Control Module (CM) Technology - Efficient Engineering in SIMATIC PCS 7

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Preface

The purpose of this document

This document describes the structure, scope of functions, project planning, as typical scenarios and advantages supported by the new type concept of SIMATIC PCS 7.

Abbreviations

The following table lists the abbreviations and designations of the type models.

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<th>Abbreviation</th>
<th>English</th>
<th>German</th>
<th>Description</th>
</tr>
</thead>
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<td>PT</td>
<td>Process Tag</td>
<td>Messstelle</td>
<td>CFC according to the old type model</td>
</tr>
<tr>
<td>PTT</td>
<td>Process Tag Type</td>
<td>Messstellentyp</td>
<td>CFC-type template for instantiation according to the old type model</td>
</tr>
<tr>
<td>CM</td>
<td>Control Module</td>
<td>Einzelsteuereinheit</td>
<td>CFC according to the new type model</td>
</tr>
<tr>
<td>CMT</td>
<td>Control Module Type</td>
<td>Einzelsteuereinheitstyp</td>
<td>CFC-type template for instantiation according to the new type model</td>
</tr>
<tr>
<td>BPCM</td>
<td>Best Practice Control Module Type Library</td>
<td>Best Practice Control Module Type Library</td>
<td>Predefined control modules types in form of a library</td>
</tr>
</tbody>
</table>

Note

This document uses the terms and abbreviations Control Module (CM) and Control Module Type (CMT).

Validity:

The description refers to the use of CM technology for SIMATIC PCS 7 V9.0 SP1. The Best Practice Control Module Type Library is available for Version SIMATIC PCS 7 V9.0 SP1.
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1 Introduction

1.1 Overview

Standardization of engineering is an important tool for continuously improving competitiveness and achieving higher planning quality. Different process steps and sequences, different equipment and flexibility in production make this task more difficult.

One approach to standardization is the consistent use of Control Modules Types (CMT) to create an automation program. The ISA-88 standard contains a CMT, e.g. a valve from the application program, as well as the physical setup. CMTs can be either a component of a technical device such as flow control or a component of a subsystem such as a stirring reactor.

1.2 Principle of operation

This application example describes the handling of Control Module technology in environment of PCS 7 using individual technology components and typical application cases. The use of CM technology results in additional improvements and increases in efficiency with regard to engineering in SIMATIC PCS 7, i.e. the automation project can be continuously adapted to the changing requirements, as shown in the figure below.

The CM technology supports the typical engineering phases that influence the automation program:
1 Introduction

- Concept: Developing a rough structure using an piping and Instrumentation (P&I diagram)
- Development: Implementing customer requirements, e.g. interlocks, process units, logic, etc.
- Test procedure: Preparing the hardware connection (sensors and actuators)

The CM technology not only supports initial engineering, but also program extensions and the detection of program changes.

1.2.1 Control module types

The basis for standardized engineering is provided by the consistent use of Control Module Types (CMTs).

By defining optional blocks in the CMT, a large number of different variants of this CMT can be instantiated in the project. One variant, for example, stands for an indicating measuring point for the input signal (4-20 mA, PA field device). A selectable function in turn refers to the program logic, such as a locking function.

The following figure shows a matrix with optional blocks for creating a variant and activating additional functions.

<table>
<thead>
<tr>
<th>ValAn (CMT Master Data Library)</th>
<th>Function</th>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ValAn_Slot</td>
<td>o o o o x x</td>
<td>o o x o</td>
<td>Controlling a valve without position feedback (analog signal)</td>
</tr>
<tr>
<td>ValAn_StufRes</td>
<td>o o o o o o</td>
<td>o o x o</td>
<td>Controlling a valve with position feedback (analog signal)</td>
</tr>
<tr>
<td>ValAn_FutRes</td>
<td>o o o o o o</td>
<td>o o x o</td>
<td>Controlling a valve with position feedback (Pneumatic)</td>
</tr>
</tbody>
</table>

x = Selecting a variant  o = Selectable functions

All instances can be compared and matched with the type at any time.

The use of CMT offers the following benefits:
- Reduced test effort (type-based testing)
- Faster configuring through instantiation
- Reduced maintenance for libraries
- Change tracking by detecting deviations on the instance
1.2.2 Best Practice Control Module Type Library

The Best Practice Control Modules (BPCM) in the form of a Type Library are available for SIMATIC PCS 7 as a master data library and contain typical, pre-projected and tested CMT. The BPCM are created with CM technology and enable more efficient engineering through standardized program components.

The following benefits are achieved by using the BPCM Type Library:

- Extensive library for different applications and industries
- Reduction of the project planning effort
- Reduced maintenance
- Standardized structures

The BPCM Type Library offers typical components as a template for building automation solutions. The CMT of the BPCM Type Library contain all necessary function and channel blocks and can be adapted to the project-specific conditions by instantiation.

The BPCM's are based on the SIMATIC PCS 7 Advanced Process Library (APL) and Industry Library (IL), are hardware-independent, pre-configured and modular. The library "109475748_BPCM_LIB_PCS7_V90SP1.zip" provides the following CMT groups:

- MonAn: Analog measured value display
- MonDi: Digital measured value display (binary signal)
- OpDi: Setting a binary value by the operator
- PIDConL Controller for standard and cascade control loops
- Mot: Engine control with simple speed control
- Vlv: Valve actuation with two defined positions
- VlvAn: Valve control with analog control valve

Note
The BPCM library uses the name of the central technology block of the APL.

