

# **DMC300**

**Machine Model and Connectivity  
with SAP Digital Manufacturing  
Cloud**

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**PARTICIPANT HANDBOOK  
INSTRUCTOR-LED TRAINING**

Course Version: 2111  
Course Duration: 2 Day(s)  
Material Number: 50158222

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# Typographic Conventions

American English is the standard used in this handbook.

The following typographic conventions are also used.

This information is displayed in the instructor's presentation



Demonstration



Procedure



Warning or Caution



Hint



Related or Additional Information



Facilitated Discussion



User interface control

*Example text*

Window title

*Example text*

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# Course Overview

## TARGET AUDIENCE

This course is intended for the following audiences:

- Project Manager
- Project Stakeholder
- Application Consultant
- Support Consultant
- Industry / Business Analyst Consultant
- Super / Key / Power User
- Business Process Architect
- Business Process Owner/Team Lead/Power User
- Enterprise Architect
- Industry Specialist
- Solution Architect
- System Administrator
- System Architect

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# UNIT 1

# Digital Manufacturing Cloud and Plant Connectivity Overview

## Lesson 1

Digital Manufacturing Portfolio

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## Lesson 2

High-Level Capabilities of the Digital Manufacturing Cloud Solution

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Integration Scenarios

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Exercise 4: Test Run Shop Floor Automation

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## UNIT OBJECTIVES

- Describe the solutions that are included with SAP Digital Manufacturing Cloud
- Provide examples on how SAP Digital Manufacturing Cloud can be integrated in various system landscape options
- Explain how SAP Digital Manufacturing Cloud fits in with the SAP Manufacturing Suite solutions
- Describe the benefits that come with Digital Manufacturing Cloud for Execution, Insights, Network and Machine and Process Orchestration
- Describe the Concepts of Plant Connectivity
- Explain scenarios for Shop Floor Integration

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## Digital Manufacturing Portfolio

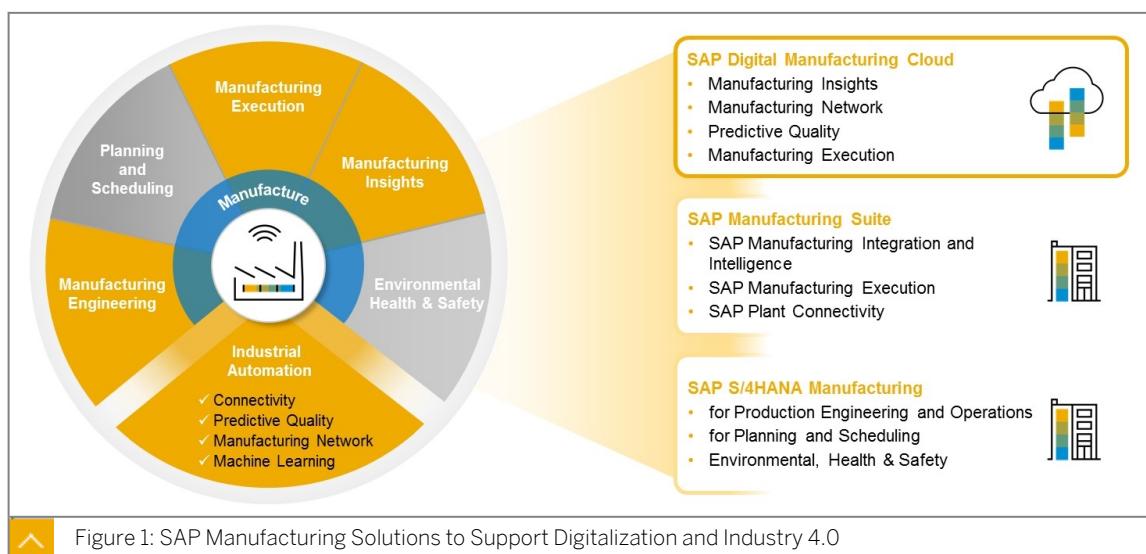


### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Describe the solutions that are included with SAP Digital Manufacturing Cloud
- Provide examples on how SAP Digital Manufacturing Cloud can be integrated in various system landscape options
- Explain how SAP Digital Manufacturing Cloud fits in with the SAP Manufacturing Suite solutions

### Describing the solutions that are included with SAP Digital Manufacturing Cloud



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SAP offers both Cloud and On-Premise solutions to meet manufacturers needs.

