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SIEMENS

SIMATIC IT UA DM Gateway 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.

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1. Introduction

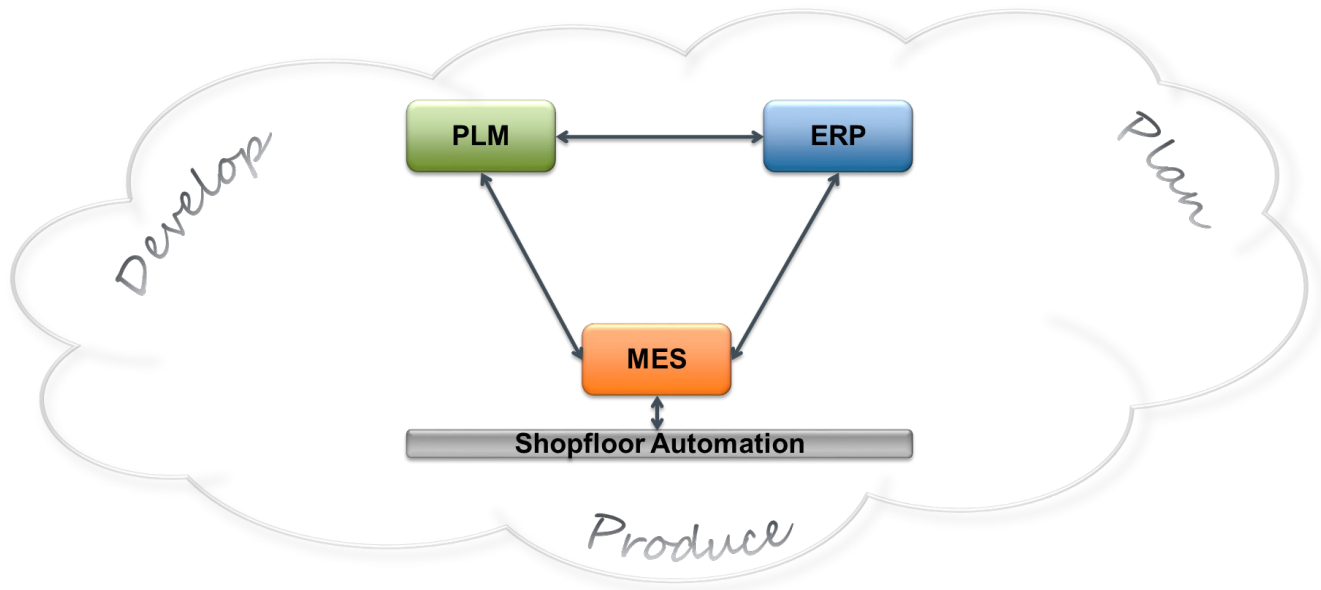
The SIMATIC IT UA DM Gateway for Teamcenter (**CLM4T**) software solution is an integration software that provides data and process integration between Teamcenter® by Siemens Product Lifecycle Management Software Inc. and SIMATIC IT Unified Architecture Discrete Manufacturing by Siemens AG. CLM4T comes with a demo configuration assuming that Teamcenter Gateway for SAP Business Suite is in place in order to close the triangle with SAP ERP. The connection between ERP and MES is assumed to be implemented by SIMATIC IT UA DM Gateway for SAP S/4HANA (CLM4S). Note that CLM4T may also be operated without Teamcenter Gateway for SAP Business Suite, CLM4S and SAP ERP. In this case order and order confirmation are out of scope.

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

This document details the components of Teamcenter - SIMATIC IT UA DM 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 UA DM Interaction

Integration Story



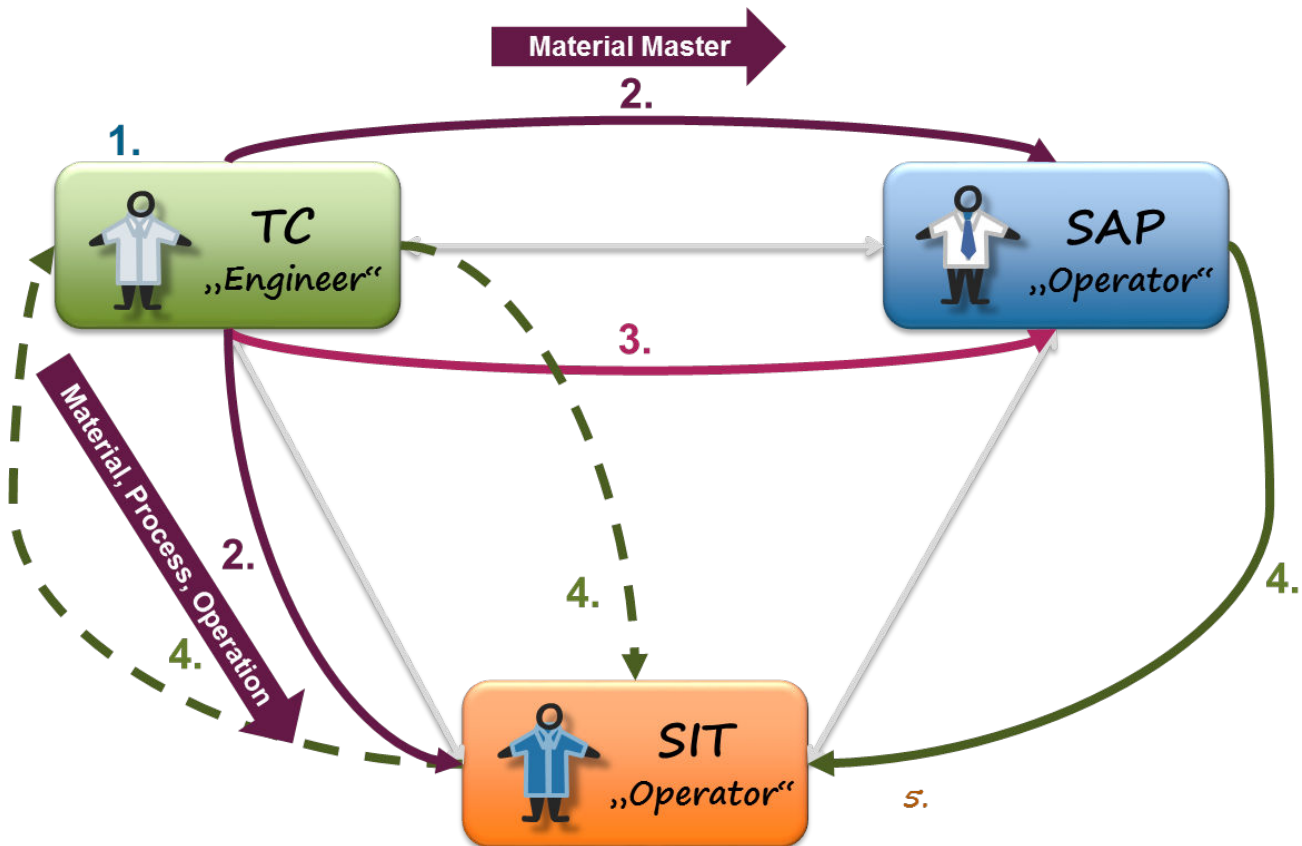
While SIMATIC IT UA DM Gateway for Teamcenter (CLM4T) only covers the integration of Teamcenter with SIMATIC IT Unified Architecture Discrete Manufacturing, the integration story makes most sense when an ERP system is also included. In this chapter, we assume SAP Business Suite® is used as the ERP system, 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 solutions or without an ERP, though. Note that CLM4T does not cover shop floor automation.

The sample scenario assumes a structure with options and variants or unit or date effectivity applied to the BOP and/or the BOM within Teamcenter. This results in a configurable structure in Teamcenter containing more components than necessary to produce a single product. This is called 150% structure or in the context of MES: a master plan. A configured structure contains only those components necessary to produce a single specific product (or 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 or "As Planned BOP".