Note
A detailed description of each CMT with function description, supported variants and control elements is included in the library.

1.3 Components used

The following list contains all files and projects used in this example.

<table>
<thead>
<tr>
<th>Component</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>109475748_PCS7_CMT_Engineering_DOC_PCS7V90_de.pdf</td>
<td>This document</td>
</tr>
<tr>
<td>109475748_BPCM_Lib_PCS7V90SP1.zip</td>
<td>BPCM library for PCS 7 V9.0 SP1</td>
</tr>
<tr>
<td>109475748_BPCM_Type_Library_DOC_de.pdf</td>
<td>BPCM Description</td>
</tr>
</tbody>
</table>
2 Basics

2.1 ISA-88 Standard (discontinuous mode)

The "ANSI/ISA-88" standard refers to batch-oriented operation in batch plants that are operated with SIMATIC BATCH, for example, and includes the relevant standards and terminology.

The following image shows an asset structure based on CM (Control Module).

2.2 ISA-106 Standard (continuous mode)

The "ISA-106" standard refers to the structure of the automation solution for continuous process plants. The standard describes, among other things, the:

- "Physical Model": Represents the physical components of the system up to the actual field device.
- "Procedure Requirements Model": Contains the process-specific requirements for the individual plant components.
- "Procedure Implementation Model": Contains the implementation procedures for the individual plant components.

The CM or CMT are to be assigned to the "Procedure Implementation Model". These are required in the automation program to connect or process the physical plant component.

The basic construction is similar to the ISA-88, but there is a difference in the way the system operates. In discontinuous operation, products are manufactured according to a recipe. Depending on the use case (phase), equipment modules are controlled differently and supplied with recipe-specific parameter sets. This means that the driving style depends on the product to be manufactured.

In continuous operation, the process is in the foreground, i.e. the plant is started up via successive process states. After reaching a stable and defined condition, a product is continuously produced with constant quality. The defined operating mode can react to abnormal conditions by means of defined measures such as a Safety Integrated System.
2.3 PT/PTT and CM/CMT structure

The Control Modules Types (CMT) marks a new type of standardized software module that enables even more efficient engineering than classic measuring point types. A CMT can contain blocks, plans, control variables (block connections such as signals and parameters) and messages.

CMT Model

Control Module types have detailed control logic inside and "Technological I/Os" outside. The assignment links the internal logic with the "Technological I/Os".

- **Assignment**: The assignment is the linking of the logic in the CFC and the technological I/Os.
- **Internal logic**: The internal logic describes the behavior and functions of the CMT and is implemented in the CFC.
- **Technological I/Os**: The technological I/Os form the connection to other CM, I/O-HW and assigned parameter values. They offer a simplified view with all signals, circuits and parameters relevant for technological engineering. A SubCM combines several objects from the "Technological I/Os" and can be declared as optional.

Technological engineering: The CMs are connected via the technological I/Os, in SIMATIC PCS 7 with the "Technological List Editor", CFC Editor and in COMOS or SIMATIC PCS 7 Plant Automation Accelerator via the "Function Diagram". The assignment maps the technological planning information to the lower abstraction level of the CFC.

**Note**

The internal logic and the assignment of the logic to the technological I/Os are only visible with the CFC editor. The properties are not displayed for the Plant Automation Accelerator, COMOS and SIMIT. Here the CMT is a "black box".
Realization of a PTT and CMT in PCS 7

The following figure shows the structure of a PTT and CMT using the example of an analog valve.

1. The blocks are shown in grey at PT/PTT. The "Technological I/Os" are not supported.
2. All created and defined objects (parameters, signal, messages, status, command) are displayed in the "Technological I/Os" area.
3. In the "Attributes" area, the "Technological I/Os" are linked to the internal logic.
4. The blocks and the "Technological I/Os" of the CM/CMT are shown in green.

Note

The colors described for the display refer to the standard setting. The colors can be adjusted in the CFC via the menu item "Extras > Settings > Colors..." for each engineering system or reset to the default values.
### 2.4 Comparison between PT/PTT and CM/CMT

The following table compares the features of PT/PTT and CM/CMT.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>PT/PTT</th>
<th>CM/CMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change tracking</td>
<td>Only with special tools</td>
<td>Yes, with the comparison function of the file transfer dialog.</td>
</tr>
<tr>
<td>Variant support</td>
<td>No, because a PTT is needed for each variant</td>
<td>Yes, through CMT with selectable variants (options)</td>
</tr>
<tr>
<td>System-supported instantiation</td>
<td>IEA (Import/Export Assistant)</td>
<td>With COMOS or Plant Automation Accelerator</td>
</tr>
<tr>
<td>Extending functions</td>
<td>Yes, by adapting the PTT and instantiating with the IEA. <strong>Caution:</strong> The export file must be adapted to the new function. Specific changes to instances are lost if they are not read back.</td>
<td>Yes, very convenient by extending the functionality in the CMT and comparing it with the instances.</td>
</tr>
<tr>
<td>Type project planning</td>
<td>Easy, by placing and interconnecting the required blocks.</td>
<td>Somewhat more extensive, since the technological I/Os must also be defined.</td>
</tr>
</tbody>
</table>
### 2.5 Typical changes of the CMTs and CM

To make the most of the instance and type concept with the synchronization function, we recommend that you make the changes to the type or instance depending on the type of change. The following table gives typical examples of changes of type or instance.

