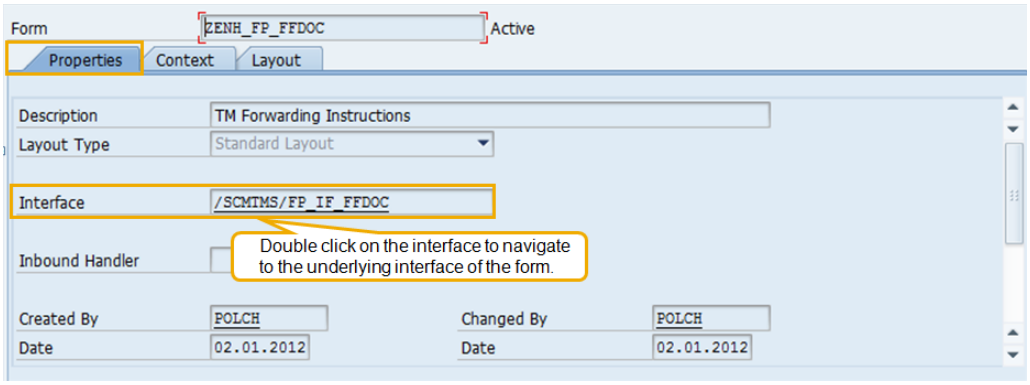
In the next step of our example, we place the additional, customer specific fields in the DDIC structure of the form from where it will get the data to be printed. To do this, we first of all need to identify the underlying DDIC structure of the form.

1) Start transaction *SFP* and display your form.



Picture: Display a form via transaction SFP.

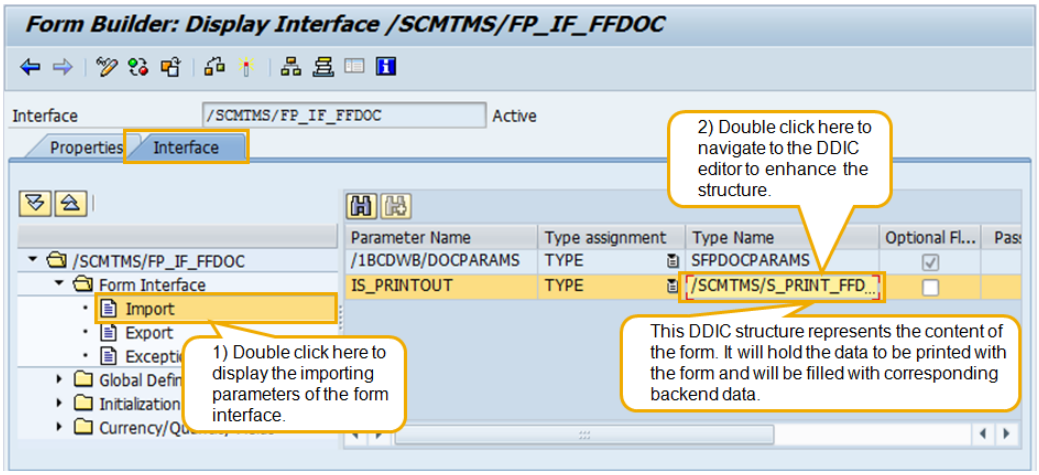
2) On the following screen, click on tab strip Properties and double click on the interface mentioned here. This interface contains the data structures that the form uses to represent its content.



Picture: Navigate to the underlying interface of the form.

3) On the next screen you can see the details of the interface. On the right side you can find the content and details of the interface represented as a tree. The example interface is */SCMTMS/FP_IF_FFDOC*. In the tree open the path */SCMTMS/FP_IF_FFDOC* → *Form Interface* and then double click on the entry *Import*.

   Here you can see now the parameter *IS_PRINTOUT* with its corresponding DDIC type */SCMTMS/S_PRINT_FFDOC* in column *Type Name*. Double click on this DDIC structure to edit it as described in the next step.



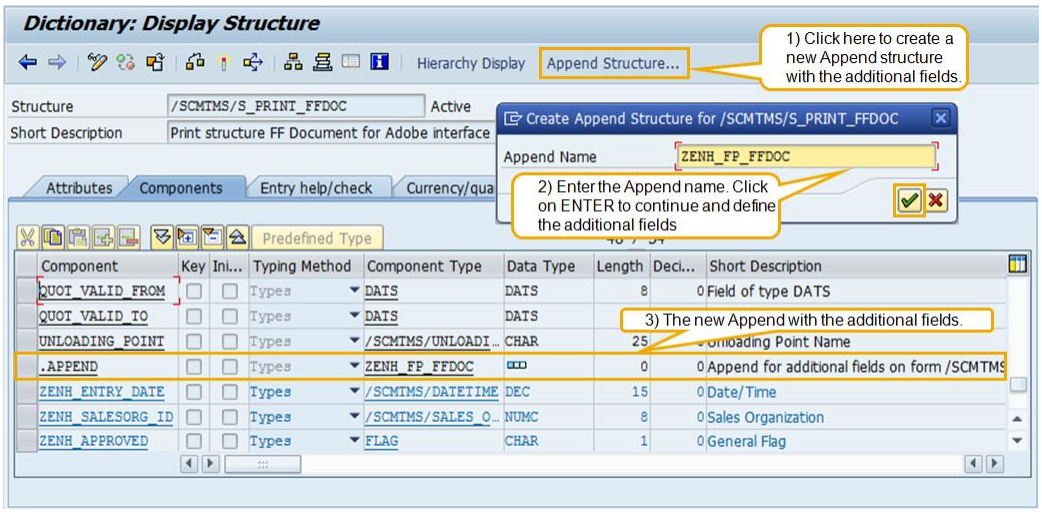
Picture: Identifying the content DDIC structure of the form.

4) After double clicking the DDIC structure */SCMTMS/S_PRINT_FFDOC*, it will open in the DDIC editor (transaction *SE11*). Here we can now add the customer specific fields to be placed on the form. On the button bar, click on *Append Structure…* for creating a new Append. On the following popup enter the Append name. Example:

Append Name	ZENH_FP_FFDOC
Short Description	Append for additional fields on form /SCMTMS/FP_FFDOC

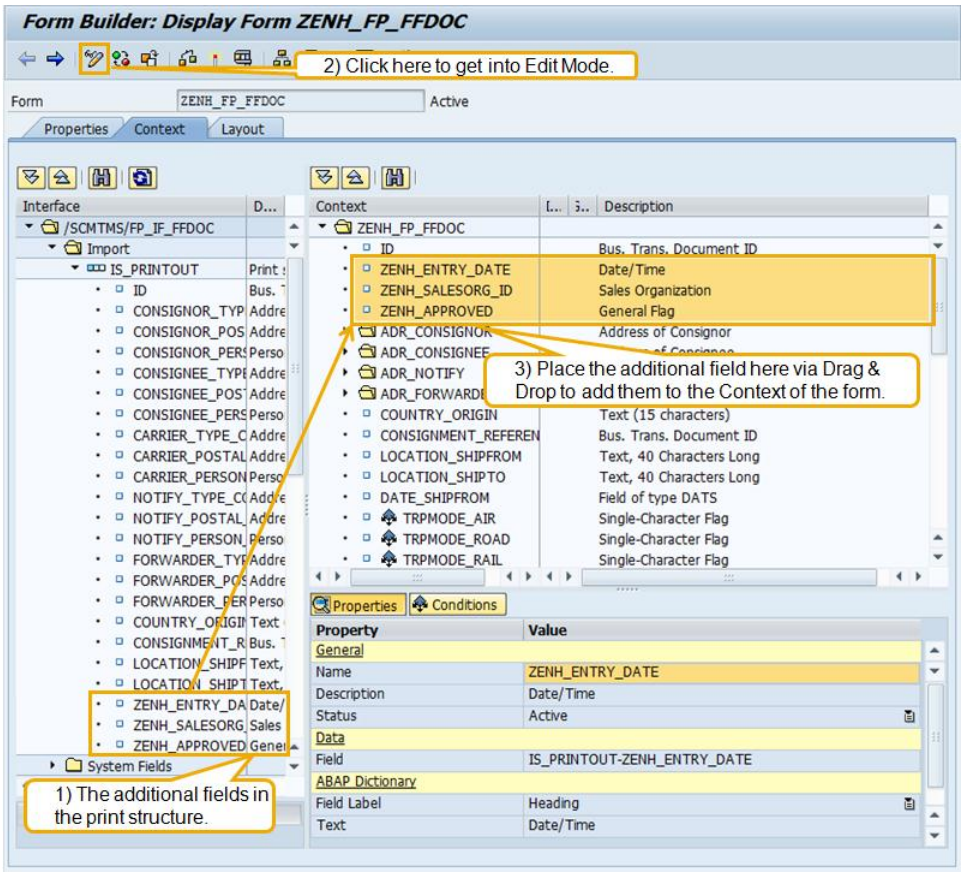
Add following fields in the new Append. Then save and activate the Append.

Component	Typing Method	Component Type
ZENH_ENTRY_DATE	Types	/SCMTMS/DATETIME
ZENH_SALESORG_ID	Types	/SCMTMS/SALES_ORG_ID
ZENH_APPROVED	Types	FLAG



Picture: The DDIC structure of the form with the new Append.

5) Now return from the DDIC Editor and the Form Interface back to transaction *SFP*. Here click on tab strip Context. Here you can see the Form Interface again. In the tree open the path */SCMTMS/FP_IF_FFDOC → Import → IS_PRINTOUT*. The fields of the new Append should now be visible here as well.



Picture: Adding the new fields to the Context of the form.

Switch into Edit mode (*CTRL + F1*). Now mark the additional fields and place them into the form context via drag & drop as shown in the picture above. Finally, save and activate the form again.

7.1.4 Providing Data to enhanced fields

Now the new fields added in the print structure need to be filled with content to be printed. For this, we first of all need to identify the corresponding print document class which provides the standard content of the form.

1) Start transaction *SE24* (Class Builder) and use the F4-Help on the initial screen to search for classes with the pattern ***/SCMTMS/*PRINT****. For our example form */SCMTMS/FP_FFDOC* (Forwarding Order) the following class is the right one:

   /SCMTMS/CL_PRINTOUT_FWO

2) All print classes inherit from super class */SCMTMS/CL_PRINTOUT* which provides in general two methods:

   - ***FILL_PRINTSTRUCTURE:*** This method will be overwritten by the implementation of print class /SCMTMS/CL_PRINTOUT_CFIPF. It contains the coding that reads the data to be printed at runtime.

- ***PRINT_DOCUMENT:*** Contains coding to prepare the printing of a form and calls method *FILL_PRINT_STRUCTURE* to get the data). Its implementation is taken over from the mentioned super class.