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 the initial masterplan (150% unconfigured components) and skeleton transfers (100% configured structures) and supplies CLM4T 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). He also creates and verifies the variability of the product using classic options and variants or unit or date effectivity. 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 subsequent 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 and additional ERP-internal processes. Note that order transfer is not part of CLM4T but is implemented e.g. in CLM4S. If the product configuration used in the ERP order is already known in the MES system, the MES system can immediately process and execute

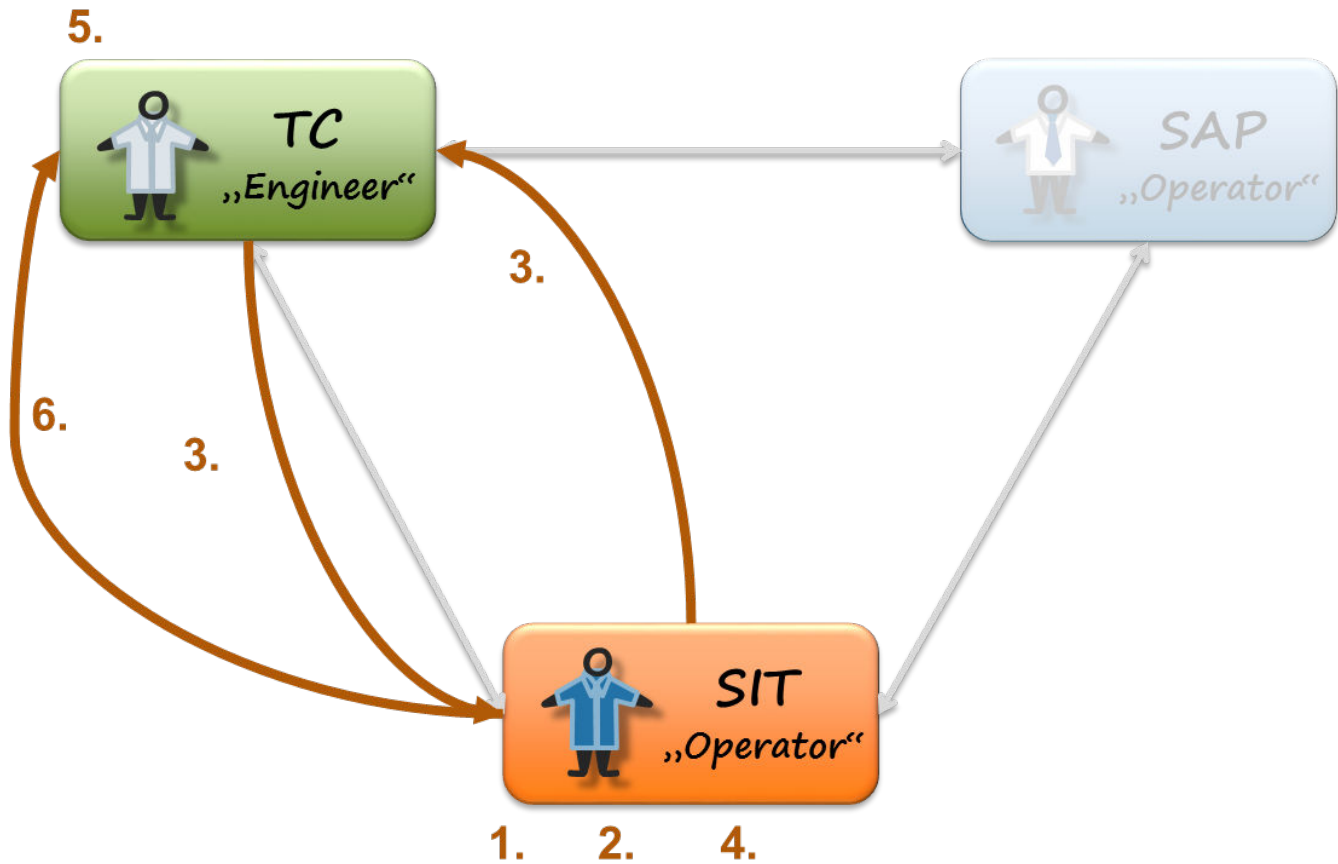
the order, if needed. If the MES system SIMATIC IT UA DM does not yet know the details of the product configuration, then it automatically triggers the download of the configured production structure (100 % BOP) from Teamcenter via CLM4T.

The sequence of the steps is not strictly required. For example, the transfers to SIMATIC IT UA DM and SAP can easily be split into smaller pieces and executed at different points in time and by different operators based on the maturity of sub-structures. 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 UA DM 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 Unified Architecture Discrete Manufacturing that needs to be escalated to product development (engineering, i.e. the PLM system Teamcenter), CLM4T supports the automatic synchronization of a change object in Teamcenter.

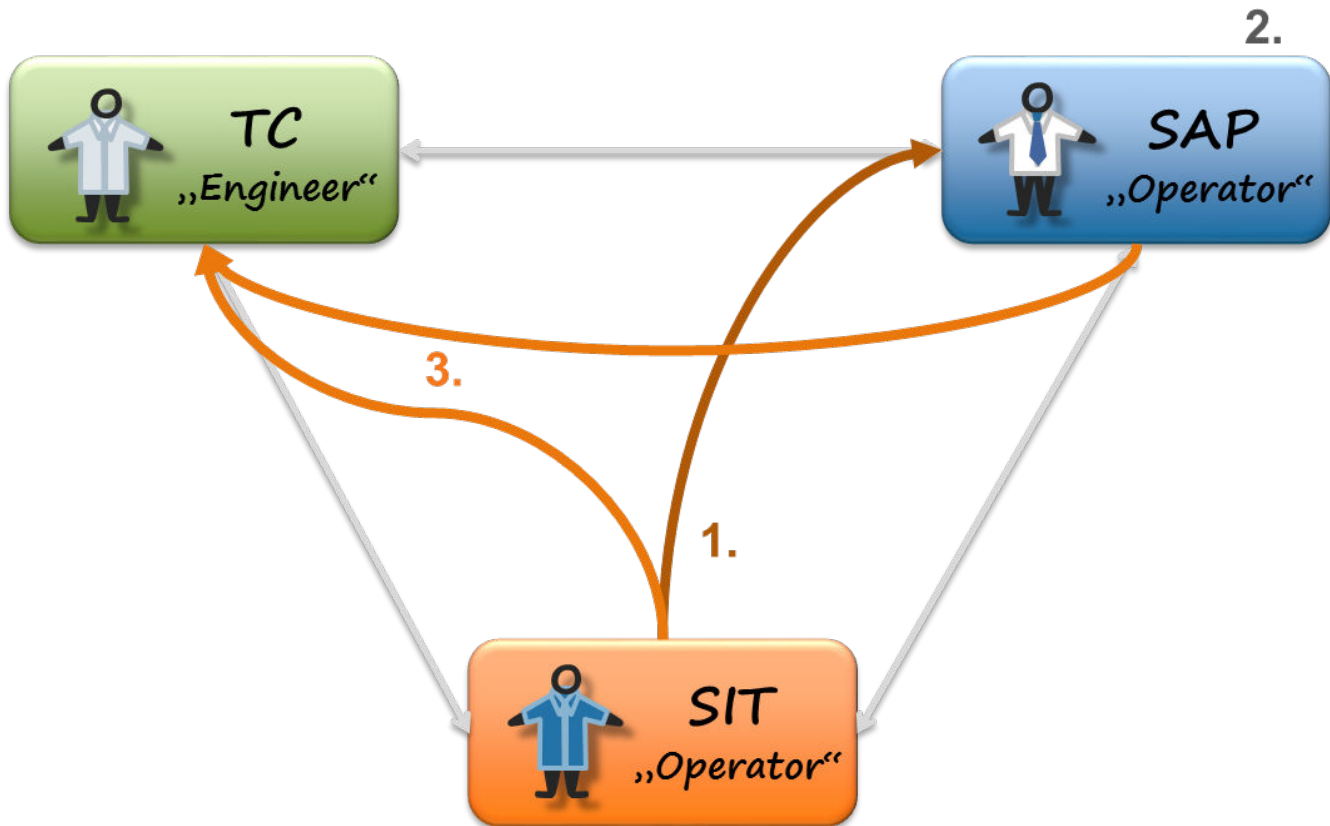


1. A SIMATIC IT UA DM operator executes the WorkOrder on the shop floor.
2. The SIMATIC IT UA DM operator creates a Non-Conformance Notification (NCN) during WorkOrder execution. Based on some decision logic in SIMATIC IT UA DM the NCN can be escalated to engineering (Teamcenter).
3. If the non-conformance is escalated, SIMATIC IT UA DM automatically triggers the creation of a specific problem report object in Teamcenter. Teamcenter will automatically retrieve details on the NCN and populate the problem report with that data. In SIMATIC IT UA DM the status of the non-conformance will be updated.
4. The SIMATIC IT UA DM 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 UA DM WorkOrder in the SIT Dataview 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 UA DM. That essentially means to repeat some of the steps from the previous section.

Closed Loop 3

This closed loop covers finishing the SIMATIC IT UA DM WorkOrder and the operation or order confirmation back to SAP Business Suite®.