The SAP Digital Manufacturing Cloud offers Public cloud-based solutions providing Shop Floor to Top Floor visibility as well as extending your reach into your Manufacturing networks.

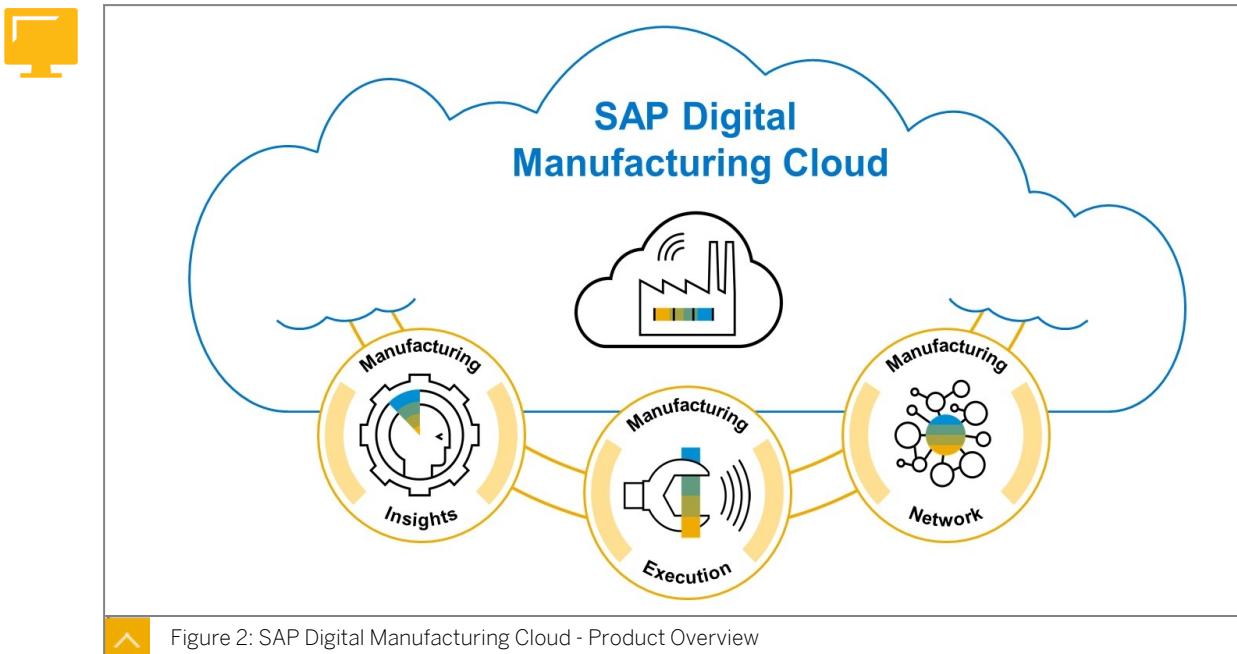
The SAP Manufacturing Suite of On-Premise solutions also provide this visibility with feature-rich solutions connecting the machinery to your Enterprise solutions.

The S/4 HANA Manufacturing Solutions provide additional Shop Floor solutions for Planning and Scheduling, Engineering-Change-driven Complex Manufacturing, as well as Environment, Health and Safety solutions.

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**Examples on how SAP Digital Manufacturing Cloud can be integrated in various system landscape options**



Connect your top floor business systems to your shop floor equipment for global visibility across all plants while orchestrating execution and monitoring production operations down to the individual work center. Take advantage of the manufacturing network to achieve greater flexibility and realize new business models.

#### Manufacturing Execution

- Manage your production using the latest technology built on the SAP Business Technology Platform.
- Orchestrate and control the shop floor with out-of-the box integration to SAP ERP and S/4HANA.