In printing class */SCMTMS/CL_PRINTOUT_FWO* you can find further methods implemented that serve as data providers.

3) In our example, the fields added to the Root node of business object /SCMTMS/TRQ are already read within method *BUFFER_DATA* of class */SCMTMS/CL_PRINTOUT_FWO*. Here helper class method */SCMTMS/CL_TRQ_HELPER=>READ_NODES* returns the required data from the corresponding BO instance.

   In other examples this might not be the case. Then you need to add coding in method *FILL_PRINTSTRUCTURE* to read the additional data and map this data to the corresponding fields in the print structure.

   In our example, we just need to add a few lines of code to map the available content of the new fields coming from the BO onto the corresponding fields of the print structure. To do this, you can e.g. create a post exit for method *FILL_PRINTSTRUCTURE*.

In any case, review the standard implementation of method *FILL_PRINTSTRUCTURE* to get to know the way how data is read and mapped for the form. In general this is easy ABAP coding that can be enhanced accordingly. When writing your own access methods for additional data to be provided to the print form, always make sure that this is done in a way that ensures a maximum of performance.

7.2 Adjusting the Layout

7.2.1 Installing Adobe LiveCycle Designer

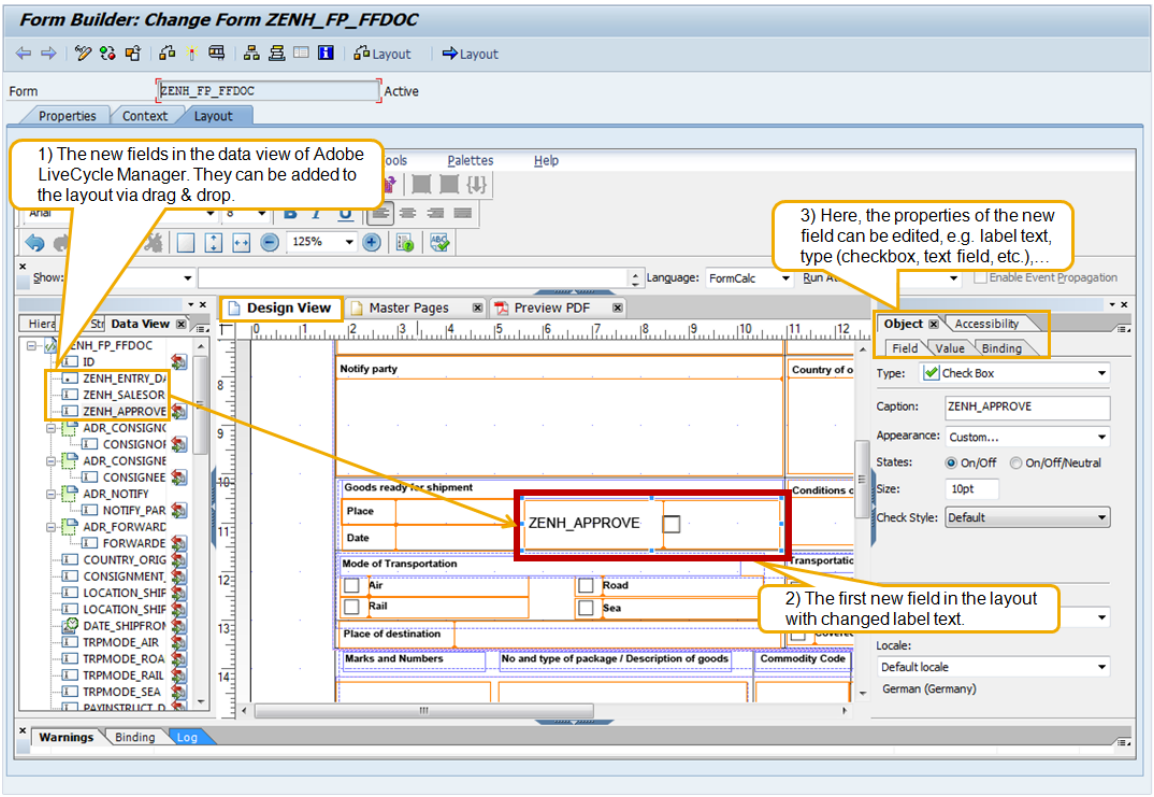
In the next step we adjust the layout of the form. This requires Adobe LiveCycle Designer to be installed on your local machine. Please review note 1522483 for instructions on how to download this tool from the SAP Service Market Place and how to install it. As a customer or partner, please make sure in advance that you have sufficient authorization to download software from the service market place (SAP internally, you can get this authorization via the access enforcer as described in note 1037575).

7.2.2 Placing additional content on the form layout

As shown in the previous picture, we now have the new fields available in the context of the form.

1) In transaction *SFP* Click on tab strip Layout to display the form definition in the Adobe LiveCycle Designer. If installed correctly, you should now see a layout as shown below.

2) In the Adobe LiveCycle Designer, you can now drag & drop the new fields from the data view into the layout view and maintain corresponding field properties.



Picture: The form in the layout view of the Adobe LiveCycle Manager.

7.3 Creating a new form

In this section we will see how to build a print form from scratch. As an example, a very simple form based on BO /SCMTMS/TRQ (Forwarding Order) is created. Before we create the actual form, we first of all need to create a corresponding print structure (and table type) and a form interface.

7.3.1 Creating a print structure and table type

In the first step we create a print structure that represents the content of the form. Remember that the data source for our new form will again be BO */SCMTMS/TRQ* (Forwarding Order). In our example, we want to place data on the form that comes from the Root and Item node of the BO. This means that the print structure is allowed to be and will be a deep structure as there can be multiple items in a corresponding BO instance.

1) Start transaction SE11, select radio button *Data type* and enter the name of the print structure in the input field next to it. Example: *ZENH_S_PRINT_TRQ*.

2) In the menu bar select *Dictionary Object* → *Create…* or press *F5*.

3) In the next step the fields and tables are specified in the new structure, representing the content of the form, keeping in mind that the data will come from BO /SCMTMS/TRQ. Two options to do this:

a. You define your own list of fields and tables that make up the structure. This will later require some coding to map the data of a BO instance onto the corresponding parts in the BO structure.

b. You can reuse the node structures and table types that are used to specify the corresponding BO nodes that deliver the data for the form. In our example, we follow this approach.

4) Define the structure for the example as by including the combined structure of the TRQ Root node and defining a component *ITEM* that is specified with the combined table type for the TRQ Item node (with transaction */BOBF/CONF_UI* you can browse the node model and identify the used component types).

Structure		**Description**
ZENH_S_PRINT_TRQ		Enh. Demo: Print Structure for a new TRQ Form
Component	**Typing Method**	**Component Type**
.INCLUDE	Types	/SCMTMS/S_TRQ_ROOT_K
ITEM	Types	/SCMTMS/T_TRQ_ITEM_K

In the example, using the combined structures will allow placing all data on the form that is coming from the Root node and the item node of a TRQ instance. As the combined structure also contains the potentially available fields of the extension includes for the nodes, they will also be available to be placed on the form.

5) Save and activate the new structure.

6) Use transaction *SE11* to create table type ZENH_T_PRINT_TRQ with structure ZENH_S_PRINT_TRQ as the line type.

7) Save and activate the new table type.

7.3.2 Creating a form interface

Now we can create the required form interface. The most important information in this interface is the assignment of the print structure which represents the data that will be available to define the content of the new form.

1) Start transaction *SFP*, select radio button *Interface* and in the menu bar select *Form Object → Create…* or press *F5*.

2) On the next popup screen enter the following data to specify the form interface:

Interface	ZENH_FP_IF_TRQ
Description	Demo Enhancement Interface for TRQ
Interface Type	ABAP Dictionary-Based Interface

3) Click button *Save* (Enter) on the popup screen and specify the package where to place the new interface (in the example we create the interface as a local object in package *$TMP*).

4) The form interface will be based on DDIC structure ZENH_S_PRINT_TRQ created in the previous step. This is assigned to the form interface as follows:

a. Navigate to tab strip *Interface*.

b. In the tree on the right side follow the path *ZENH_FP_IF_TRQ → Form Interface → Import* to define a new Importing Parameter for the form interface.

c. Click on button *Append Row* in the tool bar on the left side and create the following entry:

Parameter Name	IS_PRINTOUT
Type assignment	TYPE
Type name	ZENH_S_PRINT_TRQ

5) Save and activate the new form interface.

7.3.3 Creating the Adobe form

With the now available print structure and form interface we finally can create the actual form. This is done by using Adobe LiveCycle Designer (see also section 7.2.1 and 7.2.2). Execute the following steps to create a simple Adobe Form:

1) Start transaction *SFP*, select radio button *Form* and in the menu bar select *Form Object → Create…* or press *F5*.

2) On the next popup screen enter the following data to specify the form:

Form	ZENH_FP_TRQ
Description	Demo Enhancement Form for TRQ
Interface	ZENH_FP_IF_TRQ

3) Click button *Save* (Enter) on the popup screen and specify the package where to place the new form (in the example we create the interface as a local object in package *$TMP*).

4) On the next screen go to tab strip *Properties*. Make sure that the Layout Type is set to *Standard Layout*.

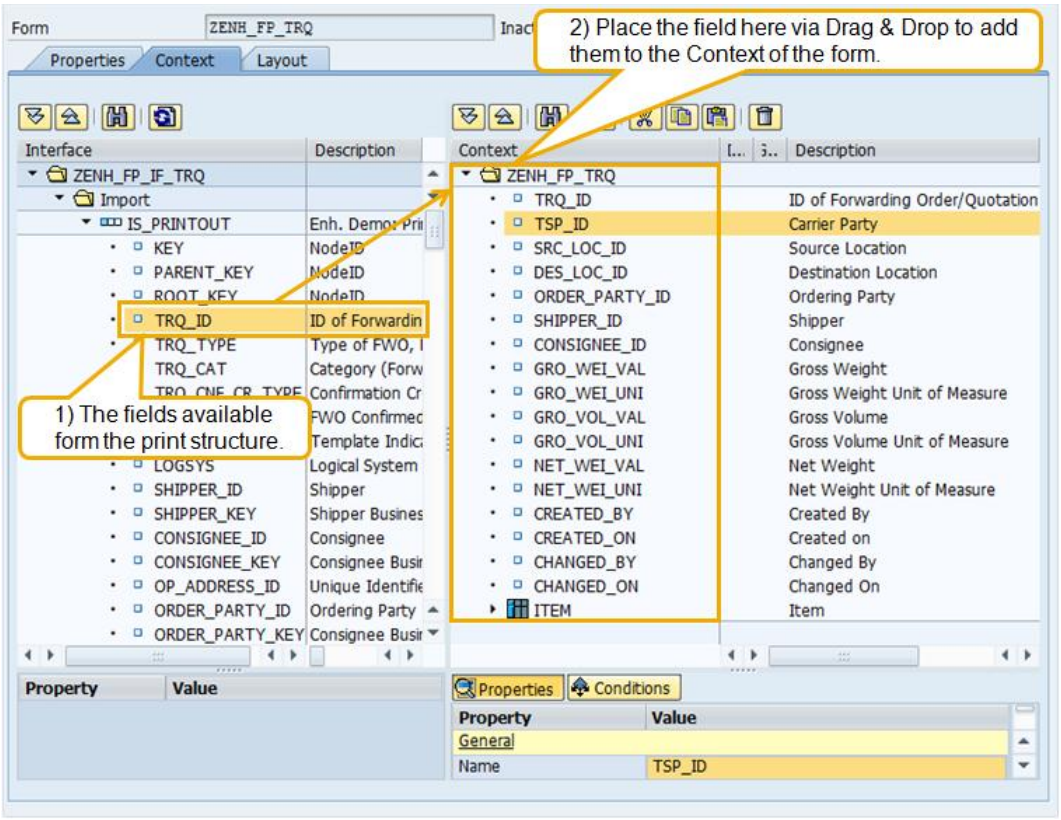
5) Change to tab strip *Context*. In the tree on the left side follow the path *ZENH_FP_IF_TRQ → Import → IS_PRINTOUT* (make sure that you expand IS_PRINTOUT). The context on the left side should be empty. Only the context root ZENH_FP_TRQ should be available.