1. When the SIMATIC IT UA DM work order is completed, SIMATIC IT UA DM will automatically confirm the production order in SAP Business Suite®. Alternatively, based on MES-internal configuration, SIMATIC IT UA DM may confirm on an operation basis to notify the ERP of the progress. In this case the ERP system will assume the order to be completed when all operations are confirmed. Note that confirmation is not part of CLM4T, but is implemented in CLM4S.
2. The SAP operator can now finalize the production order and e.g. verify or correct goods movements. This is a SAP internal process and requires no CLM integration.
3. The Teamcenter engineer can view live data of the SIMATIC IT UA DM WorkOrder and the SAP production order and its components in the SIT or T4S Dataview 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/t4clm/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, 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. In case of several GS instances, at least one of the instances has to have a job agent. From a functional point of view a single one is enough to cover CLM4S and CLM4T functionalities.

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 UA DM operations and a third level mapping file covering SIMATIC IT UA DM 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 DCDs to an operation or step have to be made in context of a structure (occurrences) while SIMATIC IT UA DM 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 UA DM objects Process, Operation, and Step. The following table shows the possible combinations:

SIMATIC IT level	Classic BOP		Compound BOP		Plant BOP	
	Teamcenter Type	TargetTypeName	Teamcenter Type	TargetTypeName	Teamcenter Type	TargetTypeName
Process (level 1)	MEProcess	Process	MEProcess	Process	Mfg0MEPlantBOP, Mfg0MEProcLine	Process
Operation (level 2)	MEOP	Operation	Mfg0MECompOP	Operation	Mfg0MEProcStatn	PlantOperation
Step (level 3)	MEActivity, MENCProgram or MENCToolActivity	implicitly handled by Operation	Mfg0MEStep	Step	MEOP	PlantStep

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 customer 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 "leaves" 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 UA DM Operation, whereas for a PlantBOP a Teamcenter MEOP translates to a SIMATIC IT UA DM Step. For the master plan (150% no structure transfer) there are 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 CLM4T will fail.

SIMATIC IT UA DM connection configuration

In `<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_mapping_config.sd` you should configure the URL to access CLM4T services. There is a piece of template code included, which you can adapt:

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

Replace `<nameOrIPofSITUAServer>` in the first line with the actual hostname of your SIMATIC IT server. Consult the administrator if necessary for any further adaptations on the URL. The next line adds additional information to that URL. Usually, you will not need to modify these settings, as any OOTB CLM4T installation will use the same values.

BaseURL: Identical to the previously configured RootConnectionString.

- ODATAApplication:** the URL extension to be appended to the BaseURL in order to address the service layer when invoking SIMATIC IT UA DM commands.
- ODATARuntime:** the URL extension to be appended to the BaseURL in order to read data from SIMATIC IT via ODATA queries.
- TokenExecutable:** 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 CLM4T 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.
- TokenAppName:** A name used during extraction of the token from the certificate.
- TokenExpiresInSeconds:** This parameter determines the validity period of the created token as configured on the server (CLM4T requests a new token after this period).

The configured `ConnectionString` 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 system. Several connections may be configured here, allowing to address different SIMATIC IT systems if required. A "preferred" CLM4T connection can be defined by `::T4X::CONNECTION2EA::selectActiveConnection2EA CLM4T"*" "UAFReal"`. This connection will be used if not otherwise specified.

Before each interaction with SIMATIC IT, CLM4T checks the connectivity using a simple and fast call to the server. This can be configured in `::CLM4T::CONNECTION2EA::CUSTOM::MAPPING::connectEA`. The demo implementation calls `::CLM4T::SERVICES::checkConnection`. The following API will be used in this function:

Target System	Used API
SIMATIC IT UA DM	DependencyType

Caution:

If your SIMATIC IT exposes an SSL (https) URL, you need to tell CLM4T which certificates should be used, otherwise no certificates will be checked - opening the connection for man-in-the-middle attacks! Active Integration clients do not use certificates from the operating system certificate store, so the certificates have to be specified using the optional `AdditionalParameters` entry in the dictionary when defining a connection. Here is an example:

```
::CLM4T::CONNECTION2EA::setConnectionInfoPlain
SITUADMServerUingHTTPS [dict create \
  BaseURL "https://
<SITUADMServerUingHTTPIPorName>:443/sit-svc" \
  ODATAApplication "/Application/AppU4DM/odata" \
  ODATARuntime "/runtime/AppU4DM/odata" \
  TokenExecutable "[rcwd]/lib/token/getToken.exe" \
  TokenAppName "" \
  TokenExpiresInSeconds 720\
  AdditionalArguments [list -cert [rcwd]/etc/cert/
server_certificate.cer] \
                        -clientcert [rcwd]/etc/cert/
client_certificate.cer]]
```

The difference is in the BaseURL ("https:") and the last two lines. The `-clientcert` option is only necessary when 2-way SSL is required. For details on `-cert` and `-clientcert` please see [CLM4T API Reference](#) for the command `tpco_httpClient`.

Addressing Multiple Simatic IT Servers

CLM4T can address one or many SIMATIC IT servers based on some mapping logic. The delivered demo mapping assumes the following restrictions:

- There is 1:1:1 relation between Teamcenter top-level-work area, SAP plant and SIMATIC IT UA DM top-level equipment element (also called enterprise or plant).
- Top-level Teamcenter work area and SIMATIC IT UA DM top-level equipment element (enterprise) are mapped according to identical names.
- The SAP production plant is mapped to the SIMATIC IT UA DM top-level equipment element (enterprise) exclusively by the `::SIT::PLANTMAPPING` functionality (see below).
- Each SIMATIC IT server can handle several top-level equipment elements (enterprises). This essentially means that a single CLM4T connection can be used to address several enterprises.

The mapping is defined by a triple of enterprise name (for SIMATIC IT UA DM and Teamcenter, if applicable), the SAP plant ID and the CLM4T connection name. In the demo mapping this is defined using `::SIT::PLANTMAPPING` functionality, similar to the following example:

```
::SIT::PLANTMAPPING::add "Factory1" "1000" "SITConnectionA"  
::SIT::PLANTMAPPING::add "Factory2" "2000" "SITConnectionA"  
::SIT::PLANTMAPPING::add "Factory3" "3000" "SITConnectionB"
```

This is a global definition and should be defined in *clm4t_custom_parameters.sd* file. The example defines that the work area with name "Factory1" (the SIMATIC IT UA DM enterprise) maps to SAP plant 1000 and the CLM4T connection "SITConnectionA" has to be used to address SIMATIC IT UA DM. A second enterprise "Factory2" is also hosted by the same SIMATIC IT server which can be addressed by the CLM4T connection "SITConnectionA", but maps to SAP plant 2000. Finally a separate SIMATIC IT server hosts "Factory3" (SAP plant 3000) and can be addressed using CLM4T connection "SITConnectionB".

Whenever CLM4T needs to transfer data to SIMATIC IT, it determines the CLM4T connection based on the top-level work area.

All incoming web service calls from SIMATIC IT carry an "Enterprise" field. Based on this value any subsequent CLM4T, CLM4S or T4S action can determine the correct connection to SIMATIC IT. The namespace `::SIT::PLANTMAPPING` contains all necessary procedures to uniformly access the previously defined plant mapping.

Note that in the demo scenario implementation the "Enterprise" value of an incoming call is copied to the description field of the initiated Teamcenter workflow by CLM4T. This value always overrules any default ("preferred") connection and also overrules the connection that results from the top-level work area or SAP plant. Since the 150% transfer does not know any structure, the demo scenario provides workflow templates that transfer the master data either to only one SIMATIC IT server, or to several servers. This can be adapted as needed using standard Teamcenter workflow definition and the CLM4T logon task.

Install Certificate

SIMATIC IT 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 host must have the identical certificate installed in the system's certificate store. Usually, this certificate is created and provided by the SIMATIC IT 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 machine's 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.

Please do not forget to keep CLM4T server clock and SIMATIC IT server clock synchronized because of attribute `nbf` (not before) in the payload part of the token.

The Chapter [SIMATIC IT UA DM connection configuration](#) describes how to configure CLM4T to use the imported certificate. For more details on certificate handling, consult the SIMATIC IT manuals.