<table>
<thead>
<tr>
<th>Change</th>
<th>Type or Instance:</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inserting a block</td>
<td>Type</td>
<td>Inserting a block</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Define as SubCM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mark as “optional”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Synchronize type with instance</td>
</tr>
<tr>
<td>Insert block (without adjusting the type)</td>
<td>Instance</td>
<td>1. Use of functions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note: See section 2.9</td>
</tr>
<tr>
<td>Parameterization for multiple instances</td>
<td>Type</td>
<td>1. Adjust parameters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Synchronize type with instance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the changed parameter is defined in the technological I/Os, the parameter is not adjusted and must be adjusted in the instances.</td>
</tr>
<tr>
<td>Parameterization for an Instance</td>
<td>Instance</td>
<td>1. Adjust parameters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The changed parameter must be defined in the technological I/Os so that the parameter is not overwritten during the next synchronization.</td>
</tr>
<tr>
<td>Interconnections between instances</td>
<td>Instance</td>
<td>1. Add interconnections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Both connections of the connection must be defined in the technological I/Os.</td>
</tr>
<tr>
<td>Connection in the instance</td>
<td>Type</td>
<td>1. Add interconnections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Synchronize type with instance</td>
</tr>
</tbody>
</table>
2.6 Conversion of a PTT into a CMT

An existing PTT can be conveniently converted into a CMT without losing the project engineering in the library. Below you will find a step-by-step guide on how to convert a PTT into a CMT.

1. Right-click on the storage folder for the PTT and click on "Plant Types > Create Control Module Type from Process Tag Type..." in the context menu.

A new dialog window "Process tag types - Create control module type from process tag type" opens.

2. Select the PTTs you want to convert to a CMT and click the button "Create...". This creates CMTs with the same name as the selected PTTs.
2.7 Mass data engineering

With a modular engineering approach, the overall project efficiency can be increased and risks minimized. High standardization and simple configuration additionally save engineering time and costs.

Technological list editor

As of PCS 7 V9.0, a new view is available with the “Technological List Editor”. The "Technological list editor" offers various displays, operations and filter options in the tabs to edit the technological types or objects with their properties and attributes in tables.

In the "Technological list editor" the signals, parameters and messages of CMs can be parameterized and interconnected. In addition to parameterization and interconnection, CMTs can also declare blocks as optional.

In addition, an export and import of Microsoft Excel is offered, which enables engineering without system-specific knowledge.
Note
Further information on the “Technological list editor” can be found in section 8.7 of the SIMATIC process control system PCS 7 Compendium Part A - Configuration Guidelines (V9.0) under the following link: https://support.industry.siemens.com/cs/ww/en/view/109756485

COMOS and Plant Automation Accelerator
The “COMOS” and “Plant Automation Accelerator” (PAA) applications support program-supported generation of automation data (hardware configuration and automation program).

Under the following links you will find examples of mass data engineering:

- Application example: SIMATIC PCS 7 Plant Automation Accelerator using a practical example (https://support.industry.siemens.com/cs/ww/en/view/109742154)
- Application example: Integrated Engineering with COMOS and SIMATIC PCS 7 using a practical example (https://support.industry.siemens.com/cs/ww/en/view/70922226)

Note
In order to avoid inconsistencies during mass data engineering with “COMOS” and “Plant Automation Accelerator” or with the simulation program “SIMIT Simulation”, the following points must be observed:

- All circuits of the CM must be routed via the technological I/Os. This means that the two connections of the connection must be defined in the technological I/Os.
- An extension of the CM by additional blocks is only permitted by selecting optional blocks or using functions.

More information on the functions is available in the section Scenario D - Creating and using functions.
2.8 Automation Interface

The Automation Interface contains an abstract data model of the Control Modules Types. The information of this data model is provided by the different data sources, PCS 7, PAA, etc. In PCS 7, for example, the projected information is provided by the technological I/Os.

The Automation Interface information is used to exchange and compare data, such as the "File Transfer" dialog when comparing CMs with CMTs.

The "File Transfer" displays which instances have changed from the CMT and what exactly has been changed. Differentiation takes place through different color and object representations, e.g. deviations that have occurred when comparing project statuses.

The following figure shows the detailed structure of the file transfer.

- (A) Data target/project: The data target corresponds to the project and contains all instantiated CM. In the bar the project name and project path are displayed in blue font color.
- (B) Data source/library: The data source corresponds to the master data library and contains all CMT of the library. Individual CMTs or the entire library can be selected for comparison. In the bar the library name and the CMT are displayed in green font color.
- Comparison view: The comparison view shows the differences between the folders/CFCs selected in the selection area and the comparison object (data source/library).
- Selection area: All instances found in the project are displayed in the selection area. On the left edge, instances that differ from the template can be selected or deselected for synchronization. All instances are selected by default.
2 Basics

- Navigation area: You can switch between the individual data records (instances) in the navigation area. The display can be switched between standard and tabular views and a prefiltered view (only deviations). The navigation area also contains buttons for updating the project comparison as well as for starting the synchronization.