   With this step the mapping between the form interface and the form is defined. Structure IS_PRINTOUT represents the set of potential fields on the form while the context represents the list of actual fields that will be available when defining the layout of the form in the next step.

   You can drag & drop attributes of the print structure IS_PRINTOUT on the left side into the context of the form on the right side. Click on an attribute on the left side (keep mouse button pressed) and drag it to the context on the left side (drop the very first one directly on the root ZENH_FP_TRQ of the context). For the example make the context contain the following:

TRQ_ID	ID of Forwarding Order/Quotation or Trsp. Reqt
SRC_LOC_ID	Source Location
DES_LOC_ID	Destination Location
ORDER_PARTY_ID	Ordering Party
SHIPPER_ID Shipper	Shipper
CONSIGNEE_ID	Consignee
GRO_WEI_VAL	Gross Weight
GRO_WEI_UNI	Gross Weight Unit of Measure

GRO_VOL_VAL	Gross Volume
GRO_VOL_UNI	Gross Volume Unit of Measure
NET_WEI_VAL	Net Weight
NET_WEI_UNI	Net Weight Unit of Measure
CREATED_BY	Created By
CREATED_ON	Created on
CHANGED_BY	Changed By
CHANGED_ON	Changed On
ITEM	Item



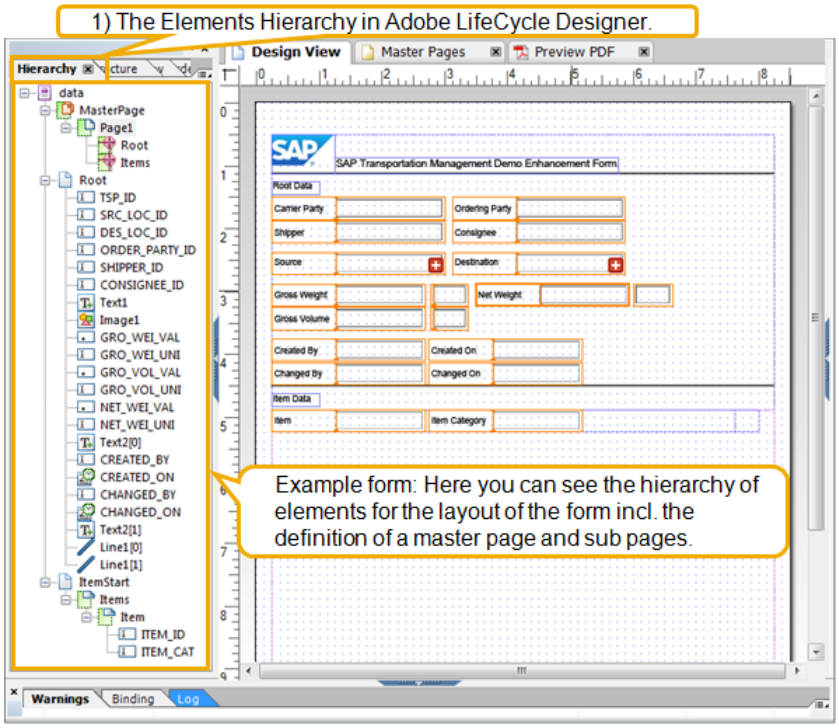
Picture: Specifying the Context of a form.

6) Change to tab strip *Layout* (make sure that you have installed Adobe LiveCycle Designer as described in section 7.2.1). On the left side of the Adobe LiveCycle Designer navigate to tab strip *Hierarchy*.

   a. Define a master page with sub forms to represent different aspects of the form content. In the example form we have created a master page that has two content areas, one for the Root data and a second one for the item data.

   b. Define a sub form for the Root data and assign it to the Root content area of the main page. Then define a sub form for the Item data and assign it to the Items content area of the main page

   For more details on how to use the Adobe LiveCycle Designer review the corresponding help documentation in your system and take a look at the master page and sub form definitions of the standard forms provided by SAP to learn more. The following picture shows the final elements hierarchy of the example form.



Picture: The hierarchy of the example form.

7) On the left side of the Adobe LiveCycle Designer navigate to tab strip *Data View*.

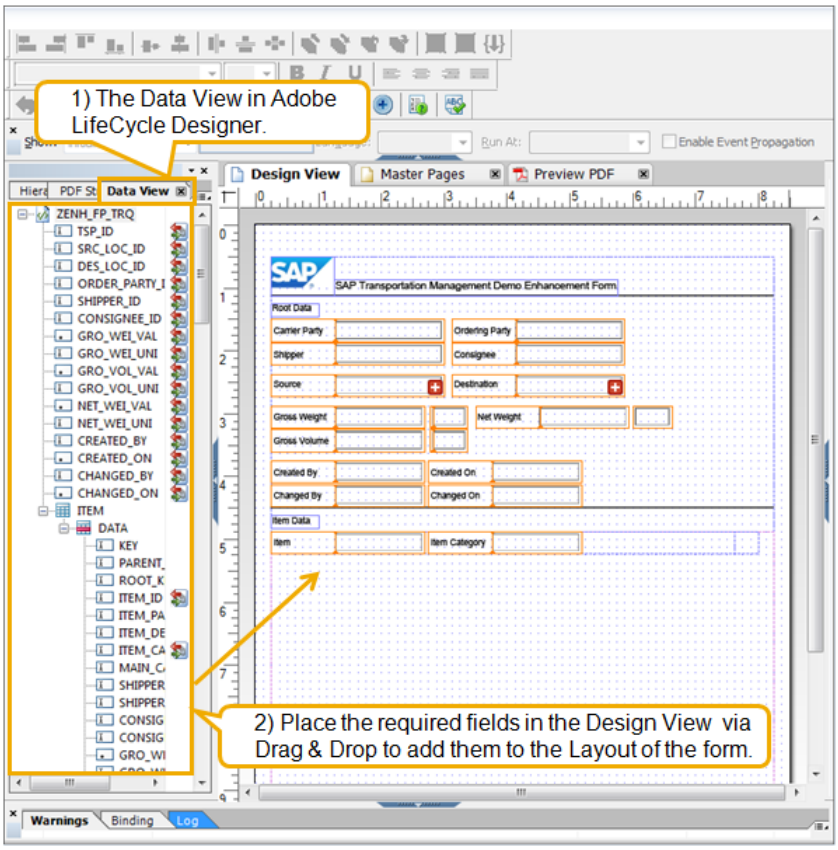
   Here the fields from the defined context are now available to be placed on the form layout. You can drag & drop any of the fields from the tree representation of the context on the left side *Data View* into the *Design View* in the middle section of the screen.

   a. Drag & drop Root fields into the Root sub form area, arrange the fields as required and maintain field properties (e.g. define fields to represent date/time information if the content represents date/time information, etc.).

   b. Drag & drop Item fields into the Item sub form area, arrange the fields as required and maintain field properties (e.g. define fields to represent date/time information if the content represents date/time information, etc.).

   c. Add additional required elements on the form like Logos, separators etc.

8) Save and activate the new form.



Picture: The data view of the example form.

7.3.4 Creating required coding in the backend

The form is now defined. In the next step, some ABAP coding is required to provide the data of a BO instance to the form. For this we need to define Printing Class and a BO Service Class as follows:

Define a Printing Class:

1) Start transaction *SE24* and create a new class that represents the Printing Class for the new form. This class will contain coding to fill the print structure of the form with data from a discrete BO instance. Use the following definitions for the example class:

   Create class ZCL_ENH_PRINTOUT_FWO which inherits from the super class /SCMTMS/CL_PRINTOUT (the TM Super Class for printing documents).

2) Add the following attributes and constants to the class:

Attribute	Level	Visibility	Typing	Associated Type
MO_SRVMGR	Instance Attribute	Protected	Type Ref To	/BOBF/IF_TRA_SERVICE_MANAGER
MT_TRQ_ROOT	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_ROOT_K
MT_TRQ_ITEM	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_ITEM_K
MT_STAGE	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_STAGE_K

MT_DOCREFERENCE	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_DOCREF_K
MT_PARTY	Static Attribute	Protected	Type	/ SCMTMS/T_TRQ_PARTY_K
MT_PARTY_LINK	Static Attribute	Protected	Type	/BOBF/T_FRW_KEY_LINK
MT_ITEMCONTENTID	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_CONTENT_IDENT_K
MT_DG_INFO_ITEM	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_DGO_INFO_K
MT_ITEMPARTY	Static Attribute	Protected	Type	/SCMTMS/T_TRQ_PARTY_K
MT_ITEMPARTY_LINK	Static Attribute	Protected	Type	/BOBF/T_FRW_KEY_LINK