The File `clm4t_mapping_config.sd`

The file `clm4t_mapping_config.sd` in the directory `<T4x_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 `clm4t_mapping_config.sd`:

- System login data, see chapter [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. 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 CLM4T is 2-legged OAuth2 (see [Install Certificate](#) for details).
- Sourcing of mapping files with `source -relax`.
 Example: `source -relax clm4t_object_mapping.sd`. This means CLM4T has to read the content of the file `clm4t_object_mapping.sd`. The argument `-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 `<T4x_GS_ROOT>\var\mmap\clm4t_mapping_config`).
 In principle, the file names may be modified freely as long as the file extension `.sd` is kept. Every file stated there that has the file extension `.sd` is actually used for the mapping functionality. In fact the only file CLM4T actually uses for the mapping is the compiled mapping file `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 `clm4t_mapping_config.sd`. However, we strongly recommend keeping only those mapping files in the `mmap` directory that you really want to use!
 Be sure to have the correct file names (the files located in `<T4x_GS_ROOT>\var\mmap\clm4t_mapping_config`) in the "source" section of this file.
- In addition to the above mentioned settings, this is also the place to define the configuration for multiple SIMATIC IT UA DM servers (see chapter [Addressing Multiple Simatic IT Servers](#)) and to configure the language of internal messages directly returned by CLM4T.
- 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 it can be ignored completely.
- Configure the language of internal messages directly returned by CLM4T:
 Example:

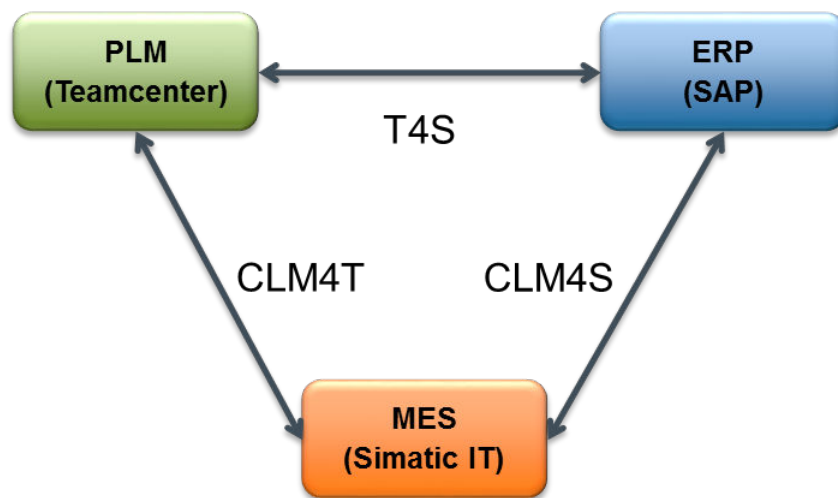
```
set strLanguageCode "en_US" ; # default language (check /var/lang/CLM4T/ for more language codes)
```

Other possible languages can be found in the directory <T4x_GS_ROOT>\var\lang\CLM4T>. It is also possible to control the language using an OS environment variable:

```
set TP_LANGUAGE_CODE=de_DE
```

Deployment Options

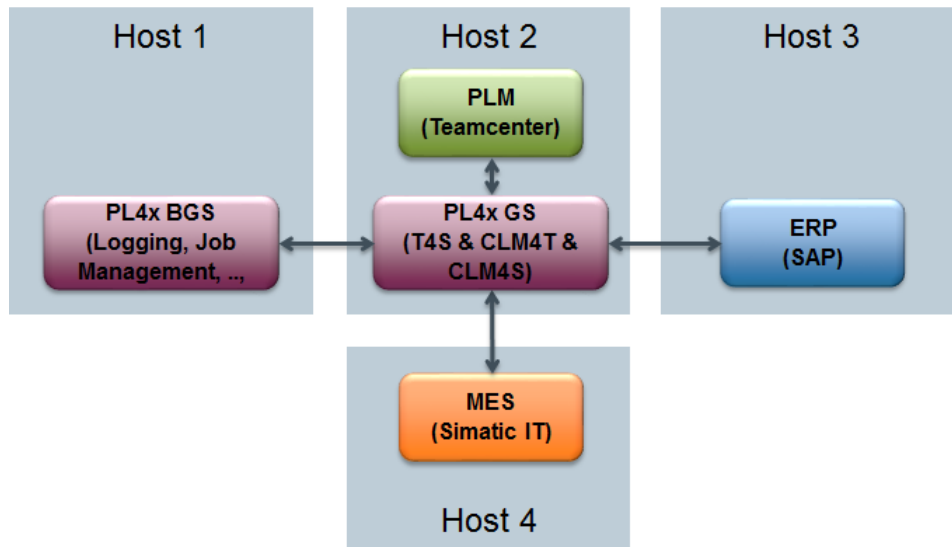
The logical structure of a Closed Loop Manufacturing integration and the participating integration products looks as follows:



The Active Integration product family allows to distribute functionalities to different locations or servers as needed. So it is possible to install two or three of the products (T4S, CLM4T and CLM4S) in a single GS (Gateway Service) instance or to distribute to several GS instances vertically (according to functionalities) or horizontally (scalability). In all scenarios it is highly recommended to keep a single BGS (Basic Gateway Service) in the network to allow a single access point for logging and job management.

Single GS

This is an example of a simple installation with a single GS instance. It assumes that all three products are installed using the Active Integration installer's "extend" option. Active Integration BGS, SIMATIC IT UA DM and SAP are each installed on a separate host. The GS is installed on the Teamcenter server host, because it needs to be called directly from the tcserver processes in the Teamcenter pool manager. (The size and number of the host boxes does not indicate any sizing or importance.)



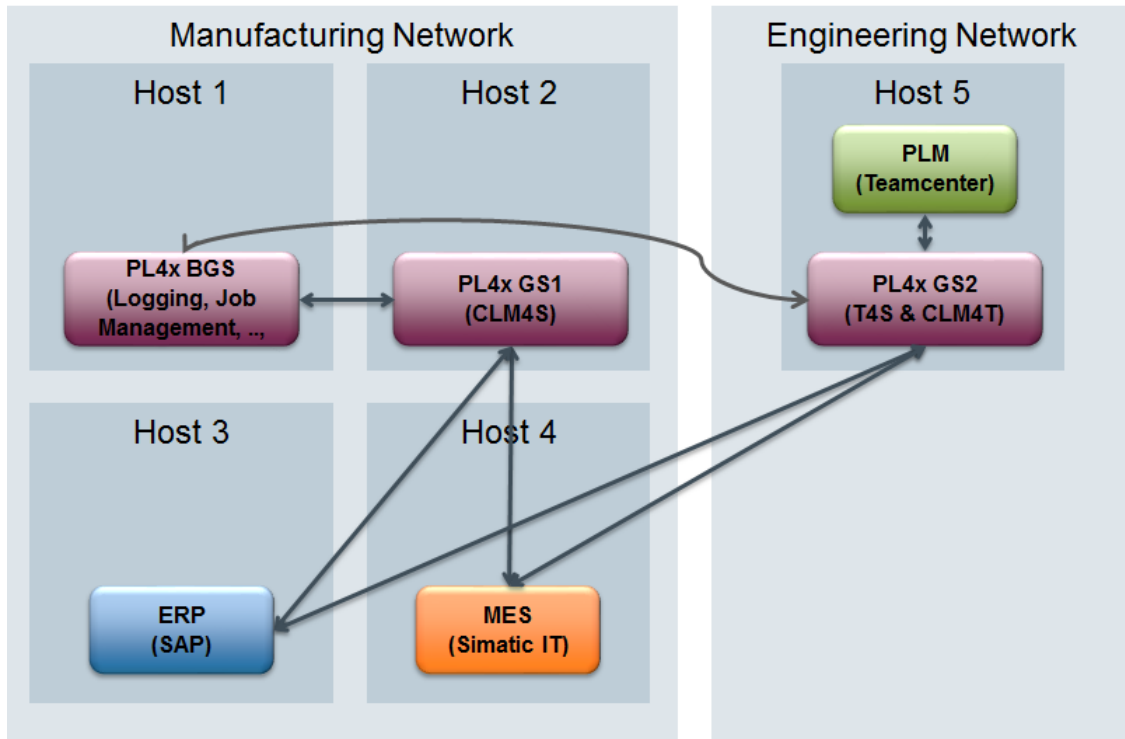
Note that the GS instance can also address several SIMATIC IT UA DM instances, either on the same host or on several hosts. In order to achieve more performance for incoming GS web service calls, one or several GS instances may be added on separate hosts that are not connected to the Teamcenter pool manager but share only the Teamcenter 2-tier installation package (see [Teamcenter Gateway - Installation Guide](#) and the Teamcenter manuals).

Separate GS Instances for Teamcenter and SIMATIC IT UA DM

Due to the stricter requirements regarding accessibility and fault tolerance it may be useful to separate the ERP-MES functionality into one GS instance ("GS1") while the all PLM-related functionality resides on another GS ("GS2"). In this case the BGS host should also be part of the MES network. It is required to install all three products on both GS instances, as the PLM-related functionalities access code that is part of the CLM4S product. Also it is recommended to share a single mapping as this makes management and maintenance easier. In this scenario a failure of the Teamcenter host does not affect order processing for materials that have already been transferred to SIMATIC IT UA DM and SAP.