- List view: The list view lists the subordinate objects of the folders/CFCs selected in the selection area in comparison to the comparison object (data source/library).

Note

For more information on synchronizing CMT via the Automation Interface, refer to the article “Synchronization of individual control module types (PCS 7 V9.0 SP1)” at the following link:

2.9 Functions

A function is created in the library as a CMT and declared as a “function” using the option field. In contrast to the CMT, the function may not have any subordinate functions (further summarized objects, SubCMs), since the function is later instantiated as an additional SubCM in a CM. In a function with optional blocks, integration in a CMT would create a further hierarchy level in the technological I/Os that is not permitted.

The created functions can be instantiated once or multiple times in a CM without the need to adapt the CMT.

By using functions in PCS 7, the CM adjustments made are also visible outside PCS 7, e.g. when exporting to the Plant Automation Accelerator, without having to adjust the CMTs.

In the Plant Automation Accelerator, functions offer the possibility to adapt the CM without changing the CMT and without having to use an additional CM. When exporting to PCS 7, the function is integrated into the instance (CM).

Note

For information on creating and using a function with SIMATIC PCS 7 and the Plant Automation Accelerator, refer to the section 4.4.
3 Principle of operation

3.1 Technological I/Os

The technological I/Os are the interfaces of the CM to other CMs and offer a simplified view on the CM, with all signals, circuits and parameters that are relevant from a technological point of view. The instance-specific parameters or connections of the signals, connections and attributes ensure that the instance-specific changes are retained during a synchronization.

CAUTION CM Engineering

Circuits at CFC level between non-technological parameters of two CMs are not available for the abstract data model.

If the CMT is changed later and the instance is adjusted, this can lead to undesired behavior. Therefore, additional wiring of the instance should always be made via the technological I/Os.

The technological I/Os can be created and extended in a user-friendly way via drag&drop. An added object is assigned automatically.

The following objects are available in the technological I/Os:

- **Control Module**: Topmost object in the structure tree of the "Technological I/Os". Represents the entire CMT or CM with the assigned CFC and subordinate objects of the technological I/Os.

- **Sub Control Module**: SubCMs are subordinate functions of the Control Module. One or more function blocks of the CFC can be assigned to a SubCM. Additionally, a SubCM can be marked as optional to be switched on or off in the instance (CM), this allows a CMT to be varied in PCS 7 at instance level. Optional SubCMs are thus the basis for variants of a CMT.

- **Parameter**: Block input or output with pre-programmed value or a circuit/multiple circuit, which can later be adapted to specific instances.
3 Principle of operation

- Signal: Connection to input or output channels of the automation hardware.
- Messages: This object can be used to transfer the information and settings of messages from the function blocks of the CFC to the interface of the technological I/Os.
- Status: The various individual conditions and OS comments are predefined in the status so that the status of the instance can be queried more easily by an SFC.
- Command: The various initializations, edits, and terminations are predefined in the command so that access to the instance is facilitated by an SFC.

**Note**
All block parameters/connections assigned in the technological I/Os are displayed in green on the block and are not changed during synchronization.

**Attributes**
In the "Attributes" area, the available attributes of an object (name, option, value, unit, etc.) are displayed and assigned CM or linked circuits are displayed. In addition, the assignment between the technological I/Os and the internal logic in the CFC is carried out in the attributes.

Each technological I/Os object has different attributes. While the designation for the connection is assigned to a block or block group or the "Optional" function is set, a process value and/or a unit can be preset for a lower-level parameter.

### 3.2 Synchronization functionality

The synchronization function in PCS 7 is performed for a project and all instances and detected changes between type and instance are displayed in the file transfer dialog. The user can deselect the differences that are not to be adjusted. For example, blocks that were added in an instance are left in the synchronization. While blocks or circuits that have been added in the type are transferred to the instances during synchronization. The function "Synchronization of Control Modules" uses parts of Version Cross Manager (VXM), a license of VXM is required to use this function.

**Note**
The instance-specific circuits that collide with a new circuit in the CMT are replaced by the circuits in the CMT.

**Note**
Filter settings, such as deselecting instances or subordinate objects, are not retained after closing the file transfer dialog.
3 Principle of operation

1. Select the AS project in the plant view of the SIMATIC Manager and select "Technological Types > Synchronize..." in the context menu.

2. Select the types you want to synchronize and click the "Synchronize..." button.
3 Principle of operation

3. In the comparison dialog, all folders are displayed in which the previously selected CMT were created as an instance. Changes made to connections that are not technological I/Os are displayed at the instance in question.

Note
If two blocks are connected together in the type and the target connection is defined as a "Technological I/Os", the change is retained in the synchronization when the connection is deleted in the instance.

If both connections are not defined as "Technological I/Os" in the type and the connection is deleted in the instance, the original state is restored during the synchronization.

Note
For more details on synchronization, refer to the following link in the "Synchronization of individual control module types (PCS 7 V9.0 SP1)" manual:
4 Application scenarios

The following scenarios refer to the handling and engineering in PCS 7 by using the CM technology:

- CMT for measured value display with variants
- Configuring an equipment module with CMT
- Efficient functional enhancement to APG via type matching
- Creating and using functions

4.1 Scenario A - Creating a CMT with variants

In this scenario, a CMT is configured for the measured value display. The CMT supports a large number of variants by means of optional SubCMs to which channel blocks are assigned. A CMT can be either generated from an existing measuring point in the project or built from scratch.