3) Redefine class method *FILL_PRINTSTRUCTURE*. This method will read the data form the BO instance to be printed and does the mapping between the BO data structure and the print structure. The example coding looks as follows:

```
METHOD fill_printstructure.

  FIELD-SYMBOLS: <lt_printout_fwo> TYPE zenh_t_print_trq,
                 <ls_trq_root>     TYPE /scmtms/s_trq_root_k.

  DATA: ls_printout_fwo      TYPE zenh_s_print_trq,
        ls_printout_fwo_item TYPE /scmtms/s_trq_item_k,
        lo_message           TYPE REF TO /bobf/if_frw_message,
        lr_trq_root          TYPE REF TO /scmtms/s_trq_root_k,
        lr_trq_item          TYPE REF TO /scmtms/s_trq_item_k.

  CREATE DATA et_printout LIKE <lt_printout_fwo>.
  ASSIGN et_printout->* TO <lt_printout_fwo>.

* Use a TRQ helper class method to read the relevant TRQ data
  CALL METHOD /scmtms/cl_trq_helper=>read_nodes
    EXPORTING
      it_key               = it_keys
    IMPORTING
      et_root              = mt_trq_root
      et_item              = mt_trq_item
      et_stage             = mt_stage
      et_docreference      = mt_docreference
      et_party             = mt_party
      et_party_link        = mt_party_link
      et_itemcontentid     = mt_itemcontentid
      et_itemdanggoodsinfo = mt_dg_info_item
      et_itemparty         = mt_itemparty
      et_itemparty_link    = mt_itemparty_link.

* Fill the print structure with the data of the BO instance
  LOOP AT mt_trq_root REFERENCE INTO lr_trq_root.
    "mapping the root node information
    ls_printout_fwo-trq_id = lr_trq_root->trq_id.
    "Document Number
    ls_printout_fwo-tsp_id = lr_trq_root->tsp_id.
```

```
      "Carrier Party
      ls_printout_fwo-src_loc_id = lr_trq_root->src_loc_id.
      "Source Location
      ls_printout_fwo-des_loc_id = lr_trq_root->des_loc_id.
      "Destination Location
      ls_printout_fwo-order_party_id = lr_trq_root->order_party_id.
      "Ordering Party
      ls_printout_fwo-shipper_id = lr_trq_root->shipper_id.
      "Shipper
      ls_printout_fwo-consignee_id = lr_trq_root->consignee_id.
      "Consignee
      ls_printout_fwo-gro_wei_val = lr_trq_root->gro_wei_val.
      "Gross Weight
      ls_printout_fwo-gro_wei_uni = lr_trq_root->gro_wei_uni.
      "Gross Weight Unit of Measure
      ls_printout_fwo-gro_vol_val = lr_trq_root->gro_vol_val.
      "Gross Volume
      ls_printout_fwo-gro_vol_uni = lr_trq_root->gro_vol_uni.
      "Gross Volume Unit of Measure
      ls_printout_fwo-net_wei_val = lr_trq_root->net_wei_val.
      "Net Weight
      ls_printout_fwo-net_wei_uni = lr_trq_root->net_wei_uni.
      "Net Weight Unit of Measure
      ls_printout_fwo-created_by = lr_trq_root->created_by.
      "Created By
      ls_printout_fwo-created_on = lr_trq_root->created_on.
      "Created on
      ls_printout_fwo-changed_by = lr_trq_root->changed_by.
      "Changed By
      ls_printout_fwo-changed_on = lr_trq_root->changed_on.
      "Changed On

      "mapping the item information
      CLEAR ls_printout_fwo-item.
      LOOP AT mt_trq_item  REFERENCE INTO lr_trq_item
        WHERE parent_key = lr_trq_root->root_key.
        CLEAR ls_printout_fwo_item.
        ls_printout_fwo_item-item_id    = lr_trq_item->item_id.
        ls_printout_fwo_item-item_cat   = lr_trq_item->item_cat.
        ls_printout_fwo_item-product_id = lr_trq_item->product_id.

        INSERT ls_printout_fwo_item
        INTO TABLE ls_printout_fwo-item.
      ENDLOOP.

      INSERT ls_printout_fwo INTO TABLE <lt_printout_fwo>.
    ENDLOOP.

  ENDMETHOD.
```

Define a BO Service Class:

4) Start transaction SE24 and create a new class that represents the BO Service class. This class will contain coding to communicate with the PPF/Output Management. Use the following definitions for the example class:

   Create class ZCL_ENH_TRQ_PPF_SERVICE which inherits from the super class /BOFU/CL_PPF_SERV_FOR_BO (PPF Services for BO).

5) Add the following attributes and constants to the class:

Attribute	Level	Visibility	Typing	Associated Type
MV_AD_TRQ_FWO_PRINT	Instance Attribute	Protected	Type	PPFDTT
MV_AD_TRQ_FWO_PRINT_MAN	Instance Attribute	Protected	Type	PPFDTT
GC_AD_TRQ_FWO_PRINT	Constant	Private	Type	PPFDTT Initial value: ZENH_TRQ_FWO_PRINT
GC_AD_TRQ_FWO_PRINT_MAN	Constant	Private	Type	PPFDTT Initial value: ZENH_TRQ_FWO_PRINT_MAN

6) Implement a constructor for the class (the method *CONSTRUCTOR* is a public instance method). The example coding for the constructor looks as follows:

```
METHOD CONSTRUCTOR.
* call super constructor
  CALL METHOD super->constructor.

* configure class with defalut action definitions
  mv_ad_trq_fwo_print      = gc_ad_trq_fwo_print.
  mv_ad_trq_fwo_print_man  = gc_ad_trq_fwo_print_man.

ENDMETHOD.
```

7) Redefine class method *PERSONALIZE_DOC_BY_ABAP* with the following coding:

```
METHOD personalize_doc_by_abap.

  DATA: lo_printout        TYPE REF TO  /scmtms/cl_printout,
        ls_key             TYPE /bobf/s_frw_key,
        lt_keys            TYPE /bobf/t_frw_key,
        lv_document_number TYPE /scmtms/trq_id.

* PPF specific variables
  DATA: lv_db_key    TYPE /bobf/conf_key.

  DATA: lr_message TYPE REF TO /bobf/if_frw_message.

* Start. Via this container, determine the Root Node ID
  CALL METHOD io_container->get_db_key
    RECEIVING
      result = lv_db_key.
```

```
* Determine BO Name and Node ID from PPF container
  ls_key-key = lv_db_key.
  APPEND ls_key TO lt_keys.

  CASE is_ppf_act-ppf_action.

    WHEN mv_ad_trq_fwo_print OR mv_ad_trq_fwo_print_man.
      " Forwarding Order: create instance of class for document
      " to be printed.
      CREATE OBJECT lo_printout TYPE zcl_enh_printout_fwo.

    WHEN OTHERS.

  ENDCASE.

  IF lo_printout IS BOUND.
*   Fill data and print document.
    CALL METHOD lo_printout->print_document
      EXPORTING
        it_keys            = lt_keys
        ip_function_name   = ip_function_name
        ip_form_name       = ip_form_name
        is_outputparams    = is_outputparams
      IMPORTING
        es_formoutput      = es_formoutput
        es_joboutput       = es_joboutput
        eo_message         = lr_message
        ev_document_number = ev_document_number
      CHANGING
        cs_docparams       = cs_docparams
        cp_document_title  = cp_document_title.
  ENDIF.

  IF ( lr_message IS NOT INITIAL ).
    CALL METHOD io_message->add
      EXPORTING
        io_message = lr_message.
  ENDIF.

ENDMETHOD.
```

8) Redefine class method DETERMINE_PRINTER_BY_ABAP with the following coding:

```
METHOD DETERMINE_PRINTER_BY_ABAP.

* Get the default printer of the actual user.
* Uses function 'SUSR_GET_USER_DEFAULTS' in order to retrieve
* printer-related data from table with entries of type USDEF.
  get_printer_for_logon_user(
  CHANGING
    cs_printer =     et_data ).

* A device is needed. Therefore set a default.
  IF et_data-device IS INITIAL.
    et_data-device = 'A000'.
  ENDIF.
```

```
ENDMETHOD.
```

9) Redefine class method /BOFU/IF_PPF_SERV_FOR_BO~GET_PROFILES with the following coding:

```
METHOD /BOFU/IF_PPF_SERV_FOR_BO~GET_PROFILES.

  DATA: lo_trq_srv_mgr TYPE REF TO /bobf/if_tra_service_manager,

        lt_trq_root    TYPE /scmtms/t_trq_root_k,
        lt_trq_root_bi TYPE /scmtms/t_trq_root_k,
        lr_s_trq_root  TYPE REF TO /scmtms/s_trq_root_k,

        lt_trq_types   TYPE /scmtms/t_trqty,
        ls_trq_type    LIKE LINE OF lt_trq_types,

        lt_key         LIKE it_key,
        lt_key_deleted LIKE it_key_deleted,
        ls_key         LIKE LINE OF lt_key,

        lt_ppf_profile TYPE /bofu/t_ppf_prof,

        lt_data        LIKE et_data,
        ls_data        LIKE LINE OF et_data.

* Clear return parameters
  CLEAR et_data.

* Retrieve TRQ Root. The setting how to determine the relevant
* PPF Action Profiles is stored at the root node.
* For created/changed instances we need the current image, for
* deleted instances we need the before image
  lo_trq_srv_mgr = /bobf/cl_tra_serv_mgr_factory=>
            get_service_manager( /scmtms/if_trq_c=>sc_bo_key ).

  lo_trq_srv_mgr->retrieve(
    EXPORTING
      iv_node_key             = /scmtms/if_trq_c=>sc_node-root
      it_key                  = it_key
    IMPORTING
      et_data                 = lt_trq_root ).

  lo_trq_srv_mgr->retrieve(
    EXPORTING
      iv_node_key             = /scmtms/if_trq_c=>sc_node-root
      it_key                  = it_key_deleted
      iv_before_image         = abap_true
    IMPORTING
      et_data                 = lt_trq_root_bi ).

  INSERT LINES OF lt_trq_root_bi INTO TABLE lt_trq_root.


* Retrieve all TRQ types.
  CALL METHOD /scmtms/cl_trq_helper_cust=>get_trqtype_all
```

```
    IMPORTING
      et_trqtype = lt_trq_types.

* Retrieve PPF Action Profiles of current output agent
  conf_get_valid_ppf_prof(
    EXPORTING
      is_ppf_conf        = is_ppf_conf
      iv_kind_of_profile = iv_kind_of_profile
      io_message         = io_message
    IMPORTING
      et_data            = lt_ppf_profile ).

* Determine relevant PPF Action Profiles Separate instances were
* the Output Profile is specified explicitly and were the PPF
* Action Profiles shall be determined automatically according to
* the settings in the output management adapter configuration

  LOOP AT lt_trq_root REFERENCE INTO lr_s_trq_root.

    READ TABLE lt_trq_types INTO ls_trq_type
         WITH TABLE KEY type = lr_s_trq_root->trq_type.
    IF sy-subrc NE 0.
      CLEAR ls_trq_type.
    ENDIF.

    IF ls_trq_type-ppf_profile_auto = abap_true.
      " PPF Action profiles are to be determined automatically
      " by output management adapter configuration
      " Collect key for automatic determination
      CLEAR ls_key.
      ls_key-key = lr_s_trq_root->key.

      READ TABLE it_key WITH TABLE KEY key_sort
        COMPONENTS key = lr_s_trq_root->key
        TRANSPORTING NO FIELDS.
      IF sy-subrc = 0.
        INSERT ls_key INTO TABLE lt_key.
      ELSE.
        INSERT ls_key INTO TABLE lt_key_deleted.
      ENDIF.
    ELSE.
      " Relevant PPF Action profile is stored in transportation
      " request root
      IF ls_trq_type-ppf_profile IS NOT INITIAL.
        READ TABLE lt_ppf_profile
          WITH TABLE KEY ppf_profile = ls_trq_type-ppf_profile
          TRANSPORTING NO FIELDS.
        IF sy-subrc = 0.
          CLEAR ls_data.
          ls_data-key         = lr_s_trq_root->key.
          ls_data-ppf_profile = ls_trq_type-ppf_profile.
          ls_data-appl_key    = lr_s_trq_root->key.
          INSERT ls_data INTO TABLE et_data.
        ENDIF.
      ENDIF.
      IF ls_trq_type-ppf_profile_add IS NOT INITIAL.
```

```
        READ TABLE lt_ppf_profile
          WITH TABLE KEY ppf_profile =
                         ls_trq_type-ppf_profile_add
          TRANSPORTING NO FIELDS.
        IF sy-subrc = 0.
          CLEAR ls_data.
          ls_data-key         = lr_s_trq_root->key.
          ls_data-ppf_profile = ls_trq_type-ppf_profile_add.
          ls_data-appl_key    = lr_s_trq_root->key.
          INSERT ls_data INTO TABLE et_data.
        ENDIF.
      ENDIF.
    ENDIF.
  ENDLOOP.

  " For all instances in LT_KEY, LT_KEY_DELETED, determine the
  " relevant PPF Action Profile automatically
  IF lt_key IS NOT INITIAL OR lt_key_deleted IS NOT INITIAL.
    super->/bofu/if_ppf_serv_for_bo~get_profiles(
      EXPORTING
        is_ppf_conf        = is_ppf_conf
        iv_kind_of_profile = iv_kind_of_profile
        it_key             = lt_key
        it_key_deleted     = lt_key_deleted
        io_message         = io_message
      IMPORTING
        et_data            = lt_data ).

    " Merge determined PPF Action Profiles
    INSERT LINES OF lt_data INTO TABLE et_data.
  ENDIF.

ENDMETHOD.
```