Distribution of the functionalities can be achieved by taking these measures:

- The trigger script for SAP orders runs on "GS1" and the job agent on "GS1" is configured to process only SAP-related jobs.
- In SIMATIC IT UA DM configuration keys, the URLs configured for CLM processing point to the host name of "GS2" for Teamcenter related services of CLM4T (triggerSkeletonTransfer and updateIssueReport) and to the host name of "GS1" for SAP related services of CLM4S (createProdOrderConfAsync and createProdOrderOperationConfAsync).



The image shows only a single MES system for simplicity, but of course also in such a separated environment each GS can address several instances of SIMATIC IT UA DM, maybe even in different networks, but with connectivity to the BGS. SAP does not necessarily have to be part of the manufacturing network but can also be in the engineering network or another segment as long as the connectivity is up.

4. 150 Percent BOP Components

General Remark

The following chapters give an overview of the capabilities of the SIMATIC IT UA DM Gateway for Teamcenter. This part of the manual is meant to support adaption of the solution to customer needs by linking each capability to the piece of TCL code where it is implemented and can be adapted. Basic knowledge of the TCL programming language is necessary to understand or change the mapping logic.

The "Maintain" chapters describe how fields can be adapted. Note that "*Maintain*" in this context does not imply "*Update*": While the Active Integration platform supports updates of existing objects, the SIMATIC IT UA DM commands used to implement the capabilities in most cases do not support *updates of existing objects*. Instead the result of such a call will be "success" but the data within the SIMATIC IT UA DM database *will not have changed*. Note that usually a clean Teamcenter release process would only transfer *released* (i.e. unchangeable) objects to SIMATIC IT UA DM. In order to semantically change master data or structures, items, processes, operations, etc. have to be *revised* on Teamcenter side. When transferring the new revisions, they will establish new objects on SIMATIC IT UA DM side, hence storing the changed values correctly.

Demo Workflow Overview

The CLM4T demo template `t4clm` comes with several sample workflows to transfer the BOP components from Teamcenter to the target systems. Note that the demo workflows assume T4S to be in place. The workflows can be adapted as needed (e.g. remove T4S components, adapt target system or connection names) and can be used as templates for the creation of specific workflows. Some of the workflows use other sub-workflows because they implement a repeated sequence of identical tasks. Here is an overview of the demo workflows that should be used for 150% transfers:

- `CLM_Release_150PerCent_StandAloneObjects_Factory1`: This workflow is an example to transfer master data of a classic or compound BOP to a single SAP system and to a single SIMATIC IT UA DM instance. The workflow can easily be extended to support a second or several SIMATIC IT UA DM instances, see next item. The workflow handles all types of components that make up a BOP like materials (items), process, operations, etc. as described in the following chapters. It does not transfer any structure information.
- `CLM_Release_150PerCent_StandAloneObjects_AllFactories`: This workflow is an example to transfer master data to a single SAP system and to two SIMATIC IT UA DM instances. It is an extension of the previous workflow.
- `CLM_Release_150PerCent_StandAloneObjects_PlantBOP`: This workflow is similar to the first one (transfer to a single SAP and single SIMATIC IT UA DM system), but it covers a plant BOP instead of a classic or compound BOP. The difference manifests in different `TargetTypeNames` in the handler configuration, accepting different Teamcenter types and interpreting the type `MEOP` differently. See [Supported BOP Structures](#) for details. This workflow can also be extended to support several SIMATIC IT UA DM systems, if needed.

SIMATIC IT UA DM Material Definition

[Create SIMATIC IT UA DM Material Definition](#)

[Maintain SIMATIC IT UA DM Material Definition Fields](#)

[Create and Associate Document to SIMATIC IT UA DM Material Definition](#)

Create SIMATIC IT UA DM Material Definition

The capability to create a Material Definition in SIMATIC IT UA DM is 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 `<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_material_mapping.sd`.

In case of PartRevision all of the Part Logistics Form attributes such as Lot or Serialized are mapped to the corresponding attributes in SIMATIC IT UA DM Material Definition. These attributes permit to create instances of the Material in SIMATIC IT UA DM having characteristics like a batch or serial number.

Target System	Used API
SIMATIC IT UA DM	PLMCreateMaterialDefinitionList

Maintain SIMATIC IT UA DM Material 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_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 UA DM.

Create and Associate Document to SIMATIC IT UA DM Material Definition

The capability to transfer and associate a Document to SIMATIC IT UA DM Material Definition is based on the document linked to the ItemRevision or PartRevision. Please refer to [Create and Associate SIMATIC IT UA DM Document](#) for details.

The `performTransfer` procedure for associating the document uses the `PLMAssociateDocumentToToolDefinitionList` command in SIMATIC IT UA DM.

Target System	Used API
SIMATIC IT UA DM	PLMCreateDocumentList
	PLMAssociateDocumentToMaterialDefinitionList

SIMATIC IT UA DM Tool Definition

[Create SIMATIC IT UA DM Tool Definition](#)

[Maintain SIMATIC IT UA DM Tool Definition Fields](#)

[Create and Associate Document to SIMATIC IT UA DM Tool Definition](#)

Create SIMATIC IT UA DM Tool Definition

The capability to create a Tool Definition in SIMATIC IT UA DM is e.g. based on MfgOMEEquipmentRevision 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`.

Target System	Used API
SIMATIC IT UA DM	PLMCreateToolDefinitionList

Maintain SIMATIC IT UA DM Tool 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 UA DM.

Create and Associate Document to SIMATIC IT UA DM Tool Definition

The capability to transfer and associate Document to SIMATIC IT UA DM Tool Definition is based on the document linked to the corresponding object `ItemRevision` or `PartRevision`. Please refer to [Create and Associate SIMATIC IT UA DM Document](#) for details.

The `performTransfer` for the associating the document will be called using `PLMAssociateDocumentToMaterialDefinitionList` command in SIMATIC IT UA DM.

Target System	Used API
SIMATIC IT UA DM	PLMAssociateDocumentToToolDefinitionList

SIMATIC IT UA DM Process

Create SIMATIC IT UA DM Process

Maintain SIMATIC IT UA DM Process

Create SIMATIC IT UA DM Process

The capability to create a Process in SIMATIC IT UA DM is based on `MEProcessRevision`, `MfgOMEPlantBOPRevision` or `MfgOMEProLineRevision` 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 the variable `::CLM4T::CONFIGURATION::PlantList` which defines all mandatory attachments of a process revision.

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`.

Target System	Used API
SIMATIC IT UA DM	PLMCreateProcessList

Maintain SIMATIC IT UA DM 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 UA DM Operation

Create SIMATIC IT UA DM Operation

Maintain SIMATIC IT UA DM Operation Fields

Create and Associate Document to SIMATIC IT UA DM Operation

Associate Skill to Operation in SIMATIC IT UA DM

Create SIMATIC IT UA DM Operation

The capability to create an Operation in SIMATIC IT UA DM is based on the MEOPRevision in the case of classic BOP structure, MfgOMECompOPRevision in the case of compound BOP structure or MfgOMEProcStatnRevision 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 `MfgOMEProcStatnRevision` (for plant BOP).

Caution:

In the demo configuration, the second level objects of the plant BOP structure do not support DCD attachments, because the used Teamcenter type `MfgOMEProcStatnRevision` does not support DCD attachments. This is why there is no structure based transfer for the plant BOP Operation.

`<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.

Target system	Used API
SIMATIC IT UA DM	PLMCreateOperationList

Maintain SIMATIC IT UA DM 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 UA DM Operation

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

The procedure `performTransfer` for associating the document will be called using `PLMAssociateDocumentToOperationList` command in SIMATIC IT UA DM.

Target System	Used API
SIMATIC IT UA DM	PLMCreateDocumentList
	PLMAssociateDocumentToOperationList

Associate Skill to Operation in SIMATIC IT UA DM

The capability to transfer and associate Skill to Operation in SIMATIC IT UA DM is based on the MOMSkill linked to the corresponding object, please refer to [SIMATIC IT UA DM Skill](#) for more details about Skill transfer.

The procedure `performTransfer` ensures that the associated Skills will be linked to the Operation by posting `MESInputDatSkillAssociations` dictionary using the generic command `LinkSkillToOperationList` in SIMATIC IT UA DM.

Later if SIMATIC IT UA DM creates `WorkOrderOperation` from the Operation the associated Skills will be taken as well.

