Closed Loop Manufacturing for Teamcenter Configuration Guide
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Preface

This documentation cannot be used as a substitute for consulting advice, because it can never consider the individual business processes and configuration. Despite our best efforts it is probable that some information about functionality and coherence may be incomplete.

Issue: July 2018

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1. Introduction

The Closed Loop Manufacturing for Teamcenter (CLM4T) software solution is an integration software that provides data and process integration between Teamcenter® by Siemens Product Lifecycle Management Software Inc. and SIMATIC IT Unified Architecture Discrete Manufacturing by Siemens AG under the assumption that SAP ERP is also included to close the loop.

CLM4T provides a wide range of automatic, interactive and workflow functions to transfer and synchronize data between Teamcenter and SIMATIC IT UADM.

This document details the components of Teamcenter - SIMATIC IT UADM integration, which are available out of the box and configurable to meet customer specific solution requirements. It also describes the prerequisites for the integration of SAP ERP using the Teamcenter Gateway for SAP Business Suite.
2. CLM4T and SIMATIC IT UADM Interaction

Integration Story

While Closed Loop Manufacturing for Teamcenter (CLM4T) mainly covers the integration of Teamcenter with SIMATIC IT UADM, the integration story makes most sense when also including the ERP system. In this document, we assume SAP Business Suite® is used as the ERP system, and the Teamcenter Gateway for SAP Business Suite is used for the integration between Teamcenter and SAP Business Suite®. CLM4T can be used with other ERP systems and integration solution, though. Note that CLM4T does not cover shop floor automation.

The sample scenario assumes a structure with unit or date effectivity applied to the BOP and/or the BOM. This results in a configurable structure in Teamcenter containing more components than necessary to produce a single item. This is called a 150% structure or in the context of MES: a master plan. A configured structure contains only those components necessary to produce a single specific unit and is called a 100% structure. In the context of MES, a pure 100% structure without detailed master data of the components is called a skeleton.

This chapter will explain the overall integration scenario, which consists of three "closed loops" (business use cases spanning two or three systems).

Closed Loop 1

This closed loop handles initial masterplan (150% unconfigured components) and skeleton transfers (100% configured structures) and supplies SIMATIC IT UADM with the necessary data to execute an order.
1. The Teamcenter engineer prepares and verifies the Bill Of Process (BOP), the Bill Of Materials (BOM) and the Bill Of Resources in Teamcenter Manufacturing Process Planner (MPP). This step is not covered in this manual as it is not related to integration. For further help on MPP, please consult the Teamcenter manuals. Please note that there are some restrictions and requirements the authored data must conform to in order to support the CLM4T scenario. These will be explained in the proceeding chapters.

2. The Teamcenter engineer (or another Teamcenter user) releases the components of the master plan (master data like e.g. Material, Process, Operation, etc.) from Teamcenter to the target ERP and MES systems. Structures, relations and configurations are not relevant in this step. Instead, it only cares about the building blocks of the unconfigured structures (150%).

3. The Teamcenter engineer (or another Teamcenter user) releases one or several configured structures (100% BOM and BOP, the "skeleton") from Teamcenter to SAP. This step assumes that all necessary components of the structures have already been transferred in the previous step.

4. The SAP operator creates and releases an SAP Production Order to MES, using the business objects created in the previous SAP releases. The MES system SIMATIC IT UADM then automatically triggers the download of the configured production structure (100 % BOP) from Teamcenter.
The sequence of the steps is not strictly required. For example, the transfers to SIMATIC IT UADM and SAP can easily be split and executed at different points in time and by different operators. Also, transfers may be repeated, e.g. if data errors have been corrected. The only restriction is that all components of a structure must be known in the target system before the structures can be transferred.

Now that all necessary data is available in MES, the SIMATIC IT UADM operator can start the execution of the WorkOrder. The execution itself is not covered in this manual as it is not part of the integration. For details see the manuals of SIMATIC IT Unified Architecture Discrete Manufacturing. The non-conformance loop is also part of the execution and includes integration-relevant transfers and is covered in the next section (Closed Loop 2). Finishing the WorkOrder is covered in the last section of this chapter (Closed Loop 3).

**Closed Loop 2**

In case a non-conformance is detected during order execution in SIMATIC IT UADM that needs to be escalated to product development (engineering, i.e. the PLM system Teamcenter), CLM4T support the automatic synchronization of a change object in Teamcenter.

1. A SIMATIC IT UADM operator executes the WorkOrder on the shop floor.
2. The SIMATIC IT UADM operator creates a Non-Conformance Notification (NCN) during WorkOrder execution. Based on some decision logic in SIMATIC IT UADM the NCN can be escalated to engineering (Teamcenter).

3. If the non-conformance is escalated, SIMATIC IT UADM automatically triggers the creation of a specific problem report object in Teamcenter. Teamcenter will automatically retrieve details on the NCN and populate the ProblemReport with that data. In SIMATIC IT UADM the status of the non-conformance will be updated.

4. The SIMATIC IT UADM operator can verify NCN status.

5. A Teamcenter engineer will be notified of the new problem report and can verify it.

6. The Teamcenter engineer can view live data of the SIMATIC IT UADM WorkOrder in the CLM4T data view in Teamcenter and start appropriate actions to correct engineering data (not requiring integration).

When the corrections are completed, changed data must be updated in SAP and SIMATIC IT UADM. That essentially means to repeat some of the steps from the previous section.

Closed Loop 3

This closed loop covers finishing the SIMATIC IT UADM WorkOrder and the order confirmation back to SAP Business Suite®.
1. When the SIMATIC IT UADM worker is completed, SIMATIC IT UADM will automatically confirm the production order in SAP Business Suite®.

2. The SAP operator can now finalize the production order and e.g. verify or correct goods movements. This is an SAP internal process and requires no CLM integration.