#### Manufacturing Insights

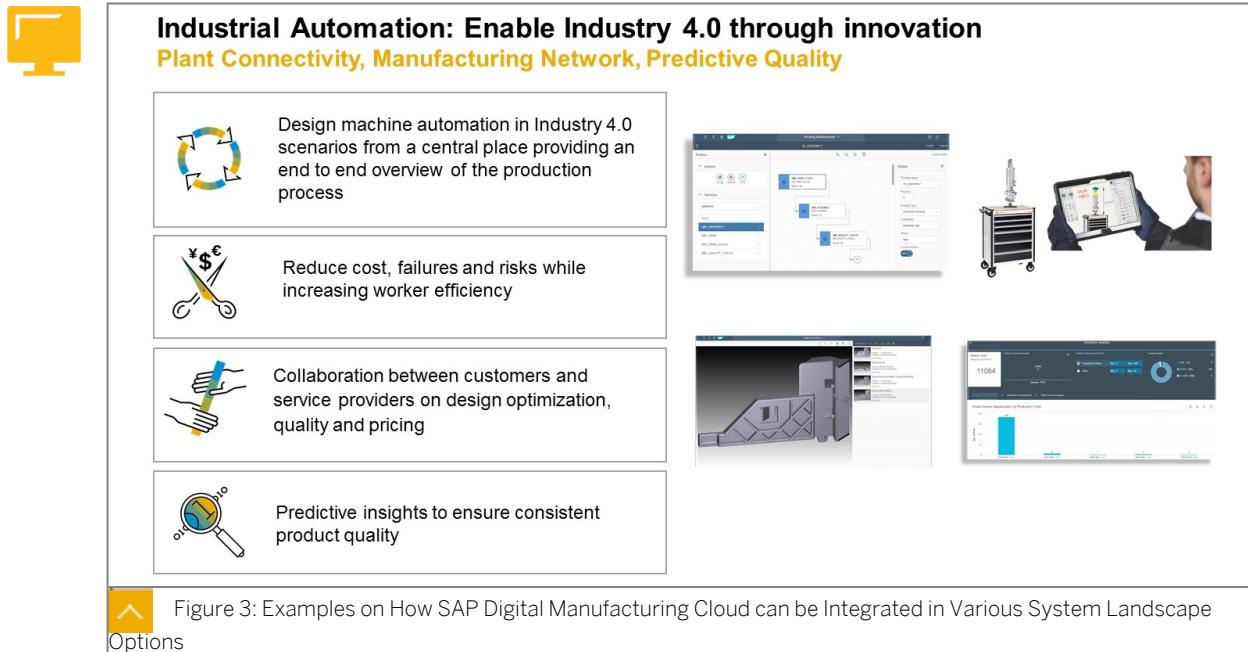
- Manage and control the production systems with real time insights and root cause analysis.
- Detect quality defects and utilize built-in machine learning for predictive quality.

#### Manufacturing Network

- Collaborate with network partners to build digital inventory to optimize the offerings.
- Allow SAP's software partners to provide extensions.

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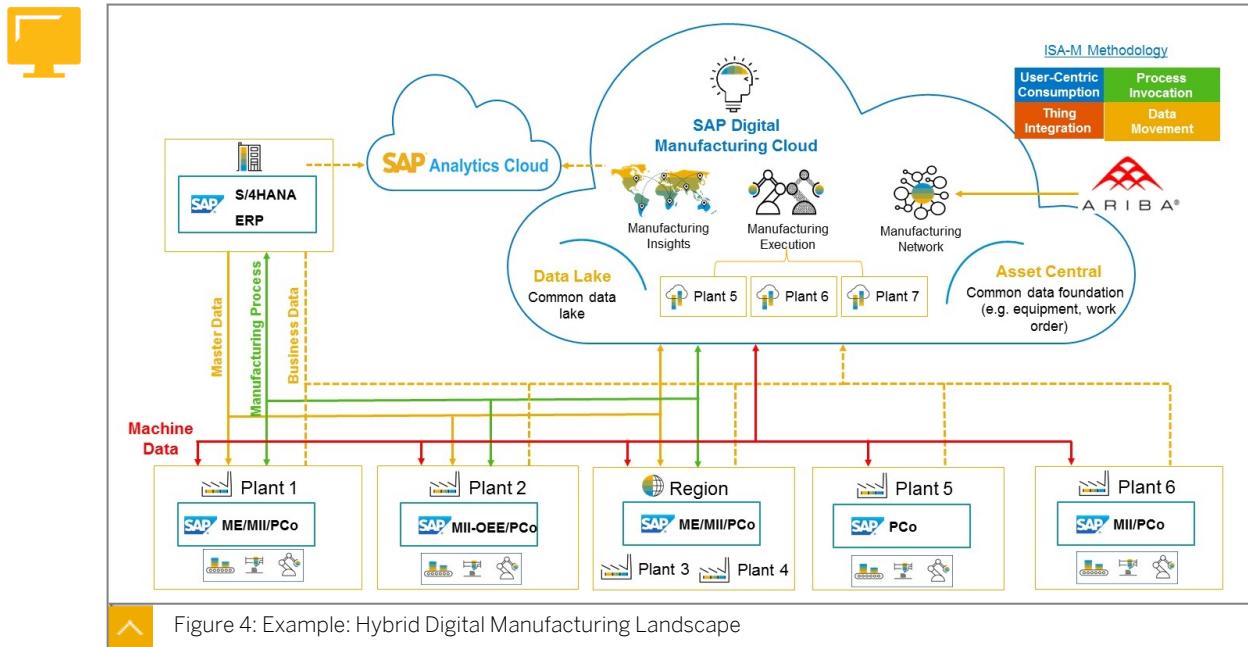
Industrial Automation is a key pillar of Industry 4.0.