Target System	Used API
SIMATIC IT UA DM	LinkSkillToOperationList

SIMATIC IT UA DM Step

[Create SIMATIC IT UA DM Step](#)

[Maintain SIMATIC IT UA DM Step Fields](#)

[Create and Associate Document to SIMATIC IT UA DM Step](#)

Create SIMATIC IT UA DM Step

The capability to create a Step in SIMATIC IT UA DM is based on `MfgOMStepRevision` 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::MESInputDatObjectdictionary` (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 `MfgOMStepRevision`. 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.

Target System	Used API
SIMATIC IT UA DM	PLMCreateStepList

Maintain SIMATIC IT UA DM 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 UA DM Step

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

Caution:

The capability to transfer and associate Document to SIMATIC IT UA DM Step for `MEActivity` as a corresponding is not supported.

The procedure `performTransfer` for associating the document will be called using `PLMAssociateDocumentToStepList` command in SIMATIC IT UA DM.

Target System	Used API
SIMATIC IT UA DM	PLMAssociateDocumentToStepList

SIMATIC IT UA DM Data Collection Definition

By default, if an object corresponding to an Operation or a Step has a Data Collection Definition (DCD) in Teamcenter, CLM4T creates and associates a DCD in SIMATIC IT UA DM. This is done by populating the dictionary `::CLM4T::GENBOM::CUSTOM::MAPPING::MESInputDatDCDs` for the Teamcenter Operation in `<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_bom_second_level_mapping.sd`.

Similarly, for the Teamcenter Step the dictionary `::CLM4T::GENBOM::CUSTOM::MAPPING::MESInputDatStepDCDs` in `<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_bom_third_level_mapping.sd` is used.

Please note the DCD supported types are configured in the `::CLM4T::CONFIGURATION::DCDList` in the `<T4x_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.

Target System	Used API
SIMATIC IT UA DM	PLMCreateOperationDCDList PLMCreateStepDCDList

SIMATIC IT UA DM Skill

Demo scenario uses custom object MOMSkill as a corresponding object for the SIMATIC IT UA DM Skill. CLM4T creates Skill and associates it to the Operation during Operation transfer in the SIMATIC IT UA DM. It is done by populating the dictionaries for the Teamcenter Skill as follows:

Note that CLM4T calls a generic SIMATIC IT UA DM command in contrast to the PLM commands used for other transfers. The procedure `::CLM4T::TOOLBOX::searchInSITQuery` will be executed to make sure that the skill with the same name does not exist in SIMATIC IT.

Target System	Used API
SIMATIC IT UA DM	CreateSkill ODATA Query: /Skill\$filter=Nid=<SkillName>

Create and Associate SIMATIC IT UA DM Document

By default, if the object in Teamcenter has a document, CLM4T creates and associates the Document in the SIMATIC IT UA DM. 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 `<T4x_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 UA DM.

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

Target System	Used API
SIMATIC IT UA DM	PLMCreateDocumentList PLMAssociateDocumentToMaterialDefinitionList PLMAssociateDocumentToOperationList PLMAssociateDocumentToStepList PLMAssociateDocumentToToolDefinitionList

5. 100 Percent Components

Prepare 100 Percent BOM and BOP

Note:

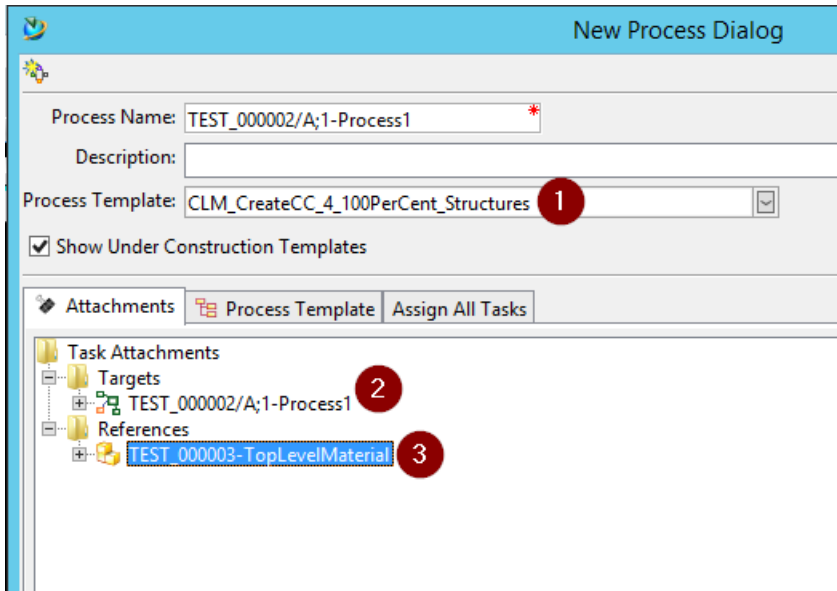
This capability is not primarily related to the integration or to Closed Loop Manufacturing. Manual creation of 100% CCOBjects is possible and valid, but error prone. Therefore the demo scenario provides a helper workflow and a web service to automate the creation of the CCOBject. However the creation can be replaced by any other process as needed without influencing the overall CLM scenario.

Workflow to Create CCOBject

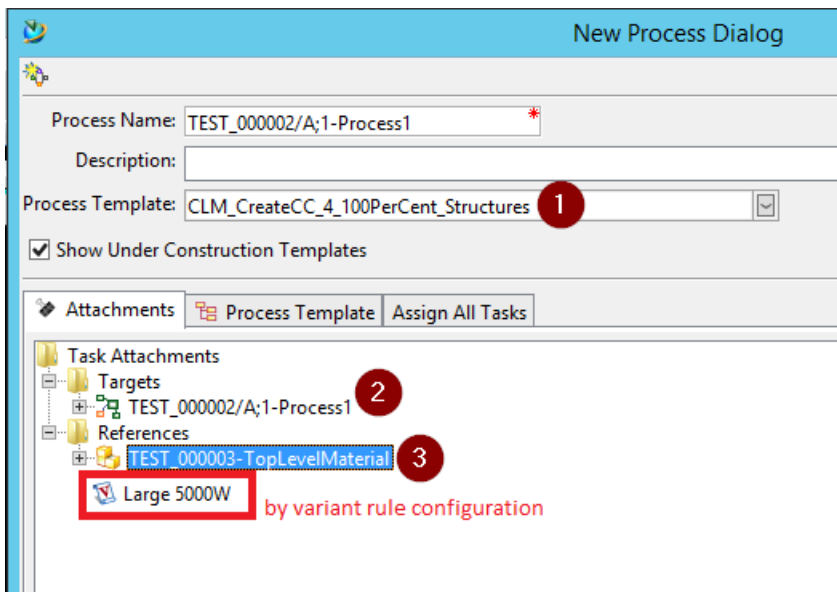
The capability to create the 100% CCOBject that represents the SIMATIC IT UA DM AsPlannedBoP is supported by a Teamcenter workflow. Demo scenario covered two possibilities to configure 100 percent structures by applying:

- revision rule using unit effectivity and/or
- variant rule using variant conditions.

Before you start the workflow, copy the Item or the ItemRevision of the BOM header and, if applicable a variant rule to the Teamcenter clipboard. The Item or ItemRevision will become the end item for the configuration and the variant rule will be used to configure options and variants. In order to transfer the 100 Percent structures in Teamcenter, please start the workflow `CLM_CreateCC_4_100PerCent_Structures` (see "1" in the below image) on the BOP header object revision, for example on the MEProcessRevision in Manufacturing Process Planner (MPP, see "2"). In the next step paste the Item or ItemRevision from the Teamcenter clipboard into References folder ("3"):



If you use classic variant rule to configure structures, add in addition to the Item a variant rule as shown in following figure.



As a result, you will find the Do task in My Worklist to perform. If you select the task, you will see a form in the "Viewer". In the next step you have to fill out the form as follows:

CLM-CAR-Assembly/A;1-Car Assembly Plan
(DetermineProductionVersion)

Task View Process View

Unit Configuration Form

BOM Alternate: 1

CC Object Name: 2

Sample Unit: 3

Unit Range: 4

General

Process Description:

Comments:

Done: Complete 5

6 Save

Please note that the value of the field "BOM Alternate" (field "1") 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 UA DM AsPlannedBoP. The field Sample Unit ("3") is used for CCOBJECT only and has no corresponding field in SAP or SIMATIC IT. The Unit Range ("4") will be stored as a string in the Production Version description in SAP.

The same workflow can be used to create the CCOBJECT using classic options and variants. The form still needs the BOM Alternate, CC Object Name and Unit Range as input. In addition to the end item the variant rule has to be attached as reference to the workflow.

Finally check the "Complete" radio button ("5") and click "Save" ("6"). This will create the CCOBJECT with the name as provided in field "2".