3. The Teamcenter engineer can view live data of the SIMATIC IT UADM WorkOrder and the SAP production order and its components in the CLM4T and T4S data views in Teamcenter.
3. Basic Configuration

Merge T4S Mapping

In case you want to use T4S to provide integration from PLM (Teamcenter) to ERP (SAP), you must adapt your T4S mapping. CLM4T provides a sample mapping for T4S. In the simplest use case, when there is no custom T4S mapping (only the OOTB T4S demo mapping), you can just delete any existing directory `<T4x GS_ROOT>/var/mmap/t4s_mapping_config` and its content and then copy the CLM4T sample mapping directory `<T4x GS_ROOT>/var/template/clm4t/mmap/t4s_mapping_config` to `<T4x GS_ROOT>/var/mmap`. If there is a custom mapping you want to keep, you will have to merge the existing `t4s_mapping_config` with the CLM4T sample mapping.

Add T4x Job Agent

For some external events, CLM4T needs to execute jobs in the background (e.g. incoming web services from MES or ERP, SAP Z-Table events, long-running transfer workflows). Therefore the CLM4T GS instance(s) need to be configured to have at least one job agent. For details on job agent creation, see chapter T4x Agent configuration in the Teamcenter Gateway - Generic Configuration Guide. Configuring at least one job agent is necessary for the demo scenario to work.

Import Orders by Schedule

To automatically import production orders from SAP, CLM4T needs to repeatedly check the so-called SAP Z-table and start import jobs if orders are available. For details on how to configure this scheduled import, see Scheduled Triggers in the Teamcenter Gateway - Generic Configuration Guide. The Z-table only gets filled with entries about new or changed orders, if a specific user exit is applied to the SAP configuration, see Teamcenter Gateway for SAP Business Suite - SAP Business Suite Preparation Guide

Mapping Templates and Preferences

Please refer to Generic Preference Concept and Generic Mapping Concept in the Teamcenter Gateway - Generic Configuration Guide to read more about how to configure preferences in Teamcenter and mapping in T4x.

CLM4T supports different Bill of Process (BOP) structures created differently in Teamcenter (see Supported BOP Structures for details) while providing a single set of mapping files and workflows. To make this possible CLM4T provides a way to make the mapping for the master plan (150% components, no structure) more flexible by separating the different levels of the BOP. Each level has its own mapping file. There is a second level mapping covering the level of the SIMATIC IT operations and a third level mapping file covering SIMATIC IT steps.

The master plan transfer (150% components, no structure) evaluates master data of the components, but for certain reasons it is useful to evaluate specific structures also: In Teamcenter assignments of
DataCollections to an operation or step have to be made in context of a structure (occurrences) while SIMATIC IT UADM assumes data points are related to operations or steps independent of a structure. In order to evaluate the correct data collections CLM4T evaluates the object to extract master data (e.g. for operations and steps), and in a separate transfer task in the workflow it also evaluates the structure below operations and steps to transfer master data of data collections and relate them to their parent.

**Supported BOP Structures**

The OOTB CLM4T demo scenario supports 3 Teamcenter BOP structure types. Each BOP type consists of three levels that correspond directly to the SIMATIC IT objects Process, Operation, and Step. The following table shows the possible combinations:

<table>
<thead>
<tr>
<th>SIMATIC IT level</th>
<th>Classic BOP</th>
<th>Compound BOP</th>
<th>Plant BOP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teamcenter Type</td>
<td>TargetTypeName</td>
<td>Teamcenter Type</td>
</tr>
<tr>
<td>Process (level 1)</td>
<td>MEProcess</td>
<td>Process</td>
<td>MEProcess</td>
</tr>
<tr>
<td>Operation (level 2)</td>
<td>MEOp</td>
<td>Operation</td>
<td>MfgOMECompOP</td>
</tr>
<tr>
<td>Step (level 3)</td>
<td>MEActivity, MENCProgram or MENCToolActivity</td>
<td>implicitly handled by Operation</td>
<td>MfgOMEStep</td>
</tr>
</tbody>
</table>

Explanations:

- In the interest of shortness, the table shows the Teamcenter item type names. However, the target of an actual transfer and the name used in the preference definition must be the corresponding revision type.

- TargetTypeName is the name used in CLM4T workflow handlers and preferences in Teamcenter that identifies a certain type of transfer. Note that you have to use a specific type for certain PlantBOP transfers.

- Most CLM4T demo workflow templates delegate workflow execution to the T4x job engine, so the interactive user's Teamcenter session is not blocked. In the OOTB configuration, the job engine uses the Teamcenter user “t4xbatch” to execute the tasks. In case of an error, the workflow is routed to an interactive “Do” task that will pop up in the Teamcenter Inbox of user "engineer", who is intended to fix data errors and then complete the workflow.

- The CLM4T demo workflow templates CLM_Release_150PerCent_StandaloneObjects and CLM_Release_150PerCent_StandaloneObjects_PlantBOP can be used on all components of a complete BOP. They consist of several tasks specific to certain parts of the BOP. It will pick the relevant parts in the corresponding tasks and ignore the irrelevant targets. This way you can select all components of an expanded BOP in Manufacturing Process Planner and start the workflow on it. In case of data errors in the workflow, do not abort the whole workflow instance and restart, but instead, correct the error in the data and then complete the previously failed task or the corresponding "Do" task.
• Classic BOP and compound BOP can be mixed, i.e. on the second level of the BOP under an MEProcess you may use MEOps (with or without Activities) and Mfg0MECompOPs in parallel.

• Teamcenter Activities do not have a specific TargetTypeName for the transfer. Instead, they are transferred together with the operation (MEOp) they are attached to.

Caution:

• The CLM4T demo scenario as provided in the demo mapping and the "t4clm" demo template, including Teamcenter data types, workflow templates, preferences, users, etc. is only meant as a sample configuration and must not be applied to productive environments. Instead, it is necessary to analyze customers needs and processes and create a customer specific configuration depending only on the base template "sit0gateway".

• While SIMATIC IT supports several levels of Processes, The CLM4T demo supports only a single process level. To transfer a multi-level process BOP, transfer all the process "leafs" separately.