7.4 Configuring PPF (Post Processing Framework)

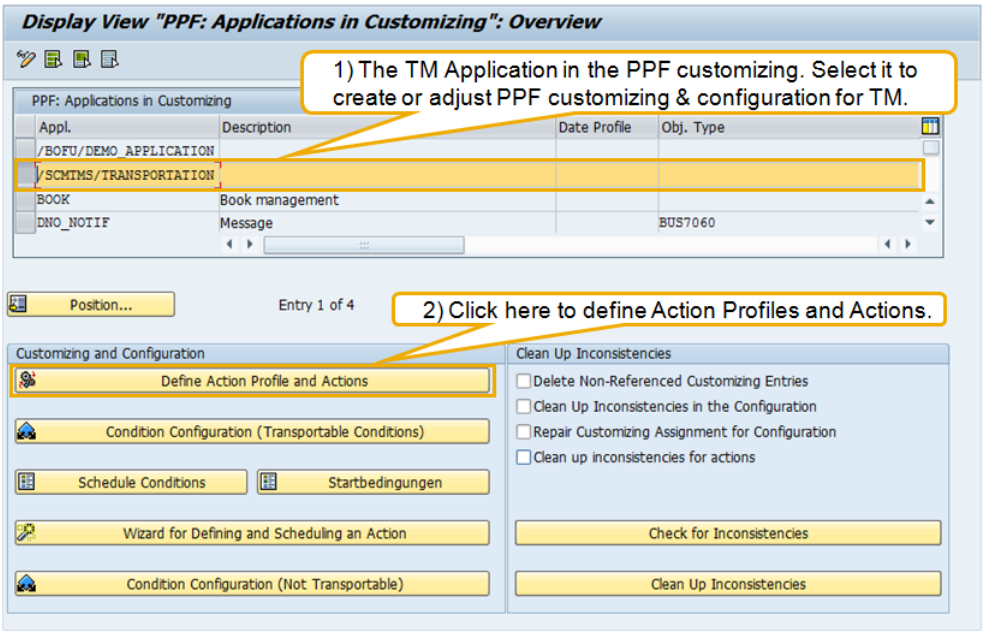
With the new form and the backend coding in place we can now configure the required Post Processing Framework (PPF) settings to get the form displayed in the print preview and printed out on paper.

7.4.1 Maintaining PPF Settings

SAP Transportation Management uses the output management framework PPF which is also used by other Business Suite applications. It generates output triggers based on the settings done for particular application data records. Based on the configuration settings, the system subsequently processes these triggers to send the actual output.

1) Start customizing transaction *SPRO* and follow the path *Cross-Application Components → Reusable Objects and Functions for BOPF Environment → PPF Adapter for Output Management → Maintain PPF Settings*.

2) On the first screen select application /SCMTMS/TRANSPORTATION and then click on button *Define Action Profile and Actions*.



Picture: Maintaining PPF Settings - Initial screen.

3) On the next screen switch to change mode (Crtl+F1), mark entry *Action Profile* in the Dialog Structure tree and click on button *New Entry* to create a new Action Profile with the following data:

Field	Value
Action Profile	ZENH_TRQ_FWO_PRINT
Description	Enhancement Action Profile for TRQ
Category of Object Type	Persistent Class
Object Type Name	/BOFU/CL_PPF_CONTAINER
Context Class	/BOFU/CL_PPF_CONTEXT

4) Mark entry *Action Definition* in the Dialog Structure tree and click on button *New Entry* to create the new Action Definition ZENH_TRQ_FWO_PRINT_MAN with the following data:

Tab strip	Field	Value
	Action Definition	ZENH_TRQ_FWO_PRINT_MAN
	Description	Enhancement TRQ Manual Print Action
Action Definition	**Action Settings**	
	Processing Time	Processing using selection report
	Processing Times Not Permitted	No Restrictions
	Schedule Automatically	X
	Changeable in Dialog	X
	Delete After Processing	[blank]
	Executable in Dialog	X
	Action Determination and Action Merging	
	Determination Technology	Determination Using Conditions that Can Be Transported
	Rule Type	Conditions Using Business Add In (BAdI)
	Action Merging	Set Highest Number of Processed Actions
Action Description		
	Description	Enhancement TRQ Manual Print Action

Action Merging	**Number of Unprocessed Actions**	
	One Unprocessed Action for each Action Definition	X
	Number of Processed Actions	
	Allow Any Number of Actions	X

To create Action Definition ZENH_TRQ_FWO_PRINT again click on button *New Entry* and enter the following data:

Tab strip	**Field**	**Value**
	Action Definition	ZENH_TRQ_FWO_PRINT
	Description	Enhancement TRQ Print Action
Action Definition	**Action Settings**	
	Processing Time	Processing when saving document
	Processing Times Not Permitted	No Restrictions
	Schedule Automatically	X
	Changeable in Dialog	X
	Delete After Processing	[blank]
	Executable in Dialog	X
	Action Determination and Action Merging	
	Determination Technology	Determination Using Conditions that Can Be Transported
	Rule Type	Conditions Using Business Add In (BAdI)
	Action Merging	Set Highest Number of Processed Actions
Action Description		
	Description	Enhancement TRQ Print Action.
Action Merging	**Number of Unprocessed Actions**	
	One Unprocessed Action for each Action Definition	X
	Number of Processed Actions	
	Allow Any Number of Actions	X

5) Double click on entry *Action Definition* in the Dialog Structure tree. You should now see the two action definitions displayed in a list. For both action definitions execute the following steps.

6) Mark an action definition in the list and double click on entry *Processing Type* in the Dialog Structure tree. Then click on button *New Entry* to create the new Processing Type for the selected action definition with the following data:

   In the list *Permitted Processing Types of Action* use the F4-Help in column *Assignment / Change Using Value Help in List* and select value *External Communication*.

7) You can now see three tab strips which allow specifying further details for the processing type. On tab strip *Document* enter the following data:

Field	**Value**
Form Name	ZENH_FP_TRQ
Form Type	PDF-Based Forms
Format	/BOFU/PPF_STANDARD
Personalization Type	Recipient-Specific Variable Replacement

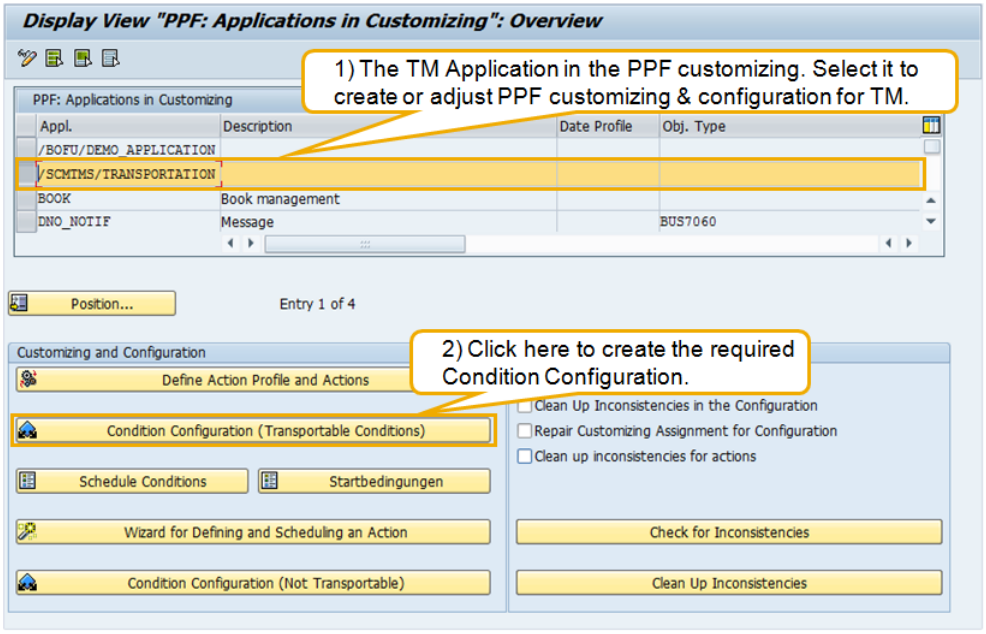
8) Double click on entry *Action Definition* in the Dialog Structure tree again to return to the list of action definitions and repeat steps 6 and 7 for the second action definition.

9) In the list of action definitions mark action definition ZENH_TRQ_FWO_PRINT as inactive (will not be used for the time being but in a future example).