Web Service to Create CCOBJECT

As an alternative to the workflow also a web service can be called to create a CCOBJECT and trigger the download of the 100% skeleton. This may be especially helpful when T4S, CLM4S and SAP are not available and an ERP system has to be emulated.

Caution:

This web service is delivered on an as-is basis. It may change in the future breaking compatibility with this version and in its current version it has some drawbacks: The JSON payload contains an embedded JSON that has to be escaped in a non-intuitive way. It is not capable to attach a Teamcenter variant rule, so no options and variants can be used.

The endpoint has to be configured in SIMATIC IT UA DM (or any other system) as follows:

`http://{{CLM4TGSInstance}}:11301/updateWorkOrderCC`

Request-Example:

```
{
  "OrderID": "OrderForMultiSITTest",
  "RoutingUID": "68665674374D74306F24244E4644",
  "TargetProductUID": "78665174374D74306F24244E4644",
  "Enterprise": "Factory1",
  "ConfigurationParameter": "{\"\\\\"EffectivityUnit\\\\"": \\\\"1\\\\"", \\\\"EffectivityParams\\\\"": [{\\\\"Name\\\\"": \\\\"ID\\\\"", \\\\"Value\\\\"": \\\\"50076677\\\\"}]}"
```

Field	Type	Description
OrderID	String	CCObject name
RoutingUID	String	BOP header tag
TargetProductUID	String	BPM header tag
Enterprise	String	Enterprise from SIMATIC IT UA DM
ConfigurationParameter	String	Parameters in JSON (escaped string)

Success-Response:

```
HTTP/1.1 200 OK
{
  "status": "OK",
  "message": "Import job (ID 596d2a2f5bed28f3926261e8) was created"
}
```

Error-Response:

```
HTTP/1.1 500
{
  "status": "ERROR",
  "message": "The job cannot be created."
}
```

Transfer 100 Percent BOM and BOP to SAP

The capability to transfer the 100% structures to SAP is supported by the `CLM_Release_100PerCent_Structures_SAPOnly` workflow. The workflow uses standard T4S functionality only and is therefore not described in detail here.

First, search and identify the CCOBJect containing the 100% configuration in Teamcenter. The demo template contains the saved query `CLM4TFindCCObjectByName`, so that you can easily find the 100% CCOBJect (e.g. the one created in the [previous step](#)).

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 CCOBJect UID hex encoded as a value for the current transfer.

```
set IDMappingKey [::CLM4S::IDMAPPING::buildConfigurationIDKey \
  $Info(InternalMaterialNumber) $Info(PlantId) $GroupId $GroupCounter \
  $Info(ProductionVersion) ]
set IDMappingValue [tpco_scanHEX16 $Info(CCOBJectTag) ]
```

This is necessary to provide the information originating from Teamcenter for later processing it during order download and confirmation, as implemented e.g. in the SIMATIC IT UA DM Gateway for SAP S/4HANA.

Transfer 100 Percent BOP to SIMATIC IT UA DM

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

`http://{{CLM4TGSInstance}}:11301/triggerSkeletonTransferService`

Request-Example:

```
{
  "PBOPIdentID": "77776274655057304a4569394d42",
  "Enterprise": "Factory1"
}
```

Field	Type	Description
PBOPIdentID	String	CCObject unique Id from Teamcenter
Enterprise	String	Enterprise from SIMATIC IT UA DM

Success-Response:

```
HTTP/1.1 200 OK
{
  "JobID": "77776274655057304a4569394d42414141414141414141414141414141",
  "status": "OK",
  "message": "Skeleton export workflow created"
}
```

Error-Response:

```
HTTP/1.1 500
{
  "status": "ERROR",
  "message": "Skeleton export workflow creation failed!"
}
```

Please read more about the [SIMATIC IT UA DM 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 UA DM AsPlannedBoP

The SIMATIC IT UA DM AsPlannedBoP is represented in Teamcenter as configured structure saved as CCOBJECT.

The SIMATIC IT UA DM AsPlannedBoP contains the information about the dependencies between SIMATIC IT UA DM Operations. It will be used to create a Work Order. The Work Order Header based on the production order from the ERP system will be merged with the linked objects. The Work Order then refers to the SIMATIC IT UA DM AsPlannedBoP, which will be validated.

If SIMATIC IT UA DM AsPlannedBoP already exists in SIMATIC IT UA DM and is up-to-date, the SIMATIC IT UA DM Work Order can be executed and is visible for the operator. Otherwise SIMATIC IT UA DM automatically triggers an event to download the SIMATIC IT UA DM AsPlannedBoP from Teamcenter (see [Transfer 100 Percent BOP](#)).

Creating the SIMATIC IT UA DM AsPlannedBoP requires a sequence of API calls that link and associate the previously created catalogue objects. Finally if everything worked well, CLM4T issues a "PLMSubmit" command. If any error occurred (either on CLM4T side or reported as a result of a web service call to SIMATIC IT UA DM), CLM4T will try to issue a "PLMRollback" command to revert all changes.

The functionality is implemented by the namespace `::CLM4T::PLMXML::OBJECT::CUSTOM::MAPPING` in `<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_plmxml_routing_mapping.sd`. This mapping file uses PLMXML to extract the necessary information in procedure `PLMXML_Data2EA_Object` and transform it into a set of dictionaries which will then be send to SIMATIC IT UA DM commands in `performEATransfer`. This mapping is usually called from the workflow `CLM_Release_100PerCent_Structures_SITOnly` after having created a Teamcenter AI object containing the PLMXML file content.

Target System	Used API
SIMATIC IT UA DM	PLMCreateAsPlannedBoP
	PLMCreateStepMaterialSpecificationFullList
	PLMCreateStepToolSpecificationFullList
	PLMLinkOperationToStepFullList
	PLMCreateStepDependencyList
	PLMCreateOperationEquipmentSpecLocationFullList
	PLMCreateOperationMaterialSpecificationFullList
	PLMCreateOperationToolSpecificationFullList
	PLMLinkProcessToOperationFullList
	PLMCreateOpDependencyList
	PLMSubmit
	PLMRollback

6. UADM and ERP interaction

Create WorkOrderHeader in SIMATIC IT UA DM

Caution:

This chapter is valid only for Teamcenter, ERP and SIMATIC IT UA DM integration scenarios. It does not apply for ERP and SIMATIC IT UA DM only integration scenarios.

The capability to create a WorkOrderHeader in SIMATIC IT UA DM 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 UI 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:

To create a Production Order in SAP use only MaterialMaster and Plant transferred from Teamcenter to SAP and SIMATIC IT UA DM and Production Version created by CLM4T from Teamcenter.

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 `::CLM4S::IDMAPPING::buildConfigurationIDKey` or `::CLM4S::IDMAPPING::readMapping` to get the linkage between Teamcenter configuration parameters and SAP.

Important: The `enrichmentList` must be executed before `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`.

Target system	Used API
SIMATIC IT UA DM	PLMCreateWorkOrderHeader
SAP	BAPI_PRODORD_GET_DETAIL

Create Confirmation in ERP

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

Caution:

This chapter is valid only for Teamcenter, ERP and SIMATIC IT UA DM integration scenarios. It does not apply for Teamcenter and SIMATIC IT UA DM only integration scenarios. The following features are shipped with CLM4S and not with CLM4T.

By default, you can decide either to send the confirmation by each of the Work Order Operations or only by completion of the whole Work Order in SIMATIC IT UA DM. In case, if a component in SAP has a backflash flag, CLM4S does not transfer any data from SIMATIC IT UA DM and uses only proposal data from SAP.

If you use components with serial number without backflash in SAP, the dictionary key `ProdOrderConf:GOODSMOVEMENTS:SERIALNO_AUTO_NUMBERASSIGNMENT:$index` has to be changed to "X". This means again that SAP assigns serial number automatically, regardless from inputs in SIMATIC IT UA DM. In contrast to serial number, by using components with `batchId` CLM4S is able to transfer the `batchId` value from SIMATIC IT UA DM as shown in the following example (backflash is not set in SAP).

```
set SITMaterialItemValue [dict get $SITODATADictConsumedMat\
MaterialItem BatchId]
if {$SITMaterialItemValue ne "null"} {
  dict set res ProdOrderConf:GOODSMOVEMENTS:batch:$index\
  $SITMaterialItemValue
} else {
  dict set res\
  ProdOrderConf:GOODSMOVEMENTS:SERIALNO_AUTO_NUMBERASSIGNMENT:$index ""
}
```

Note that the current mapping supports either serial number auto assignment or batch number assignment, but not both at the same time.