• The interpretation of an MEOp object is different depending on the structure type you are working in: For a classic or a Compound BOP a Teamcenter MEOp translates to a SIMATIC IT Operation, whereas for a PlantBOP a Teamcenter MEOp translates to a SIMATIC IT Step. For the master plan (150% no structure transfer) there are two different Teamcenter workflow templates that take care of this difference. This is the reason why you can’t mix a PlantBOP structure with the other two types. All other actions (100% transfer) are identical.

• The top-level Process in all structure types has to have a single product structure assigned via the GRM relation "Mfg Targets" and a single top-level work area with GRM relation "IMAN MEWork area", else a later request to create a Teamcenter CollaborationContext object or a configuration request from SIMATIC IT UADM will fail.

Configurable URL for SIMATIC IT UADM

In <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config.sd you should configure the URL to access SIMATIC IT UADM services. There is a piece of template code included, which you can adapt:

```
set RootConnectString http://<nameOrIPofSITUAServer>/sit-svc
set ConnectString [dict create \n  BaseURL    "${RootConnectString}" \n  ODATAApplication /Application/AppU4DM/odata" \n  ODATARuntime  "/runtime/AppU4DM/odata/File" \n  TokenExecutable [rcwd]/lib/token/getToken.exe" \n  TokenAppName  T4CLMIntegration \n  TokenExpiresInSeconds 720]
```

Replace <nameOrIPofSITUAServer> in the first line with the actual hostname of your SIMATIC IT UADM server. Consult the administrator if necessary for any further adaptions on the URL. The next line adds additional information to that URL. Usually, you will not need to modify these settings, as any OOTB SIMATIC IT UADM installation will use the same values.
<table>
<thead>
<tr>
<th><strong>BaseURL:</strong></th>
<th>Identical to the previously configured RootConnectString.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ODATAApplication:</strong></td>
<td>the URL extension to be appended to the BaseURL in order to address the service layer when invoking SIMATIC IT UADM commands.</td>
</tr>
<tr>
<td><strong>ODATARuntime:</strong></td>
<td>the URL extension to be appended to the BaseURL in order to read data from SIMATIC IT UADM via ODATA queries.</td>
</tr>
<tr>
<td><strong>TokenExecutable:</strong></td>
<td>the configured binary path is executed whenever CLM4T needs to extract a token from the certificate. The token is necessary in order to authenticate against the SIMATIC IT UADM server. For details on the certificate, see Install Certificate. The default value refers to a Windows binary delivered with CLM4T. The binary must take one parameter (the TokenAppName) and return the corresponding token on the standard output.</td>
</tr>
<tr>
<td><strong>TokenAppName:</strong></td>
<td>A name used during extraction of the token from the certificate.</td>
</tr>
<tr>
<td><strong>TokenExpiresInSeconds:</strong></td>
<td>This parameter determines the validity period of the created token as configured on the server (CLM4T requests a new token after this period).</td>
</tr>
</tbody>
</table>

The configured ConnectString variable is then used in calls like ::CLM4T::CONNECTION2EA::setConnectionInfoPlain to build a named connection that is used in RAC or in the mappings in order to address a specific SIMATIC IT UADM system. Several connections, allows addressing different SIMATIC IT UADM systems if required. Note however that incoming calls will always assume the "preferred" SIMATIC IT UADM connection (as defined by ::CLM4T::CONNECTION2EA::selectActiveConnection2EA) to be active, and currently the OOTB mapping does not support any diversification for incoming calls and the transfers triggered by them. The OOTB mapping configures only a single connection.

### Install Certificate

SIMATIC IT UADM uses 2-legged OAuth 2.0 for authentication. This mechanism does not require the user to enter any credentials, but instead, the host running the service (each CLM4T GS host in our case) and the SIMATIC IT UADM must have the identical certificate installed in the system's certificate store. Usually, this certificate is created and provided by the SIMATIC IT UADM administrator. On Windows, such a certificate is a file with the extension .pfx. Usually, when double clicking it, Windows will open a wizard to import it into the local machines certificate store. The wizard may ask for a password, which should be provided by the administrator who created the certificate. Usually, the default settings for the wizard will work well, and you should leave them unchanged unless the creator of the certificate tells you to.

The Chapter Configurable URL for UADM describes how to configure CLM4T to use the imported certificate. For more details on certificate handling, consult the SIMATIC IT UADM manuals.

### The File clm4t_mapping_config.sd

The file clm4t_mapping_config.sd in the directory `<GS_ROOT>\var\mmap\clm4t_mapping_config` is the first configuration file of the CLM4T software that is read by each TCL worker thread or process. It loads
the rest of the mapping files and may contain basic settings as well as variables which are supposed to be used in more than one mapping file.

The following basic settings can be configured in $\textit{clm4t\_mapping\_config.sd}$:

- System login data, see chapter \textit{Configurable URL for UADM}

- '::ITK::setConnectionParameter' allows to set the Teamcenter connection parameters.

- '::CLM4T::CONNECTION2EA::selectActiveConnection2EA, '::CLM4T::CONNECTION2EA::readConnectionInfo4Session' and '::CLM4T::CONNECTION2EA::setConnectionInfoPlain' are used to setup the connection(s) to SIMATIC IT Unified Architecture Discrete Manufacturing (SIMATIC IT UADM). You can specify the connection URL which CLM4T uses, and set a default connection to use, if no other connection has been specified, e.g. in the workflow. The only implemented authentication method for SIMATIC IT UADM is 2-legged OAuth2 (see \textit{Install Certificate} for details).

- Sourcing of mapping files with \texttt{source -relax}.
  
  Example: \texttt{source -relax clm4t\_object\_mapping.sd}. This means CLM4T has to read the content of the file $\textit{clm4t\_object\_mapping.sd}$. The argument \texttt{-relax} means the file is looked up in the memory first and only if its content is not there, the file is loaded from disc (only in the same directory $\texttt{<GS\_ROOT>\var\mmap\clm4t\_mapping\_config}$).