Initially, the user needs to think about the structure, static or variable parameters, block messages, as well as about possible variants.

This example considers the following configuration:

- Measured value display via the "MonAnL" block
- 3 different channel drivers (analog, thermocouple and fieldbus) are supported
- As an alternative to the channel drivers, it is possible to choose a differential measurement
- Central parameter assignment of the scaling and unit
- Program logic and functionality in chart partition A and channel driver in chart partition B

Creating a CMT

In preparation, a new folder was created in the "Plan View" of an existing project library in the SIMATIC Manager. An empty CMT with the name "AMon" for measured value display has been added to the folder.

1. Open the CMT and create a second segment plan for channel drivers.
2. Add the following blocks with the corresponding names to the CFC.
   a. MonAnL block as "I" in chart partition A, sheet 1
   b. StruScOu block as "PV_Scale" in chart partition A, sheet 1
   c. DI_I block as "PV_Unit" in chart partition A, sheet 1
   d. Sub02 block as "DeltaCalc" in chart partition A, sheet 1
   e. Pcs7AnIn block as "PV_In" in chart partition B, sheet 1
   f. Pcs7AnIn block as "PV_TE_In" in chart partition B, sheet 1
   g. FbAnIn block as "PV_Fb_In" in chart partition B, sheet 1
3. Switch the following block inputs and outputs visible or invisible.
   a. PV_Unit: Hides the inputs "In2", "SelMode", "Sel_In2" and the output "In2Selected"

Pre-configuration and interconnection

The following parameters are adjusted for the basic configuration:

- I: Deactivate all limit value messages "PV_xx_En" ("0")
- I: Preassign all upper limit values "PV_xH_Lim" to "99999.0"
- I: Preassign all lower limit values "PV_xL_Lim" to "-99999.0"
- PV_TE_In: Preset the scale to "0" (Low) and "1" (High).

In addition, the following block interconnections are carried out:

<table>
<thead>
<tr>
<th>Source (output)</th>
<th>Target (input)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV_Scale.Scale</td>
<td>I.PV_OpScale</td>
<td>Central scaling of the process variable for display and channel driver</td>
</tr>
<tr>
<td></td>
<td>PV_In.Scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PV_Fb_In.Scale</td>
<td></td>
</tr>
<tr>
<td>PV_Unit.Out</td>
<td>I.PV_Unit</td>
<td>Central scaling of process unit for display and channel driver</td>
</tr>
<tr>
<td></td>
<td>PV_TE.In.PV_InUnit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PV_In.PV_Unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PV_Fb_In.PV_Unit</td>
<td></td>
</tr>
<tr>
<td>PV_In.Bad</td>
<td>I.CSF</td>
<td>Display if process value is invalid</td>
</tr>
<tr>
<td>PV_In.PV_Out</td>
<td>I.PV</td>
<td>Display of the process value</td>
</tr>
<tr>
<td>PV_In,OosAct</td>
<td>I.OosLi</td>
<td>Indication when process device is in maintenance</td>
</tr>
</tbody>
</table>
4 Application scenarios

Synchronization parameters and messages

In the following, all parameters (inputs or outputs) and messages are created in the technological I/Os.

1. Open the "Technological I/Os" in the CMT.

2. In the "Name" area, enter the corresponding plan name in the "Assignment" column.
3. Add the display block "I" to the technological I/Os using drag&drop. A SubCM is created and the block "I" is assigned to it.

4. Drag each connection of the block (inputs and outputs) to the created CM "I" and update the screen display with the function key "F5". The assignment has been performed and all connected connections are displayed in green.
5. Change the "PV" attribute "Variable Type" from Signal to Parameter. Only then can several circuits be linked to the input.

6. Add the messages "MsgEvId1" to the technological I/Os by drag&drop. Enter the message identifier e.g. "SIG1" in the attributes of MsgEvId1.

Note
In the object properties of the reportable block under "Messages..." you will find the available message identifiers. This is only possible with signalable blocks, such as display and controller modules.

7. Carry out step 5 for the message identifiers "SIG2" to "SIG8" and repeat the procedure for "MsgEvId2".

8. Also add the following blocks and parameters to the technological I/Os:

<table>
<thead>
<tr>
<th>CM designation</th>
<th>Block with parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeltaCalc</td>
<td>DeltaCalc.In1</td>
</tr>
<tr>
<td></td>
<td>DeltaCalc.In2</td>
</tr>
<tr>
<td></td>
<td>DeltaCalc.Out</td>
</tr>
<tr>
<td>Opt_PV_Scale</td>
<td>PV_Scale.HiScale</td>
</tr>
<tr>
<td>Note:</td>
<td>PV_Scale.LoScale</td>
</tr>
<tr>
<td></td>
<td>PV_Unit.In1</td>
</tr>
<tr>
<td>PV_Fb_In</td>
<td>PV_Fb_In.PV</td>
</tr>
<tr>
<td>PV_Unit is also included in the group.</td>
<td></td>
</tr>
</tbody>
</table>
### Multiple interconnections (variants)

Simple connections to a block input can be created as usual. For variants in which the selection of the interconnection partners changes, these options must be configured in the technological I/Os.