- If the execution of the SIMATIC IT UA DM Work Order Operation is completed, SIMATIC IT UA DM sends a signal to trigger confirmation for the corresponding operation in the production order. Add the URL as followed (please adapt the `<GSInstance>`):

```
http://<GSInstance>:11301/pxml/createProdOrderOperationConfAsync.
```

Request-Example:

```
{ "orderId": "000100004298", "Enterprise": "Factory1" }
```

Field	Type	Description
orderId	String	Production order unique ID from SAP with leading zeroes will be used for SAP BAPI call.
Enterprise	String	Enterprise from SIMATIC IT UA DM.

Success-Response:

```
HTTP/1.1 200 OK
{
  "status": "QUEUED",
  "message": "9bba11525aec537240317d57"
}
```

Error-Response:

```
HTTP/1.1 500 Internal Server Error
{
  "status": "ERROR",
  "message": "The job cannot be created"
}
```

The Web API above calls the following BAPI's:

Target system	Used API
SAP	BAPI_PRODORD_GET_DETAIL BAPI_PRODORDCONF_GET_HDR_PROP BAPI_PRODORDCONF_CREATE_HDR

OData query to retrieve the data for the given Work Order and Work Order Operation:

Target system	Used API
SIMATIC IT UA DM	WorkOrder? \$expand=ProductionType(\$select=NId),WorkOrderOperations(\$filter=Sequence%20eq%20'0010')&\$filter=NId%20eq%20'000100001234'

OData query to retrieve the ActualConsumedMaterials data for the given WorkOperationNId:

Target system	Used API
SIMATIC IT UA DM	WorkOrderOperation? \$expand=ActualConsumedMaterials(\$expand=MaterialItem,ToBeConsumedMaterial(\$expand=MaterialDefinition))&\$filter=NId%20eq%20'34059838-8fb8-4b7e-9c1b-8d9f14b54426'

- If the execution of the SIMATIC IT UA DM Work Order is completed, SIMATIC IT UA DM sends a signal to trigger confirmation for the entire production order in ERP system by calling the web API in CLM4S: `http://<GSInstance>:11301/pxml/createProdOrderConfAsync`.
Request-Example for SAP and SIMATIC IT UA DM integration scenarios only:

```
{
  "confirmationId": "000000014298",
  "Enterprise": "Factory1"
}
```

Request-Example for Teamcenter, SAP and SIMATIC IT UA DM integration scenarios:

```
{
  "orderId": "000100004298",
  "operationId": "0040",
  "Enterprise": "Factory1"
}
```

Field	Type	Description
orderId	String	Production order unique ID from SAP.
operationId	String	Occurrence ID tag from Teamcenter hex- encoded, CLM4T and CLM4S integration scenario only.
confirmationId	String	Confirmation ID from SAP for operation, CLM4S standalone integration scenario only.
Enterprise	String	Enterprise from SIMATIC IT UA DM.

Success-Response:

```
HTTP/1.1 200 OK
{
  "status": "QUEUED",
  "message": "9bba11525aec537240317d67"
}
```

Error-Response:

```
HTTP/1.1 500 Internal Server Error
{
  "status": "ERROR",
  "message": "The job cannot be created"
}
```

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

The payload for this API consists only of `orderId` and `Enterprise` for the completed SIMATIC IT UA DM Work Order. For the Work Order Operation `operationId` is the additional attribute in the

payload. The data for the Work Order or Work Order Operation will be retrieved from SIMATIC IT UA DM in the step `getWorkOrderExecutionData` via an OData query. For more details please take a look at `<T4x_GS_ROOT>/var/mmap/clm4s_mapping_config/clm4s_operation_conf_config.sd` for operation confirmation and `<T4x_GS_ROOT>/var/mmap/clm4s_mapping_config/clm4s_production_order_conf_config.sd` for production order.

If the backflash flag is enabled for the component in SAP, CLM4S sends the confirmation using proposal data from SAP otherwise CLM4S retrieves the `ActualConsumedMaterials` from SIMATIC IT UA DM and sends it to SAP instead of proposal for values.

The Web API above calls the following BAPI's:

Target system	Used API
SAP	BAPI_PRODORD_GET_DETAIL BAPI_PRODORDCONF_GET_TT_PROP BAPI_PRODORDCONF_CREATE_TT

- OData query to retrieve the `ActualConsumedMaterials` data for the given `WorkOperationNId`:

Target system	Used API
SIMATIC IT UA DM	WorkOrder? \$expand=ParentOrder(\$select=NId),ProducedMaterialItems(\$expand=MaterialItem),FinalMaterial,ProductionType(\$select=NId),WorkOrderOperations(\$expand=ActualConsumedMaterials(\$expand=MaterialItem,ToBeConsumedMaterial(\$expand=MaterialDefinition)))&\$filter=NId%20eq%20'000100001234'

7. SIMATIC IT UA DM Non-Conformance Notification

Import Non-Conformance Notification

The capability to transfer the SIMATIC IT UA DM Non-Conformance Notification (NCN) to Teamcenter is based on the Problem Report (PR). According to the demo scenario, the operator can rise a SIMATIC IT UA DM 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 UA DM user can send the SIMATIC IT UA DM NCN to Teamcenter by changing the status to NOTIFYING-ENGINEERING-ISSUE. As a result, the SIMATIC IT UA DM triggers an event to send the NCN by posting on the preconfigured endpoint in CLM4T:

```
http://<CLM4TGSInstance>:11301/pxml/updateIssueReport
```

Request-Example:

```
{
  "NonConformanceID": "NCN-123",
  "Enterprise": "Factory1"
}
```

Field	Type	Description
NonConformanceID	String	NCN unique Id from SIMATIC IT UA DM.
Enterprise	String	Enterprise from SIMATIC IT UA DM.

Success-Response:

```
HTTP/1.1 200 OK
{
  "JobID": "9bba11525aec537240317d57",
  "NonConformanceID": "NCN-123",
  "ProblemReportUID": "426C5270505841766F4C61696343",
  "completed": true,
  "status": "OK",
  "message": "Problem report was successfully created"
}
```

Error-Response:

```
HTTP/1.1 500 Internal Server Error
{
  "status": "ERROR",
  "message": "The job cannot be created"
}
```

CLM4T creates the import job to create a PR. 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 Issue Report (IR) 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.

Explore in more detail `<T4x_GS_ROOT>/var/mmap/clm4t_mapping_config/clm4t_issuereport_import_mapping.sd` especially the implementation of the function `ImportIssueReport`. The current mapping executes the following steps:

- Create object.
- Get data for SIMATIC IT UA DM NCN by calling OData query.
- Download files (if needed).
- Associate objects to the preconfigured reference folder.

After the job execution, CLM4T sends the notification to SIMATIC IT UA DM in case if the job executed correctly, SIMATIC IT UA DM NCN status is updated to `NOTIDIED-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_mapping_config/clm4t_issuereport_import_mapping.sd`. Please note that every object exposed from the OData query from SIMATIC IT UA DM has to exist in Teamcenter.

OData query to retrieve details for Non-Conformance Notification (NCN)

Target system	Used API
SIMATIC IT UA DM	NonConformance?\$filter=Nid%20eq%20'NCN-123'&\$expand=WorkOrder(\$expand=FinalMaterial),WorkOrderOperation

OData query for attachments

Target system	Used API
SIMATIC IT UA DM	NonConformanceHistory?\$filter=NonConformance%20eq%20'NCN-123'&\$expand=Attachments(\$expand=Document)

The function `getObjectAndAttach` seeks for the object and attaches to the just created PR. The download of the files attached to the SIMATIC IT UA DM NCN will be started at the end of the procedure.

8. Dataview

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.

OData query to retrieve data for the given PBOPIdentID by clicking on MECollaborationContext in Teamcenter

Target system	Used API
SIMATIC IT UA DM	WorkOrder?\$filter=PBOPIdentID%20eq%20'524F6174356A5F584A4569394D42'

OData query to retrieve the data for the given ERPOrder by clicking on ProblemReportRevision in Teamcenter

Target system	Used API
SIMATIC IT UA DM	WorkOrder?\$filter=ERPOrder%20eq%20'NCN-123'

A. CLM4T Glossary Topic

<

<T4x_GS_ROOT>

The installation directory of the Gateway Service (e.g. C:\Siemens\GS).

A

Admin UI

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 Enterprise Applications.

GUI

Graphical user interface.

N

NCN

Non-Conformance Notification

T

TEM

Teamcenter Environment Manager.

U

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

Z-Table

"Z" is a well-known prefix name for custom tables in the SAP world. A special table used with is the table `/TESISPLM/ZPTC`.

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