  In principle, the file names may be modified freely as long as the file extension .\texttt{sd} is kept. Every file stated there that has the file extension .\texttt{sd} is actually used for the mapping functionality. In fact the only file CLM4T actually uses for the mapping is the compiled mapping file $\textit{clm4t\_mapping\_config.rfdt}$.

  So this is what you need to think about in order to create the compiled mapping file correctly.

  In order to not use, a mapping file it is enough to not "source" it in $\textit{clm4t\_mapping\_config.sd}$. However, we strongly recommend keeping only those mapping files in the \texttt{mmap} directory that you really want to use!

  Be sure to have the correct file names (the files located in $\texttt{<GS\_ROOT>\var\mmap\clm4t\_mapping\_config}$) in the "source" section of this file.

- The code starting with \texttt{set overlay...} is only relevant in SPLM-internal development and testing environments and will not become active in any custom environment, so that it can be ignored.

### The File $\textit{mom4s\_mapping\_config.sd}$

The file $\textit{mom4s\_mapping\_config.sd}$ in the directory $\texttt{<GS\_ROOT>\var\mmap\mom4s\_mapping\_config}$ is the first configuration file of the CLM4T software that is read by each TCL worker thread or process. It loads the rest of the mapping files and may contain basic settings as well as variables which are supposed to be used in more than one mapping file.

The following basic settings can be configured in $\textit{mom4s\_mapping\_config.sd}$:

- Sourcing of mapping files with \texttt{source -relax}: 

---

• By default, set ::MOM4S::IDMAPPING::Implementation ::MOM4S::JDBC::SQLSERVER enables the using of MS SQL Server database to store the mapping keys

• Setting of connection data and concatenating to the MS SQL Server database connection string

```plaintext
set dbPassword      dba
set dbUser          domain\dba
set dbServerHost    192.168.1.100:1433
set database        clm4t
set connUrl         "jdbc:sqlserver://${dbServerHost}\;DatabaseName=${database}\;integratedSecurity=true;"
```

• The code starting with set overlay... is only relevant in SPLM-internal development and testing environments and will not become active in any custom environment, so that it can be ignored.

### Teamcenter SAP ID Mapping

In order to synchronize data over all three systems PLM, ERP and MES, you must make sure to uniquely identify objects when transferring them. In our scenario, Teamcenter is the leading system for material IDs, routing IDs, BOM IDs and others. SAP Business Suite® consumes some of these IDs and creates new artifacts, e.g. orders. SIMATIC IT UADM consumes data from both other systems and must keep track of identities. The Teamcenter and SIMATIC IT UADM data models are easily adaptable to store identification and reference information. It has proven more difficult to adapt ERP data models and so we need to keep track of the mapping of ERP identifiers to PLM identifiers and vice versa. Although Teamcenter implicitly stores all these mappings (e.g. for materials it can store the SAP material master ID on the revision), CLM4T uses separate storage to externalize this information. The implementation of this storage can change.

In the demo scenario, a configurable MSSQL server database is used to store the ID mappings. The parameters have to be adapted in `<T4x_GS_ROOT>/mom4s_mapping_config/mom4s_mapping_config.sd` in the following segment:

```plaintext
set dbPassword      dba
set dbUser          domain\dba
set dbServerHost    192.168.1.100:1433
set database        clm4t
set connUrl         "jdbc:sqlserver://${dbServerHost}\;DatabaseName=${database}\;integratedSecurity=true;"
```

```plaintext
set ::MOM4S_Defaults(EASystem)          SQLServer
set ::MOM4S_Defaults(EAConnectString)   $connUrl
set ::MOM4S_Defaults(EALanguage)        ""
set ::MOM4S_Defaults(EAUser)            $dbUser
set ::MOM4S_Defaults(EAPassword)        $dbPassword
```

The database must have three columns, all are of string type:
denotes the context of the mapping. Valid contexts are defined and explained in
<T4x_GS_ROOT>/mom4s_mapping_config/mom4s_idmapping.sd.

FIELD This is the "key" identifier. Depending on the context, it can be a Teamcenter identifier
(UID), an SAP identifier or a combined key.

VALUE This is the mapped value for the given key in the given context.

Other implementations can easily be added as long as the interface described in <T4x_GS_ROOT>/
mom4s_mapping_config/mom4s_idmapping.sd is fulfilled.
4. 150 Percent BOP Components

SIMATIC IT UADM Material Definition

Create SIMATIC IT UADM Material Definition

Maintain SIMATIC IT UADM Material Definition Fields

Create and Associate Document to SIMATIC IT UADM Material Definition

Create SIMATIC IT UADM Material Definition

The capability to create a Material Definition in SIMATIC IT UADM based on ItemRevision or PartRevision released from Teamcenter. The Material Definition transaction uses the ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatObject dictionary (see table below for detailed specification). The dictionary key MaterialList::dicts has a list of single dictionaries ItemDict. Each of the ItemDict contains the fields mapping based on the T4x approach using preferences and mapping by calling ::T4X::TC::MAPPING::FieldMapping. To learn more about mapping by invoking perform function have a look at the performTransfer in <GS_root>/var/mmap/clm4t_mapping_config/clm4t_material_mapping.sd.

<table>
<thead>
<tr>
<th>Key</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaterialList::dicts</td>
<td>PLMCreateMaterialDefinitionList</td>
</tr>
</tbody>
</table>

Maintain SIMATIC IT UADM Material Definition Fields

The maintained fields are the keys of the ItemDict. Go to the TC_Object2MES_Object procedure in <GS_root>/var/mmap/clm4t_mapping_config/clm4t_material_mapping.sd to get more details. Note that the same procedure populates the DocumentList::dicts used to create Documents and DocumentAssociationList::dicts used to associate the given DocumentList::dicts to the Material Definition in SIMATIC IT UADM.