10) Save your settings. The action profile and assigned actions are now configured to be used in the next configuration steps.

In the next steps we create the required condition configuration. This is done with the following steps:

1) On the first screen select application /SCMTMS/TRANSPORTATION and then click on button *Condition Configuration (Transportable Conditions)*.



Picture: Maintaining PPF Settings - Initial screen.

2) On the next screen double click on entry *Enhancement Action Profile for TRQ* (which represents the action profile that was created before) in the list on the left side. Then switch to change mode (*Ctrt+F1*).

3) Click on button Create on the right side of the action profile list. Select the listed action definitions one after the other to add them to the list. For both action definitions execute the following steps.

4) Double click on an action definition in the list on the right side. Navigate to tab strip *Schedule Condition* below the list. Use the F4-Help of field *Schedule Condition* to select the value /BOFU/EVAL_SCHEDULE_CONDITION.

   The schedule condition decides whether an action should be scheduled for processing. An action is therefore only generated if the schedule condition is met. In our example a standard default schedule condition is used. You could also create your own schedule condition here with your own logic.

5) Navigate to tab strip *Start Condition.* Use the F4-Help of field *Start Condition* to select the value /BOFU/EVAL_START_CONDITION.

The start condition is checked before the action is executed. The action is only executed when the start condition has been fulfilled. As for the schedule condition, we use a standard default start condition for the example. You could also create your own start condition here with your own logic.

6) Save your settings. The condition configuration is now complete and ready to be used in the next steps.

7.4.2 Maintaining Output Management Adapter Settings

In this step the output management adapter settings are done. These settings determine output for a given Business Object (BO) node. To finalize the example configuration execute the following steps.

1) Start customizing transaction *SPRO* and follow the path *Cross-Application Components → Reusable Objects and Functions for BOPF Environment → PPF Adapter for Output Management → Maintain Output Management Adapter Settings*.

2) On the first screen double click on entry *PPF Output Agents for BO Nodes* in the Dialog Structure tree and then click on button *New Entries*. Enter the following data:

Field	Value
Business Object	/SCMTMS/TRQ
Node	ROOT
Output Agent	ZENH_TRQ_STANDARD
Agent Class for Node	ZCL_ENH_TRQ_PPF_SERVICE
Enable	X

3) In the Dialog Structure tree double click on entry *Assign PPF Profiles* and enter the following data:

Field	Value
Action Profile	
Application for Action Profile	[blank]
Enable	X
Output Type	Has Uncritical o/p: Process after Commit (background)
Create DB Image	X

4) Save your settings.

7.4.3 Maintaining an output device/printer for your user

Open the menu path *System → User Profile → Own Data* and navigate to the tab strip *Defaults*. In section *Spool Control* enter the output device name (e.g. T818_BW) in field *Output Device* or select an existing one via the F4-Help. Also set the flag *Output Immediately*.

7.4.4 Preparing an example print document

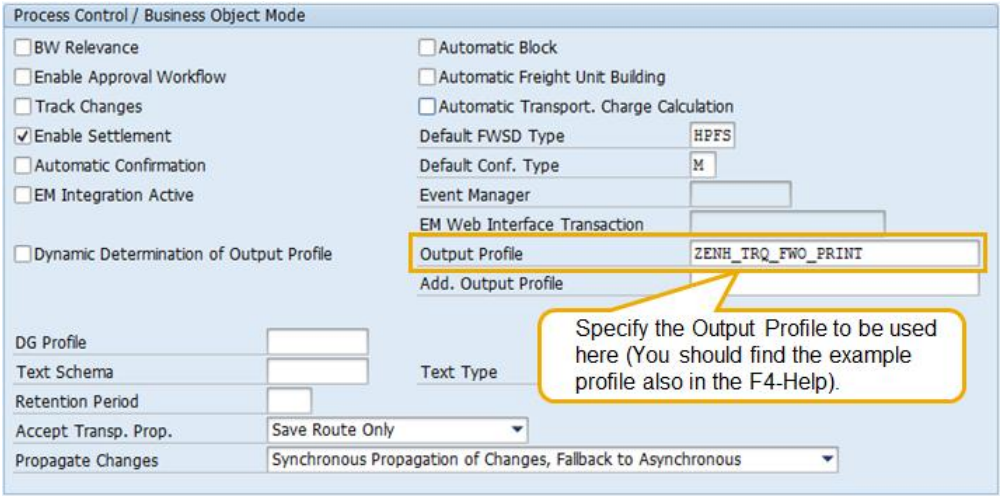
The new form is based on the BO /SCMTMS/TRQ that provides its Root node and Item node data as the content for form. For testing the new form proceed as follows:

1) Start customizing transaction *SPRO* and follow the path *SAP Transportation Management → Forwarding Order Management → Forwarding Order → Define Forwarding Order Types*.

   Switch into change mode (*Ctrl+F4*) Create a new Forwarding Order Type (click on button *New Entries*) or choose an existing one from the list.

2) In section *Process Control / Business Object Mode* on the main screen enter the output profile / action profile ZENH_TRQ_FWO_PRINT that was created in section 7.4.1, step 3.

   Any Forwarding Order that you create now with this type will now make use of this output profile with its settings and the example form.



Picture: Specifying the Output Profile in the Forwarding Order Type.

3) Maintain all other mandatory or required settings and save the Forwarding Order Type settings.

4) Create a new Forwarding Order with the corresponding Forwarding Order Type.

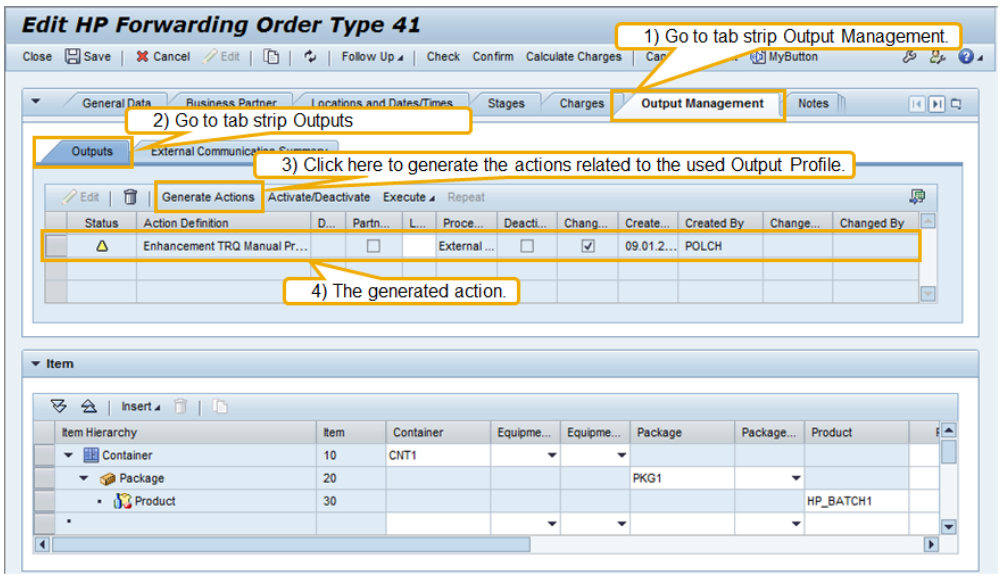
   You can do this via the TM UI in the Netweaver Business Client (NWBC) or the standalone UI triggered via the user menu path *User Menu for [user] → Forwarding Order Management → Forwarding Order → Create Forwarding Order*.

   Provide all mandatory fields on tab strip *General Data*. Define the required business partners on tab strip *Business Partner* and maintain the required location information on tab strip *Location and Dates / Times*. Moreover, maintain item data in the item list of your example document (e.g. an item hierarchy of Container, Package and Product).

5) Save the new document (*Ctrl+S*) and switch into Edit mode again (button *Edit* or *Ctrl+E*).

6) On the Forwarding Order UI go to tab strip *Output Management* and here navigate further to tab strip *Outputs*. In the tool bar click on button *Generate Actions*.

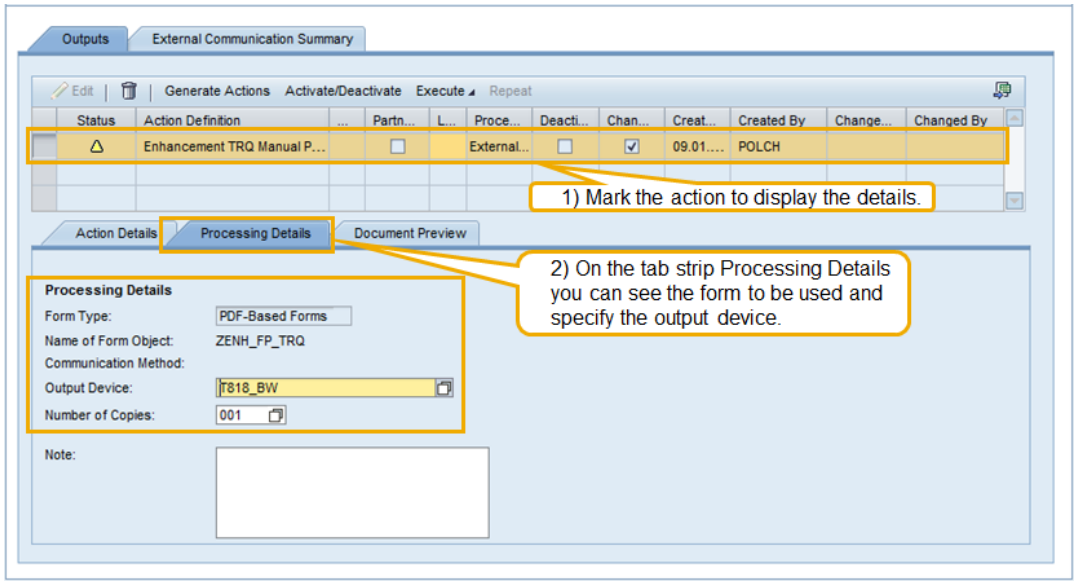
   In the list of generated actions you should now see an entry with the action definition *Enhancement TRQ Manual Print Action* that was created in the example action profile.



Picture: The generated action in an example document.