In the following, the CMT is preconfigured for the display of different process values (channel driver or difference formation). For this purpose, optional block or block groups and the optional circuits are created in the technological I/Os.

1. In the technological I/Os, select the CM "Opt_PV_Scale" and enable the Optional attribute. This action can be used to deselect the central setting of the scaling and unit.

#### Table: CM designation and Block with parameter

<table>
<thead>
<tr>
<th>CM designation</th>
<th>Block with parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PV_FB_In.PV_Li</td>
</tr>
<tr>
<td></td>
<td>PV_FB_In.PV_ST</td>
</tr>
<tr>
<td></td>
<td>PV_FB_In.Bad</td>
</tr>
<tr>
<td></td>
<td>PV_FB_In.OosAct</td>
</tr>
<tr>
<td>PV_In</td>
<td>PV_In.PV_In</td>
</tr>
<tr>
<td></td>
<td>PV_In.Bad</td>
</tr>
<tr>
<td></td>
<td>PV_In.PV_Out</td>
</tr>
<tr>
<td></td>
<td>PV_In.OosAct</td>
</tr>
<tr>
<td>PV_TE_In</td>
<td>PV_TE_In.PV_In</td>
</tr>
<tr>
<td></td>
<td>PV_TE_In.Bad</td>
</tr>
<tr>
<td></td>
<td>PV_TE_In.PV_Out</td>
</tr>
<tr>
<td></td>
<td>PV_TE_In.OosAct</td>
</tr>
</tbody>
</table>

#### NOTE

Setting the default option in the CMT enables an optional block to be selected by default for a new instance.

Open the corresponding CMT in the master data library and select the "Set as Default Option" option.
2. To create variants, activate the optional attribute for the CM "DeltaCalc", "PV_FB_In", "PV_In" and "PV_TE_In".

3. Link the other process value outputs of the channel drivers and the differential with the PV input of the display block using Drag&Drop.

**Note**

All links or connections are listed in the attribute "Connection to".
4. Perform the wiring as in step 10 for the following parameters in the technological I/Os from the source to the destination:

<table>
<thead>
<tr>
<th>Parameter source</th>
<th>Parameter target</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV_Fb_In.Bad</td>
<td>I.CSF</td>
</tr>
<tr>
<td>PV_In.Bad</td>
<td></td>
</tr>
<tr>
<td>PV_TE_In.Bad</td>
<td></td>
</tr>
<tr>
<td>PV_FB_In.OosAct</td>
<td>I.OosLi</td>
</tr>
<tr>
<td>PV_In.OosAct</td>
<td></td>
</tr>
<tr>
<td>PV_TE_In.OosAct</td>
<td></td>
</tr>
</tbody>
</table>

**Note**
The multiple interconnections for variant creation only work if the attribute "Optional" was activated for all variant blocks (CM) at the beginning. The connections from the parameter source to the parameter target are only made in the technological I/Os.

**Note**
The display CMT is part of the BPCM library and the project "Equipment Modules for SIMATIC PCS 7 using the example of the Chemical Industry". You can find the sample project under the link https://support.industry.siemens.com/cs/ww/en/view/53843373

### 4.2 Scenario B - Planning a cascade control with CMT

The basis for sustainable engineering in PCS 7 is the use of a master data library with CMT. For the following scenario, the Best Practice Control Module Type Library (BPCM library) is used to create a "Temperature Flow Cascade" control. Cascade control is used for applications where variations within the auxiliary control loop (from the flow controller) need to be compensated or where the actuator has a nonlinear valve characteristic. The following figure shows the P&I diagram of a temperature flow cascade.

**Note**
The project/multiproject was created according to the procedure in the manual "SIMATIC Process Control System PCS 7 Compendium Part A - Configuration Guidelines (V9.0)". The project planning guidelines can be found under https://support.industry.siemens.com/cs/ww/en/view/109756485
1. Change to the "Plant View" of your project in the SIMATIC Manager and create a hierarchy folder with the name "CMT" in your master data library.

Note: The folder name is not binding. Even the Process Tag Type folder can be used.

2. Retrieve the Library "109475748_BPCM_Lib_PCS7V90SP1.zip" and switch to the "Plant view".
3. Drag the included CMT folders in the master data library of your project.

Note

All the necessary blocks are adopted when transferring the CMT.

4. Change the folder names in the AS project "CMT_Eng_AS" for the hierarchy folder subsystem "Unit" and subordinate the equipment module "Temperature-Flow-Cascade".

5. Copy two controller CM "Ctrl" and one valve CM "ValAn" from the master data library into the folder "Temperature-Flow-Cascade".

6. Change the names of the CM "PIDCon" to "TIC_Temperature", "PIDCon(1)" to "FIC_ServMedium" and "VlAn" to "YC_ServMedium".

7. Open the CFC "YC_ServMedium", show the "Technological I/Os" and select "Variants..." from the context menu.
8. In this example, the valve receives the manipulated variable from the controller, the range of adjustment and the unit are configured centrally and the valve (actuator) delivers an analog signal including readback of the manipulated position.

If you cannot imagine an exact function under the individual selection points, then you receive a complete overview of the interconnected blocks and configured technological I/Os in the CMT. You can find the assigned CMT in the object properties of the CFC.