Create and Associate Document to SIMATIC IT UADM Material Definition

The capability to transfer and associate Document to SIMATIC IT UADM Material Definition is based on the document linked to the ItemRevision or PartRevision. Please refer to Create and Associate SIMATIC IT UADM Document for details.

The performTransfer for the associating the document will be called using PLMAssociateDocumentToToolDefinitionList command in SIMATIC IT UADM.
SIMATIC IT UADM Tool Definition

Create SIMATIC IT UADM Tool Definition

Maintain SIMATIC IT UADM Tool Definition Fields

Create and Associate Document to SIMATIC IT UADM Tool Definition

Create SIMATIC IT UADM Tool Definition

The capability to create a Tool Definition in SIMATIC IT UADM is e.g. based on Mfg0MEEquipmentRevision or MfgOMEResourceRevision release from Teamcenter. The Tool Definition transaction makes use of the ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatObject dictionary (see table below for detailed specification). The dictionary key ToolList:dicts has a list of single dictionaries ItemDict. Each of the ItemDict contains the fields mapping based on the T4x approach using preferences and mapping by calling ::T4X::TC::MAPPING::FieldMapping. Please also refer to Mapping Templates and Preferences for more details about how to configure preferences in Teamcenter and mapping in T4x.

To learn more about mapping by invoking perform function have a look at the performTransfer in <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_tool_mapping.sd.

<table>
<thead>
<tr>
<th>Key</th>
<th>Command name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToolList:dicts</td>
<td>PLMCreateToolDefinitionList</td>
</tr>
</tbody>
</table>

Maintain SIMATIC IT UADMTool Definition Fields

The maintained fields are the keys of the ItemDict. Go to the TC_Object2MES_Object procedure in <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_tool_mapping.sd to get more details. Note that the same procedure populates the DocumentList:dicts used to create Documents and DocumentAssociationList:dicts used to associate the given DocumentList:dicts to the Tool Definition in SIMATIC IT UADM.

Create and Associate Document to SIMATIC IT UADM Tool Definition

The capability to transfer and associate Document to SIMATIC IT UADM Tool Definition is based on the document linked to the corresponding object ItemRevision or PartRevision. Please refer to Create and Associate SIMATIC IT UADM Document for details.

The performTransfer for the associating the document will be called using PLMAssociateDocumentToMaterialDefinitionList command in SIMATIC IT UADM.
SIMATIC IT UADM Process

Create SIMATIC IT UADM Process

Maintain SIMATIC IT UADM Process

Create SIMATIC IT UADM Process

The capability to create a Process in SIMATIC IT UADM is based on MEProcessRevision, Mfg0MEPlantBOPRevision or Mfg0MEProcLineRevision release from Teamcenter. The transaction makes use of the ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatObject dictionary (see table below for detailed specification). The dictionary key ProcessList:dicts has a list of single dictionaries ItemDict. Each of the ItemDict contains the fields mapping based on the T4x approach using preferences and mapping by calling ::T4X::TC::MAPPING::FieldMapping. Please also refer to Mapping Templates and Preferences for more details about how to configure preferences in Teamcenter and mapping in T4x.

Please note that by default, function validateProcess will verify the Bill of Process (BOP) structure using preconfigured ::CLM4T::CONFIGURATION::PlantList and ::CLM4T::CONFIGURATION::PlantList.

To learn more about perform function have a look at the performTransfer in <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_process_mapping.sd.

<table>
<thead>
<tr>
<th>Key</th>
<th>Command name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProcessList:dicts</td>
<td>PLMCreateProcessList</td>
</tr>
</tbody>
</table>

Maintain SIMATIC IT UADM Process

The maintained fields are the keys of the ItemDict. You can configure the the fields in the TC_Object2MES_Object procedure in <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_process_mapping.sd.

SIMATIC IT UADM Operation

Create SIMATIC IT UADM Operation

Maintain SIMATIC IT UADM Operation Fields

Create and Associate Document to SIMATIC IT UADM Operation
Create SIMATIC IT UADM Operation

The capability to create an Operation in SIMATIC IT UADM is based on the MEOPRevision in the case of classic BOP structure, Mfg0MECompOPRevision in the case of compound BOP structure or Mfg0MEProcStatnRevision in the case plant BOP release from Teamcenter. The transaction makes use of the ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatObject dictionary (see table below for detailed specification). The dictionary key `OperationList::dicts` has a list of single dictionaries `ItemDict`. Each of the `ItemDict` contains the fields mapping based on the T4x approach using preferences and mapping by calling ::T4X::TC::MAPPING::FieldMapping. Please also refer to Mapping Templates and Preferences for more details about how to configure preferences in Teamcenter and mapping in T4x.

The preferences are organized in two sets and shipped by demo template. One set of the preferences has `CLM4T_Operation*` at the beginning and is defined for the classic and compound BOP structure. Another set of the preferences, containing `CLML_PlantBOPOperation*` is the configuration for the corresponding object Mfg0MEProcStatnRevision (for plant BOP).

Caution:

No structure transfer for the plant BOP Operation supported, because Mfg0MEProcStatnRevision does not support Data Collection Definitions (DCD).

In the demo configuration, the second level objects of the plant BOP structure do not support DCD attachments.

<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_operation_mapping.sd operates as capsule and handle different corresponding objects in Teamcenter depending on the chosen kind of the BOP structure.