Plant Connectivity (PCo), is SAP's on-premise solution used to connect shop floor machinery for facilitating automation with SAP's manufacturing solutions including S/4HANA, MII, ME, as well as Digital Manufacturing Cloud.

Manufacturing Networks reduces costs through improved collaboration between vendor and customer regarding product design, quality, and pricing.

Predictive Quality provides machine-learning insights used to improve product quality and reduce analysis efforts.

## Explaining how SAP Digital Manufacturing Cloud fits in with the SAP Manufacturing Suite solutions



SAP knows that customer's manufacturing and manufacturing support needs vary from location to location. As such, SAP's solutions have been constructed such that they are complimentary and can be used together to best serve the needs of the individual locations while providing common Key Performance Indicators for analyzing location manufacturing performance and health.

This diagram shows one possible example where there are 7 plants manufacturing within the organization. The ERP platform, powered by S/4 HANA is the single source of planning and master data for all shop floor processing. Plant 1 has an independent implementation of SAP Manufacturing Execution and MII and Plants 3 and 4 have a shared regional implementation of SAP ME and MII. Plant 2 represents a facility utilizing MII-OEE. Plant 6 and 7 serve Manufacturing Execution in the Cloud. All sites utilize on-premise Plant Connectivity for machine integration.

All data rolls up to common KPI's using Manufacturing Insights with a Common Data Lake.

Data can be made available for SAP Analytics Cloud from the SAP Digital Manufacturing Cloud for enhanced reporting.



## LESSON SUMMARY

You should now be able to:

- Describe the solutions that are included with SAP Digital Manufacturing Cloud
- Provide examples on how SAP Digital Manufacturing Cloud can be integrated in various system landscape options
- Explain how SAP Digital Manufacturing Cloud fits in with the SAP Manufacturing Suite solutions

# Unit 1

## Lesson 2

# High-Level Capabilities of the Digital Manufacturing Cloud Solution



## LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Describe the benefits that come with Digital Manufacturing Cloud for Execution, Insights, Network and Machine and Process Orchestration