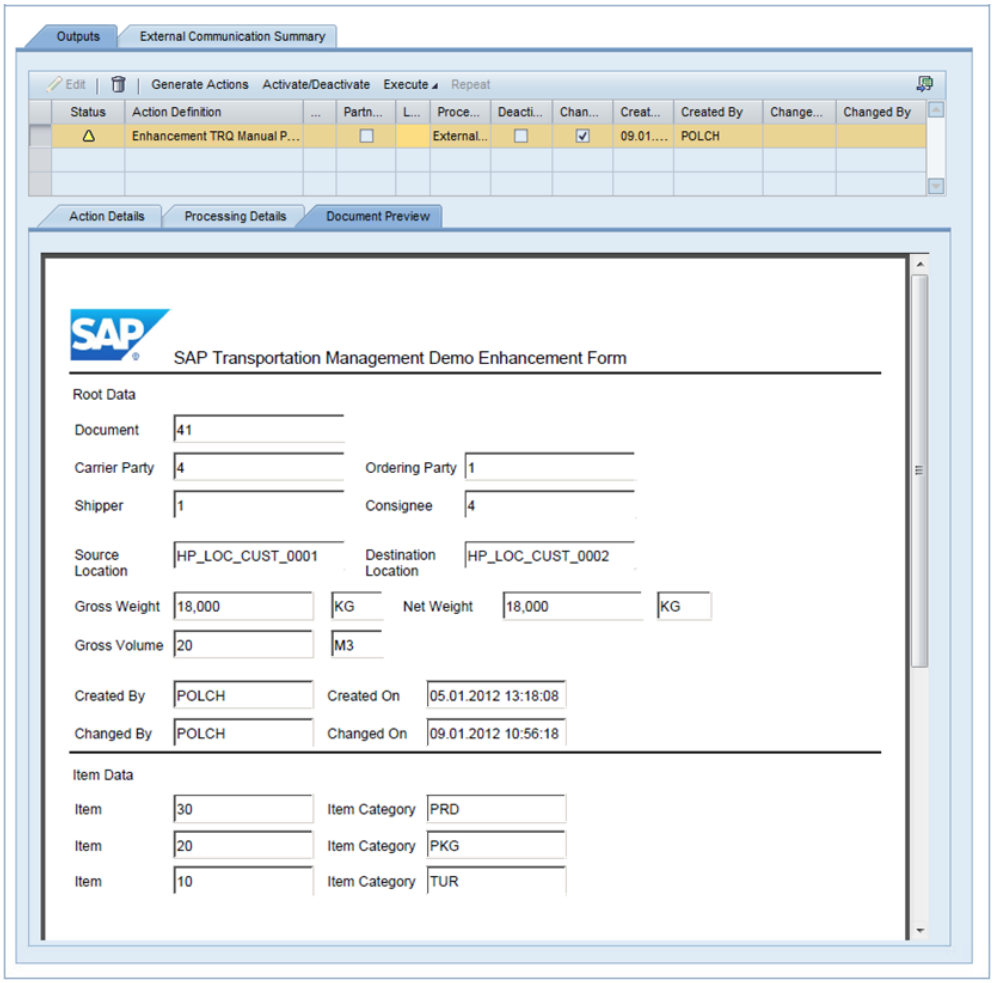
7) Mark this entry in the list. Below the list you can now see further tab strips with the details of the generated action.

   On tab strip *Processing Details* add/change the output device that shall be used for further processing (use F4-Help of field *Output Device* if not yet filled with your default printer name).



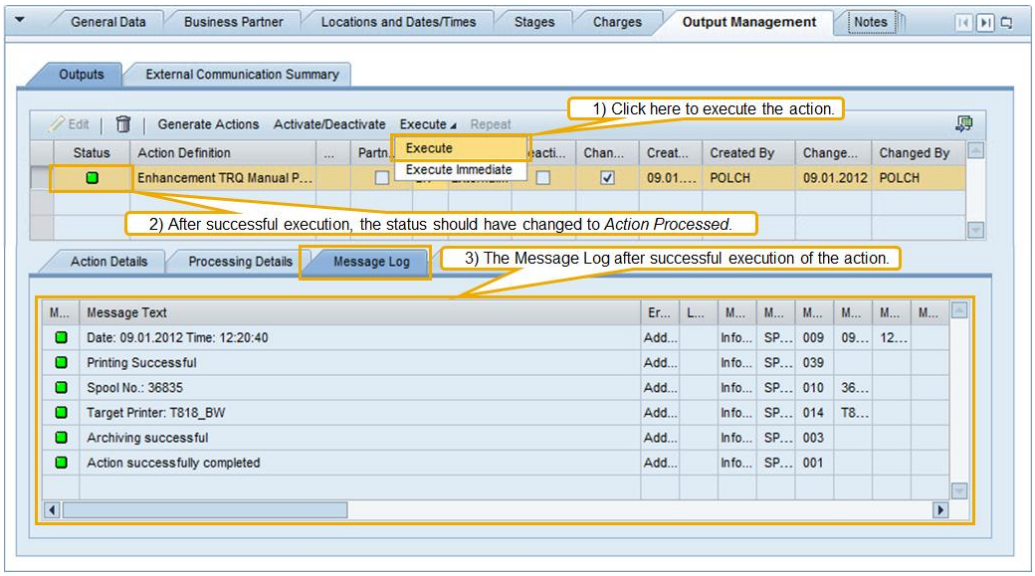
Picture: Action Definition Details.

Click on tab strip *Document Preview*. Here you can finally see the new document populated with the data of the Forwarding Order.



Picture: The new form in the document preview.

8) In the tool bar of tab strip *Outputs* click on selection button *Execute* and then choose option *Execute*. With this, the form will finally be send to the specified printing device.



Picture: Executing an action in the example document with message log.

9) In the list of actions you should now see your action in status *Action Processed* (indicated with a green light). On tab strip *Message Log* below the action list you can see the list of messages generated during the execution of the action.

8 Enhancing Services

SAP TM 8.0 uses Enterprise Services for business process integration and the integration with the outside world. This comprises A2A Services for the integration with other components and applications within an enterprise as well as B2B Services for the communication across enterprise boundaries. The standard A2A and B2B Services provided with TM are designed and implemented for the most common standard use cases, i.e. they represent the core content of related business objects.

Enhancements of Enterprise Services are required in case customers or partners have enhanced the standard TM business functionality or applications integrated with TM and want to provide these enhancements in existing services as well.

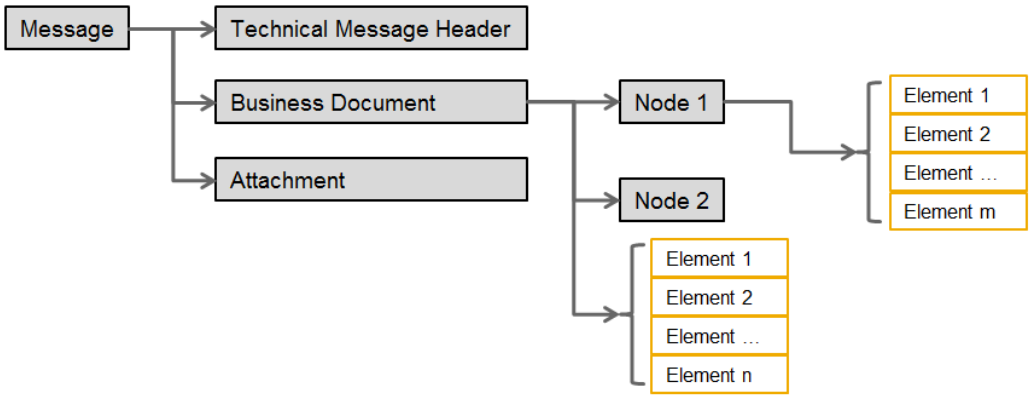
The following sections describe the necessary steps to create such service enhancements, focusing on the procedure recommended by SAP for customers and partners: **Enhancing the standard service in a new enhancement name space**.

In this approach, customers and partners define their enhancement elements in their own name spaces. These enhancements nevertheless refer to the SAP standard service.

- Every SAP Enterprise Service can be enhanced.
- Customer can communicate additional fields to the Business Partner according own business logic.
- The Enhancement Concept is modification free.
- The Enhancement structure and the backend implementation do not change by an upgrade, if the Enterprise Service does not change or changes in compatible way.
- For a new version of the Enterprise Service a new enhancement should be developed.

8.1 General remarks on Service Enhancements

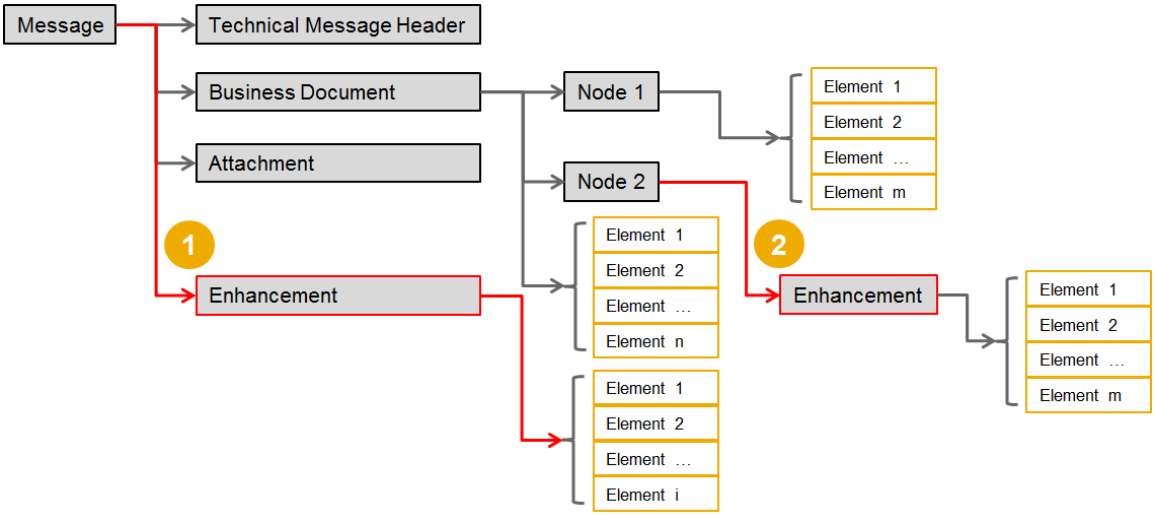
The first step is choosing the right part of the structure of the Enterprise Service to be enhanced. A service message typically contains a message header, a business document and (optionally) an attachment. The business document contains one or more nodes that again contain elements, i.e. further nodes and/or attributes (message node hierarchy). It represents the actual business related content of the message.



Picture: General structure of a message.

There are two options to enhance a message as shown in the next picture. The first one is to enhance the message data type. You can add an enhancement data type to the message data type that contains all your enhancement elements.

The second one is to enhance the Business Document structure of the message. It is the recommended approach to be used. This allows you adding your enhancement elements to a section of the Business Document data type that it semantically belongs to. Adding an additional party to a message should be done on the already existing party node in the business document structure, i.e. you add your enhancement data type to the corresponding node data type. In case your enhancement is semantically not represented in the existing nodes, you can of course create your own enhancement node within the Business Document structure.



Picture: Two options for a service enhancement.