<table>
<thead>
<tr>
<th>Key</th>
<th>Command name</th>
</tr>
</thead>
<tbody>
<tr>
<td>StepList::dicts</td>
<td>PLMCreateOperationList</td>
</tr>
</tbody>
</table>

Maintain SIMATIC IT UADM Operation Fields

The maintained fields are the keys of the `ItemDict`. To find this dictionary follow the `TC_Object2MES_Object` procedure in the <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_operation_mapping.sd. Depending on the Teamcenter BOP structure type the `TC_Object2MES_Object` procedure executes the ::CLM4T::GENBOM::CUSTOM::MAPPING::SECONDLEVEL::TC_Object2MES_Object or the ::CLM4T::GENOBJ::CUSTOM::MAPPING::SECONDLEVEL::TC_Object2MES_Object function call. Please go to the <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_bom_second_level_mapping.sd or <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_second_level_mapping.sd, to find the `ItemDict` that you can use to change the current field mapping or add the additional fields.
Create and Associate Document to SIMATIC IT UADM Operation

The capability to transfer and associate Document to SIMATIC IT UADM Operation is based on the document linked to the corresponding object, please refer to Create SIMATIC IT UADM Operation for supported Teamcenter objects. Read about Create and Associate SIMATIC IT UADM Document to learn how the generic configuration for the Document SIMATIC IT UADM transfer looks like.

The performTransfer for the associating the document will be called using PLMAssociateDocumentToOperationList command in SIMATIC IT UADM.

SIMATIC IT UADM Step

Create SIMATIC IT UADM Step

Maintain SIMATIC IT UADM Step Fields

Create and Associate Document to SIMATIC IT UADM Step

Create SIMATIC IT UADM Step

The capability to create a Step in SIMATIC IT UADM is based on Mfg0MEStepRevision in the case of compound BOP structure, MEOPRevision in case of plant BOP or MEActivity in case of classic BOP structure release from Teamcenter. The transaction makes use of the ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatSteps by classic BOP structure or ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatObject dictionary (see table below for detailed specification). The dictionary key StepList:dicts has a list of single dictionaries ItemDict. Each of the ItemDict contains the fields mapping based on the T4x approach using preferences and mapping by calling ::T4X::TC::MAPPING::FieldMapping. Please also refer to Mapping Templates and Preferences for more details about how to configure preferences in Teamcenter and mapping in T4x.

The preferences are organized in two sets and shipped by demo template. One set of the preferences has CLM4T Step* at the beginning and is defined for the Mfg0MEStepRevision. Another set of the preferences, with CLML PlantBOPStep*, is the configuration for the MEOPRevision (for plant BOP). There is no need to set the preferences for the MEActivity in Teamcenter.

<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_step_mapping.sd operates as a wrapper and handles different corresponding objects in Teamcenter depending on the chosen kind of the BOP structure.

<table>
<thead>
<tr>
<th>Key</th>
<th>Command name</th>
</tr>
</thead>
<tbody>
<tr>
<td>StepList:dicts</td>
<td>PLMCreateStepList</td>
</tr>
</tbody>
</table>
Maintain SIMATIC IT UADM Step Fields

The maintained fields are the keys of the ItemDict. To find this dictionary follow the TC_Object2MES_Object procedure in the <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_step_mapping.sd. Depending on the Teamcenter BOP structure type the TC_Object2MES_Object procedure executes the ::CLM4T::GENBOM::CUSTOM::MAPPING::THIRDLEVEL::TC_Object2MES_Object or the ::CLM4T::GENOBJ::CUSTOM::MAPPING::THIRDLEVEL::TC_Object2MES_Object function call. Please go to the <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_bom_third_level_mapping.sd or <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_third_level_mapping.sd, accordingly to find the ItemDict that you can use to change the current field mapping or add the additional fields.

Create and Associate Document to SIMATIC IT UADM Step

The capability to transfer and associate Document to SIMATIC IT UADM Step is based on the document linked to the corresponding object, please refer to Create SIMATIC IT UADM Step for supported Teamcenter objects. Read about Create and Associate SIMATIC IT UADM Document to learn how the generic configuration for the Document SIMATIC IT UADM transfer looks like.

Caution:
The capability to transfer and associate Document to SIMATIC IT UADM Step for MEActivity as a corresponding is not supported.

The performTransfer for the associating the document will be called using PLMAssociateDocumentToStepList command in SIMATIC IT UADM.

SIMATIC IT UADM Data Collection Definition

By default, if an Operation or a Step corresponding object in Teamcenter has a Data Collection Definition (DCD), CLM4T creates and associates the a DCD in the SIMATIC IT UADM. It is done by populating the dictionaries for the Teamcenter Operation as follows:

<table>
<thead>
<tr>
<th>Dictionary</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>::CLM4T::GENBOM::CUSTOM::MAPPING::MESInputDatDCDs</td>
<td>PLMCreateOperationDCDList</td>
</tr>
</tbody>
</table>

in <GS_root>/var/mmap/clm4t_mapping_config/clm4t_bom_second_level_mapping.sd.

And for the Teamcenter Step:

<table>
<thead>
<tr>
<th>Dictionary</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>::CLM4T::GENBOM::CUSTOM::MAPPING::MESInputDatStepDCDs</td>
<td>PLMCreateStepDCDList</td>
</tr>
</tbody>
</table>
in <GS_root>/var/mmap/clm4t_mapping_config/clm4t_bom_third_level_mapping.sd.

Please note the DCD supported types are configured in the ::CLM4T::CONFIGURATION::DCDList in the <GS_root>/var/mmap/clm4t_mapping_config/clm4t_custom_parameter.sd. These parameters are used for the data extraction in Teamcenter. To add a new type, you need to add a new dict into the ::CLM4T::CONFIGURATION::DCDList. Please do not forget to extend the preferences after all.

The performTransfer (see table above for the command) for the creation will be called in the appropriated mapping.

**Create and Associate SIMATIC IT UADM Document**

By default, if the object in Teamcenter has a document, CLM4T creates and associates the Document in the SIMATIC IT UADM. It is done by populating the dictionaries ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatDocuments with a key DocumentList:dicts and DocumentList as value and another key ::CLM4T::GENOBJ::CUSTOM::MAPPING::MESInputDatDocumentAssociations with a key DocumentAssociationList:dicts and DocumentAssociationsList. Please note the DataSetType, MIMEType and the Reference are configured in the ::CLM4T::CONFIGURATION::FileHandlingDatasetMap in the <GS_root>/var/mmap/clm4t_mapping_config/clm4t_custom_parameter.sd. These parameters are used for the data extraction in Teamcenter. To extract a new data type from Teamcenter, you need to add a new key named exactly as the object_type, e.g. for a .pdf file it must be PDF or for .docx - MSWordX. Please do not forget to extend the preferences afterwards.