9. If necessary, change the setting range at the block "MV_Scale" and the unit at the block "MV_Unit". The default is 0% to 100%.

**Note**
If the communication interfaces of the actuator are not known, the variant can be subsequently changed in the CFC.

10. Open the CFC “FIC_ServMedium”, show the “Technological I/Os” and select "Variants..." from the context menu.

11. In this example, the controller receives its setpoint from a master controller and defines the manipulated variable for the valve. The process size and unit are set centrally and the flow rate is measured by a field device with digital communication.
12. For the process variable, set the range 0 to 10 on the "PV_Scale" block and the unit 1328 (t/h) on the "PV_Unit" block.

13. Connect the block output "to_Actor_Slave" to the block input "from_Ctrl" of the valve CM and the block output "to_Ctrl" to the block input "from_Actor_Slave".

14. Open the CFC "TIC_Temperature", show the "Technological I/Os" and select "Variants..." from the context menu.

15. In this example, the master controller "TIC_Temperature" gives the setpoint to the slave controller "FIC_ServMedium". The process variable and unit are set centrally and the temperature is recorded as an analog measured value.

16. For the process variable, set the range 0 to 200 on the "PV_Scale" block and the unit 1001 (°C) on the "PV_Unit" block.

17. Connect the block output "to_Actor_Slave" with the block input "from_Master" of the slave controller "FIC_ServMedium" and the block input "from_Actor_Slave" of the master controller "TIC_Temperature" with the block output "to_Master" of the slave controller "FIC_ServMedium".
Note
In addition, you must link the individual channel drivers of the CM with the respective periphery via the symbolic name. In the second step, the two control loops must be set, starting with the flow control "FIC_ServMedium" and then the temperature control "TIC_Temperature".

Note
The preconfigured and simulated "Temperature Flow Cascade" is part of the project "Equipment Modules for SIMATIC PCS 7 using the example of the Chemical Industry" under the link: https://support.industry.siemens.com/cs/ww/en/view/53843373
4 Application scenarios

4.3 Scenario C - Efficient functional enhancement to APG via type matching

The following shows how the existing "Unit Template Distillation Column" project can be expanded to include optimized process operation by APG (Advanced Process Graphics). The project has a structured structure, i.e. it contains the levels subsystem, Equipment Module (EM) and Control Module (CM) and is based on the Basis Control Modul library.

APG provides both an AS object for connection to the automation software and some OS objects for displaying the process information. In this scenario, the focus is on efficient AS project planning, which can be carried out quickly and with the necessary flexibility with the help of CM technology. The APG Connector block required for the display is added and preconfigured once in each type and is then available to each instance as an option.

Preparation

1. Dearchive the sample project "Distillation column" in the SIMATIC Manager and switch to the "plant view" of your project.
2. Add the APG Connector block "HMIpConn" to the master data library.

Note

The block is available with the installation of Advanced Process Graphics. A description of the installation and integration can be found in the application example "Integration of Advanced Process Graphics in SIMATIC PCS 7" at https://support.industry.siemens.com/cs/ww/en/view/89332241.

3. Add the "HMIpConn" block with the designation "HMI" to the CMT "Ctrl".

4. Connect the "ReadPointer" input of the "HMIpConn" block to an output of the "PIDConL" block.
4 Application scenarios

**Note**
Use an unused output of the source device for the casing. For this project planning example, the output "Status2" of the controller block was made visible and connected.

5. Parameterize the "HMIpConn" device with the following parameterization:
   "BlockType": 2 as a suitable representation of PIDConL
   "ViewMode": 1 for absolute value range
   "ViewRange": 4 to display the working range
   "DispRatio": 0.6 ratio of display to ViewRange

6. Use drag&drop to add the APG block "HMIpConn" with the designation "APG" to the technological I/Os.

7. Drag the block inputs "ViewMode", "ViewRange", "DispRatio" and the working and limit value monitoring "PV_Xx_Li" onto the CM "APG" and update the screen display with the function key "F5".

8. Select the CM "APG" in the technological I/Os and activate the optional attribute. Thanks to this action, the visualization can be selected when needed.

9. Repeat steps 3 to 7 for the CMT "AMon" with "BlockType": 1 as a suitable representation of MonAnL.

**Note**
Project planning is carried out for both controller and display CMT with "MonAnL" blocks. The output "Status2" of the "MonAnL" device can be connected to the APG Connector block.
The "ENO" output of the block must not be used for the "ReadPointer" circuit.
If you configure a different range for the "ViewRange" parameter, e.g. the alarm range, you must also configure the corresponding "PV_Xx_Li" limits.

**Synchronization**

1. Select the AS project in the plant view of the SIMATIC Manager and select "Plant Types > Synchronize..." in the context menu.

2. Mark the two types "AMon" and "Ctrl" and press the button "Synchronize...".
3. Click on the "Synchronize template" button in the comparison dialog.

**Note**

After propagating the change, the "APG" option is available in the instances. The option is not selected by default.