Similar to modeling a BOPF BO, there should be as few nodes as possible and as much as necessary and it should be checked whether the enhancement information can be an attribute of an existing node rather than introducing a new node.

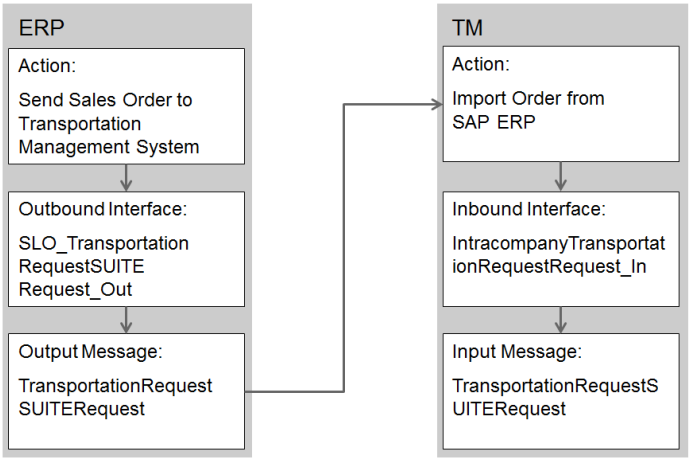
Each message is represented by a message data type that consists of subcomponents (a hierarchy of nodes and attributes) that are again represented by corresponding data types. These data types are modeled in the Enterprise Service Repository (ESR). In general any of these data types can be enhanced as long as they have an explicit ESR data type representation.

It is recommended to only enhance data types that are uniquely used in a single message as otherwise your enhancement will also be included in other messages that reuse the same data type. In case this is not possible the BAdIs for all affected messages should be implemented to make sure that all services handle your enhancement in a consistent and common way. In ESR you can create a “where-used” list of the data type to be enhanced to identify all affected places where the data type to be enhanced is reused.

8.1.1 Example Service Enhancement

As an example for a service enhancement we take a look at the Sales Order Integration scenario between ERP and TM. In this scenario, a sales order is send from an ERP system to a connected TM system where it will be transferred into a corresponding transportation request. Let’s assume there are already customer/partner specific fields added to the sales order on ERP side that now shall also be taken into consideration in the processing of the related transportation request on TM side.

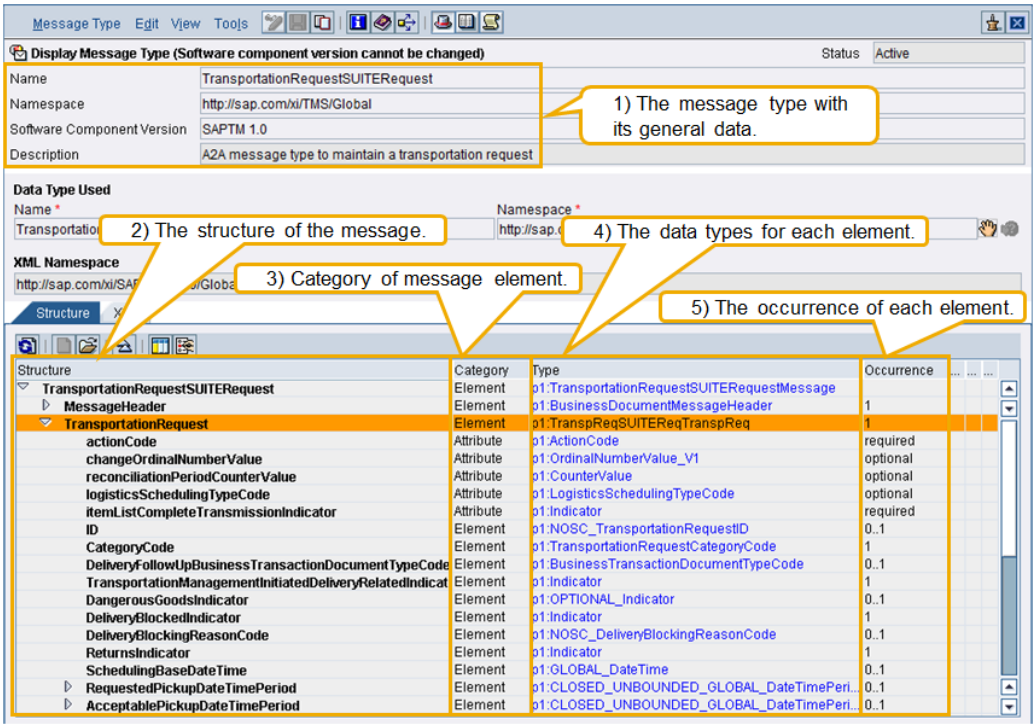
In the example, we will add a new attribute to the corresponding message that will allow transferring a Route ID from an ERP Sales Order to TM that shall be used for further processing of the resulting transportation request.



Picture: Schema of the example integration scenario.

On the sending side, the service operation (or action) *Send Sales Order to Transportation Management System* of Outbound Interface *SLO_TransportationRequestSUITERequest_Out* takes the data of a Sales Order created in ERP and puts this data into the related Output Message of type *TransportationRequestSUITERequest*.

On the receiving side, the service operation (or action) Import Order from SAP ERP of Inbound Interface *IntracompanyTransportationRequestRequest_In* receives the message and takes its data into the related Input Message of type *TransportationRequestSUITERequest*.



Picture: The message type representation in ESR.

In the above picture you can see the message type relevant for the example displayed in the ESR. The example enhancement attribute *Route* will be added as an additional direct sub element of the business document node *TransportationRequest*. The data type that specifies this node is *TranspReqSUITEReqTranspReq* which represents the header level of the business document. Placing the new attribute as a direct sub component of this level would fit from a business perspective, i.e. this fits semantically.

8.1.2 Basic steps to enhance an Enterprise Service

In general it takes the following 10 steps in three different areas to create an enhancement for an Enterprise Service. They will be described in more detail in the next sections:

Development in System Landscape Directory (SLD):

1) Create a Product and Software Component.
2) Define Dependencies between an EnSWCV and an underlying SWCV.

Development in Enterprise Service Repository (ESR):

3) Import an EnSWCV into ESR.
4) Create a Namespace in EnSWCV.
5) Create an Enhancement Data Type in the SWC.
6) Create an Enhancement Data Type for TM in the SWC.
7) Create an Enhancement Data Type for ERP (ECC) in the SWC.
8) Activate all objects.

Development in the Backend Systems:

9) Generate the Enhancement Proxy Structure in ERP (ECC) and Enhance the Outbound Program.
10) Generate the Enhancement Proxy Structure in TM and Enhance the Inbound Program.

8.2 Development in System Landscape Directory (SLD)

For the following steps logon to the PI system which is connected to your ERP and TM system and start the *Integration Builder*, transaction *SXMB_IFR*.

8.2.1 Creating a Product and Software Component

The first step is to create a non-SAP product, a product version. Choose a name that clearly identifies the enhancements to be placed here.
(To be completed in the next version).

8.2.2 Defining dependencies between EnSWCV and SWCV

(To be completed in the next version).

8.3 Development in Enterprise Service Repository (ESR)

8.3.1 Import an EnSWCV into ESR.

(To be completed in the next version).

8.3.2 Create a Namespace in EnSWCV.

(To be completed in the next version).

8.3.3 Create an Enhancement Data Type in the SWC.

(To be completed in the next version).

8.3.4 Create an Enhancement Data Type for TM in the SWC.

(To be completed in the next version).

8.3.5 Create an Enhancement Data Type for ECC in the SWC.

(To be completed in the next version).

8.3.6 Activate all objects.

(To be completed in the next version).

8.4 Development in the Backend Systems

(To be completed in the next version).

8.4.1 Enhancements in ERP (ECC)

(To be completed in the next version).

8.4.2 Enhancements in TM

(To be completed in the next version).

9 Enhancing further Objects & Functions

9.1 Transportation Charge Management Enhancements

9.1.1 Adding a new scale base

(Short summary – detailed description with examples will follow soon).

1) Extend the Scale Item structure with the required extension fields in extension include /SCMTMS/INCL_EEW_TC_SCALE_ITEM. Do the enhancements as described earlier within a new append structure and add the required extension fields there.

2) Add a new scale base in customizing.

    a. In the IMG (SPRO) follow the path Transportation management -> Basic Functions -> Charge Calculation -> Data Source Binding for Charge Calculation -> Define Scale Bases.
    b. Add a new entry and use the new field for the field assignment.
    c. Set the other properties accordingly.

3) Enhance the Scale UI: Open Web Dynpro Component configuration /SCMTMS/WDCC_TCM_SCALE_ITM (package /SCMTMS/UI) Use the Web Dynpro enhancement concept to add a new column - the new field from the scale item structure will be available here The column visibility is controlled by TCM view exit class /SCMTMS/CL_UI_VIEWEXIT_TCM, method SCALE_ITEM_PROP. No changes should be necessary.

9.1.2 Adding a new calculation base

(Short summary – detailed description with examples will follow soon).

1) Extend communication structure: Use the Extension Include for the calculation base structure /SCMTMS/INCL_EEW_TCC_CB Append a new field with the corresponding data element. The component name must be the same as on the underlying document. The field will be copied over to the internal communication structure and available in the engine automatically

2) Add calculation base in customizing In IMG go to Transportation Management - Basic Functions - Charge Calculation - Data Source Binding for Charge Calculation - Define Calculation Bases Add new entry and use the new field for the field assignment. Set scale base and other properties

3) Optionally implement BAdI or helper class
   If the calculation base needs additional logic, you can use the BAdI method GET_CALC_BASE_VALUES of BAdI /SCMTMS/TCC_BO_DATA_ACCESS . Please refer to the BAdI documentation for details. Set BAdI flag in calculation base customizing. You can also use the helper class approach, which allows you to extend existing helper classes. The interface /SCMTMS/IF_TCC_CALC_BASE is very similar to the BAdI interface. You can refer to existing helper classes /SCMTMS/CL_TCC_CB_* for sample implementations. The BAdI or helper class is called after the value has been retrieved from the communication structure if a field assignment is provided as well.

9.1.3 Adding a new resolution base

(Short summary – detailed description with examples will follow soon).

1) Adapt resolution base configuration. Add new resolution base to table /SCMTMS/C_RES_BS. This used to be customizing but is now delivered as control table. Only the resolution base name has to be maintained, all other fields are currently not used.

2) Implement logic in BAdI: The Data Access Object provides a BAdI /SCMTMS/TCC_BO_DATA_ACCESS for customer implementations which will be called in case no standard implementation for the resolution base is found. The method GET_RES_BASE_KEYS needs to be implemented. Please refer to the BAdI documentation or the standard implementation for details.

(To be completed in the next version).

9.2 Change Controller (TOR)

(To be completed in the next version).