The performTransfer for the document transfer uses always the same command PLMCreateDocumentList by posting the payload during transfer to SIMATIC IT UADM.

The transfer for associating the document will be called in a different way. Please have a look in the appropriate mapping file.
5. 100 Percent Components

Prepare 100 Percent BOM and BOP

The capability to create the 100 % CCObject that represents the SIMATIC IT UADM AsPlannedBoP will be supported by Teamcenter workflow. Before you start the workflow, copy the Item of the BOM header to the Teamcenter clipboard. In order to transfer the 100 Percent structures in Teamcenter, please start the workflow CLM_CreateCC_4_100PerCent_Structures on the BOP header object revision, for example in the MEProcessRevision in Manufacturing Process Planner (MPP). In the next step paste the Item from the Teamcenter clipboard into References folder:

As a result, you will find the Do task in My Worklist to perform. In the next step you have to fill out the form as following:
Please note that the value of the field "BOM Alternate" will be used to create BOM Alternative, Routing Group Counter and Product Version in SAP as well. Furthermore, it will be used as the name of the SIMATIC IT UADM AsPlannedBoP. The field Sample Unit is used for CCObject only and has no directly corresponding object in SAP or SIMATIC IT. The Unit Range will be stored as a string in the Production Version context.

**Transfer 100 Percent BOM and BOP to SAP**

The capability to transfer the 100 percent structures to SAP is supported by the CLM_Release_100PerCent_Structures_SAPOnly workflow.

If the CCObject containing 100 percent configuration created, search for the CCObject in previous step. The demo template contains the preconfigured search query CLM4TFindCCObjectByName, so that you can make use of it.
Transfer 100 Percent BOP to SIMATIC IT UADM

The capability to transfer 100 Percent BOP to SIMATIC IT UADM presupposes the transfer 100 percent BOP and BOM to SAP.

Trigger the transfer to SAP by starting the workflow
Clm_Release_100PerCent_Structures_SAPOnly on the CCObject you just found. At the end of the transfer, CLM4T will store the mapping between SAP and Teamcenter by using the SAP concatenated object's Ids as a key and the Teamcenter CCObect UID hex encoded as a value for the current transfer.

```plaintext
set IDMAPPINGKEY [::MOM4S::IDMAPPING::buildConfigurationIDKey \
    $Info(InternalMaterialNumber) $Info(PlantId) $GroupId $GroupCounter \
    $Info(ProductionVersion)]
set IDMAPPINGVALUE [tpco_scanHEX16 $Info(CCObjectTag)]
```

The transfer of the 100 Percent BOP usually gets triggered by SIMATIC IT UADM by calling the web API published on the CLM4T GS instance. The endpoint has to be configured in SIMATIC IT UADM configuration keys in the section "CLM4T Integration" as follows:

http://<nameOrIPofCLM4T:11301>/triggerSkeletonTransferService

Please read more about the SIMATIC IT UADM AsPlannedBoP.

The transfer can also be triggered by manually starting the workflow
"Clm_Release_100PerCent_Structures_SITOnly" on a configured (100%) CCObject as created using the procedure described in Prepare 100 Percent BOM and BOP.

**SIMATIC IT UADM AsPlannedBoP**

The SIMATIC IT UADM AsPlannedBoP is represented in Teamcenter as configured structure saved as CCObject.

The SIMATIC IT UADM AsPlannedBoP contains the information about the dependencies between SIMATIC IT UADM Operations. It will be used to create a WorkOrder. The WorkOrderHeader based on the production order from the ERP system will be merged with the linked objects. The WorkOrder refers to the SIMATIC IT UADM AsPlannedBoP, which will be validated.

If SIMATIC IT UADM AsPlannedBoP already exits in SIMATIC IT UADM and is up-to-date, the SIMATIC IT UADM WorkOrder can be executed and is visible for the operator. Otherwise SIMATIC IT UADM starts an event to download the SIMATIC IT UADM AsPlannedBoP from Teamcenter (see Transfer 100 Percent BOP).
6. UADM and ERP interaction

Create WorkOrderHeader in SIMATIC IT UADM

The capability to create a WorkOrderHeader in SIMATIC IT UADM based on the production order from the ERP system. According to the demo scenario, the following steps are required:

- Configure T4S or T4S4 to maintain the Z-Table and implement the creation of the PROD_ORDER entry (stands for Production Order) in Z-Table. This can be done for example on release or save Production Order user exits;

- Start trigger script called "MOM Service Start PO Import Trigger" in the CLM4T GS Admin GUI to check the Z-Table for the created Production Order. Learn more about the Script-based (scheduled) Triggers in the Teamcenter Gateway - Generic Configuration Guide;

- Create a production order in SAP.

Caution:
Use only synchronized:

The Material, Plant with Teamcenter and SIMATIC IT UADM and
Production Version with Teamcenter

to create the Production Order in ERP system.

For the implementation mapping details you can take a closer look at <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_work_order_header_steps.sd. Please note that the mapping contains so called steps. The list of steps ProdOrderStepsCustom can be extended.

Moreover remember, that the enrichWithTCData step requires the data synchronization during 100 Percent transfer to SAP, in particular by invoking ::MOM4S::IDMAPPING::buildConfigurationIDKey or ::MOM4S::IDMAPPING::readMapping to get the linkage between Teamcenter configuration parameters and SAP. The enrichmentList contains the attributes, which must be executed before to map mapProdOrder2WorkOrderHeader step, i.e. prepare the data for the transferring.

And finally the execution of the callSITCreateWorkOrderHeader step to post the payload with a command named PLMCreateWorkOrderHeader.
Create Confirmation in ERP

Create Confirmation in ERP is the capability to send a confirmation about completion from the SIMATIC IT UADM Operator Landing Page to ERP system.