**Instance adjustment**

1. Activate the option "HMI" for the following instances:
   a. Controller: "FIC_Feed", "FIC_Reflux", "FIC_Vapor", "PIC_ColuHead", "LIC_Bottom", "LIC_RefluxDrum"
   b. Display: "TI_Head", "TI_HeadPacking", "TI_AboveFeed", "TI_BelowFeed", "TI_BottomPacking", "TI_Bottom", "PI_ColuBottom", "FI_Disitl", "FI_Bottom"

2. The final steps are:
   a. Setting the work areas "PV_Ol_Li" and "PV_Oh_Li" in each instance
   b. Create a process image with APG objects using the templates "@Template_APG.pdl" and "@Examples_APG.pdl".
   c. Link the process screen objects with the relevant instance using the Dynamic Wizard.

**Note**

A detailed description for configuring the process image and interconnecting the APG objects (AS-OS connection) can be found in the application example "Integration of Advanced Process Graphics in SIMATIC PCS 7" under the following link:

4.4 Scenario D - Creating and using functions

Creating a function

1. In the plant view, right-click on the CMT storage folder and click on "Create New Object > Control Module Type".
2. Enter a sensible name for the Control Module Type and open it.
3. Use Drag&Drop to drag the required blocks into the CFC and assign them sensible names.
   If several blocks are used, connect the blocks.
4. Define the technological I/Os by dragging and dropping the required parameters and signals into the "Technological I/Os" field.
   This creates the corresponding objects in the "Technological I/Os" and links them to the block.
4 Application scenarios

5. Activate the "Function" option in the technological I/Os.

By activating the option "Function" the symbol changes from CMT 🔄 to symbol of a function. 🔄.

**Note**
The "Function" field can only be selected if no SubCM is used. With a function with SubCM, a further hierarchy level would be created in the technological I/Os with the integration in a CMT that is not allowed.
4 Application scenarios

Using Functions in PCS 7

1. Open the plan of the instance where you want to insert the function.
2. Select the project library with the CMTs from the "Templates" tab and drag the created function into the "Technological I/Os" window of the opened instance.

![Image of PCS 7 interface]

This creates the function in an empty CFC subchart.

3. Drag the function to the desired mounting position.
4. Connect and parameterize the function.

The adaptation of the instance (CM) is known when importing into the mass data engineering tools (COMOS and (PAA)) and SIMIT.

Use of Functions in PAA

1. Click on the "Import/Export PCS 7" button in the PAA menu bar.

![Image of PAA interface]

The dialog "Import / Export PCS 7" opens in the working view of PAA.
4 Application scenarios

2. Open the "Import" tab.
3. Select the PCS 7 project.
4. Select your PCS 7 project.
5. Activate the option boxes "CM Types", "Enumerations" and "Functions" in the "Filter" directory and deactivate the remaining option fields.
6. Select option "DCS".
7. Click on the "Import" button.
8. Click on the "Import from B to A" button to start the import from PCS 7 to PAA.

Note
The "Import from B to A" button is only enabled if differences are found between the PAA and PCS 7 projects. Only changes are ever imported.

9. After the data transfer, click on the "Close" button to close the import dialog.

10. Open the "Plant" view.
11. Navigate to the Control Module where you want to use the function and open the subordinate objects.

12. Double-click to open the respective “Function diagram”.

13. Drag the function from the folder "<Project name> > Templates > Template container > Functions” into the “Function diagram”.

14. Connect and parameterize the function.

The adjustments of the CM are made directly in the Plant Automation Accelerator without changing the CMT. When exporting to PCS 7, the function is integrated into the CM.
5 Appendix

5.1 Service and support

Industry Online Support

Do you have any questions or need assistance?
Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.
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- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts
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support.industry.siemens.com/cs/sc

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You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
support.industry.siemens.com/cs/ww/en/sc/2067
5.2 Links and literature

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<td>1.1</td>
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<td><a href="https://support.industry.siemens.com">https://support.industry.siemens.com</a></td>
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<td>3.1</td>
<td>Synchronization of individual control module types (PCS 7 V9.0 SP1)</td>
<td><a href="https://support.industry.siemens.com/cs/ww/en/view/109758382">https://support.industry.siemens.com/cs/ww/en/view/109758382</a></td>
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<tr>
<td>4.1</td>
<td>SIMATIC PCS 7 Overview (link collection to FAQ, manuals, compendium, forum, application examples and videos)</td>
<td><a href="https://support.industry.siemens.com/cs/ww/en/view/63481413">https://support.industry.siemens.com/cs/ww/en/view/63481413</a></td>
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<tr>
<td>5.1</td>
<td>SIMATIC PCS 7 Plant Automation Accelerator using a practical example</td>
<td>(<a href="https://support.industry.siemens.com/cs/ww/en/view/109742154">https://support.industry.siemens.com/cs/ww/en/view/109742154</a>)</td>
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<td><a href="https://support.industry.siemens.com/cs/ww/en/view/70922226">https://support.industry.siemens.com/cs/ww/en/view/70922226</a></td>
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5.3 Change documentation

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<th>Modifications</th>
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<td>V1.0</td>
<td>09/2015</td>
<td>First version</td>
</tr>
<tr>
<td>V2.0.</td>
<td>03/2019</td>
<td>Update to V9.0 SP1, Additional sections:</td>
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<td>2.5 “Typical changes of the CMTs and CM”</td>
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<td>2.6 “Conversion of a PTT into a CMT”</td>
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<td>2.9 “Functions”</td>
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<td>4.4 “Scenario D - Creating and using functions”</td>
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<tr>
<td>V2.1</td>
<td>04/2020</td>
<td>correction</td>
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