By default, you can decide either to send the confirmation by each of the WorkOrderOperations or only by completion of the whole WorkOrder in SIMATIC IT UADM. The combination of both does not make sense for the SAP. The reason is that if you started to confirm on the operation level in SAP, the confirmation on the production level is no more possible.

- If the execution of the SIMATIC IT UADM WorkOrderOperation is completed, SIMATIC IT UADM sends a signal to trigger confirmation for the corresponding operation in the production order. Add the URL as followed (please adapt the {{CLM4TGSInstance}}):
  http://{{CLM4TGSInstance}}:11301/pxml/createProdOrderOperationConfAsync.

- If the execution of the SIMATIC IT UADM WorkOrder is completed, SIMATIC IT UADM sends a signal to trigger confirmation for the entire production order in ERP system by calling the web API in CLM4T:
  http://{{CLM4TGSInstance}}:11301/pxml/createProdOrderConfAsync.

The web API must be configured in SIMATIC IT UADM configuration keys in the section "CLM4T Integration" accordingly.

The payload for this API consists only of the orderId and Enterprise for the completed SIMATIC IT UADM WorkOrder. For the WorkOrderOperation operationId is the additional attribute in the payload. The details about the WorkOrder or WorkOrderOperation will be retrieved from SIMATIC IT UADM in the step getWorkOrderExecutionData via an OData query. For more details please take a look at <T4x_GS_ROOT>/var/mmap/clm4t_mapping_configclm4t_operation_conf_config.sd for operation confirmation and <T4x_GS_ROOT>/var/mmap/clm4t_production_order_conf_config.sd for production order.

If the backflush flag is enabled for the component in SAP, CLM4T sends the confirmation using proposal data from SAP otherwise CLM4T retrieves the ActualConsumedMaterials from SIMATIC IT UADM and sends it to SAP instead of proposal for values.
7. SIMATIC IT UADM Non-Conformance Notification

Import Non-Conformance Notification

The capability to transfer the SIMATIC IT UADM Non-Conformance Notification (NCN) to Teamcenter is based on the ProblemReport. According to the demo scenario, the operator can raise a SIMATIC IT UADM NCN during the execution of the operation in shop floor, might attach documents and save it. In the next step, the foreman as a SIMATIC IT UADM user can send the SIMATIC IT UADM NCN to Teamcenter by changing the status to NOTIFYING-ENGINEERING-ISSUE. As a result, the SIMATIC IT UADM triggers an event to send the NCN by posting on the preconfigured endpoint in CLM4T:

http://{{CLM4TGSInstance}}:11301/pxml/updateIssueReport

CLM4T creates the import job to create a ProblemReport. Please note that you have the possibility to configure in <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_custom_parameter.sd a different corresponding object like IssueReport by changing as followed:

```variable IssueReportType IssueReport
variable IssueReportRevision A
variable ReferenceFolder CMReferences```

You can change the default IssueReportRevision or the corresponding ReferenceFolder as well.

Please take a close look for details in ImportIssueReport <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_issuereport_import_mapping.sd. The current mapping executes the following steps:

- creates ProblemReport,

- gets all details about SIMATIC IT UADM NCN by calling OData query

- downloads files (if needed),

- associates objects to the preconfigured reference folder.

After the job execution, CLM4T sends the notification to SIMATIC IT UADM, in case if the job executed correctly, SIMATIC IT UADM NCN status is updated to NOTIFIED-ENGINEERING-ISSUE.

Maintain Non-Conformance Notification Objects

The maintained fields are configured in the ImportIssueReport function in the mapping file <T4x_GS_ROOT>/var/mmap/clm4t_issuereport_import_mapping.sd. Please note that every object
exposed from the OData query from SIMATIC IT UADM has to be exist in Teamcenter. The function `getObjectAndAttach` seeks for the object and attaches if it is found to the just created `ProblemReport`. The download of the files attached to the SIMATIC IT UADM NCN will be started at the end of the procedure.
8. Data View

Dataview Configuration

The CLM4T Dataview extension for the Teamcenter RAC needs no configuration once the demo template is installed. However, if you want to change the mapping or add a new field, please learn first about how to configure the Dataview in the Teamcenter Gateway - Generic Configuration Guide.

<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_prop_mapping.sd includes all functions related to the Dataview handling. The configurable part ::CLM4T::CONFIGURATION::RACDataViewConfig you can find under <T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_custom_parameter.sd.
A. CLM4T Glossary Topic

A

Admin GUI
Teamcenter Gateway Administrative User Interface.

B

BGS
Basic Gateway Service.

BOM
A Bill Of Materials is a list of the parts or components and their quantities that are required to build a product.

BOP
The Bill Of Process describes a manufacturing process and lists the operations and steps with all their instructions, consumed materials, resources, work places and machines.

C

CCObject
Collaboration Context Object

D

DCD
Data Collection Definition

G

GS
Gateway Service, manages the communication between Teamcenter and the Enterprise Application.

GS_ROOT
The installation directory of the T4S Gateway Service (e.g. C:\Siemens\T4S_GS or C:\UGS\T4S_Apps)

GUI
Graphical user interface.
NCN
Non-Conformance Notification

TEM
Teamcenter Environment Manager.

URL
Unified Resource Locator: a string with a certain format, allowing to load a resource from a network. URLs are a specific form or URNs.

Z-Table
"Z" is the prefix name for custom tables well-known in SAP world.
Siemens Industry Software

Headquarters
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 972 987 3000

Americas
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 314 264 8499

Europe
Stephenson House
Sir William Siemens Square
Frimley, Camberley
Surrey, GU16 8QD
+44 (0) 1276 413200

Asia-Pacific
Suites 4301-4302, 43/F
AIA Kowloon Tower, Landmark East
100 How Ming Street
Kwun Tong, Kowloon
Hong Kong
+852 2230 3308

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