## High-Level Capabilities of the Digital Manufacturing Cloud Solution



Paperless production



Dynamic Shop Floor Control



Resource Orchestration



Cross plant real-time analytics



Collect and share product genealogy data between members of the network

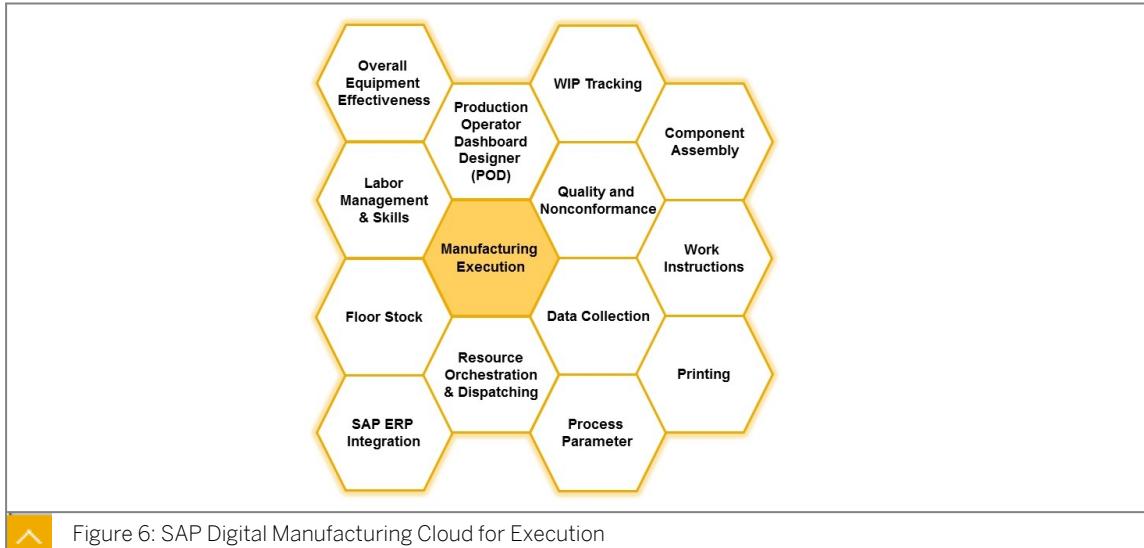
Figure 5: Automate Processes and Resources to Improve Manufacturing Efficiency, Quality and Productivity

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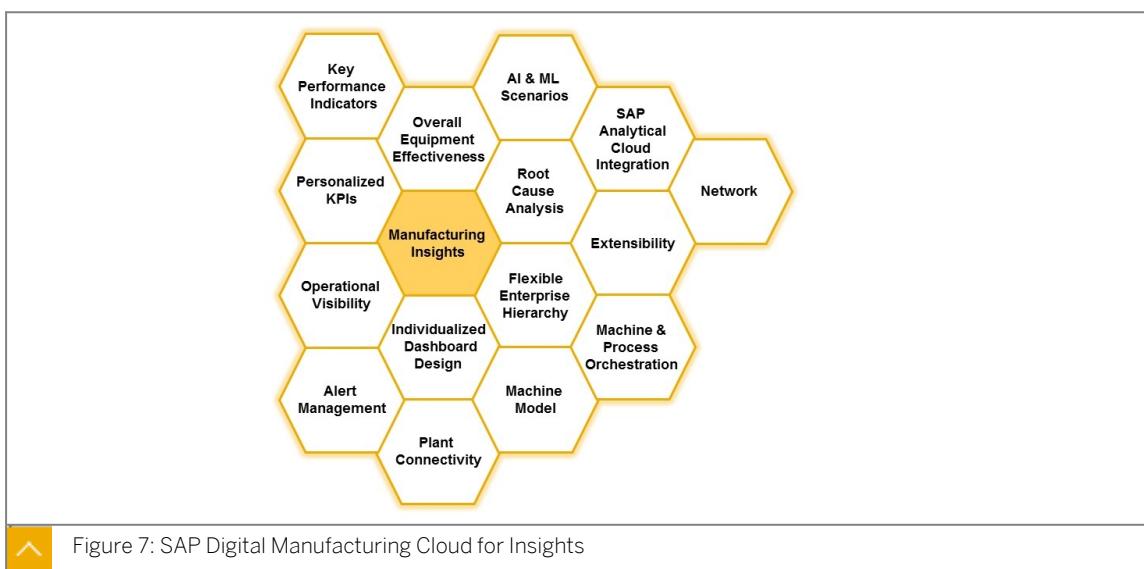
As manufacturer, you improve manufacturing efficiency, quality and productivity via:

- Paperless production with intuitive user interfaces for production operators, automatic data collections and set machine parameters, thereby lowering cost, increasing productivity and quality.
- Design, distribute and dynamically control manufacturing shop floor activities enabling a smart factory.
- Shift and Labor planning to ensure business operations with right qualifications. Production Order scheduling and dispatching considering labor, resource and maintenance constraints to plan operations and adopt to short term changes.
- Cross plant real-time analytics for manufacturing performance e.g. Perfect Order Fulfillment, Overall Equipment Effectiveness, loss analysis along with machine data to identify improvement opportunities.
- Ability to collect and share product genealogy data between members of the network to trace accountability and provide transparency.



### Key Capabilities

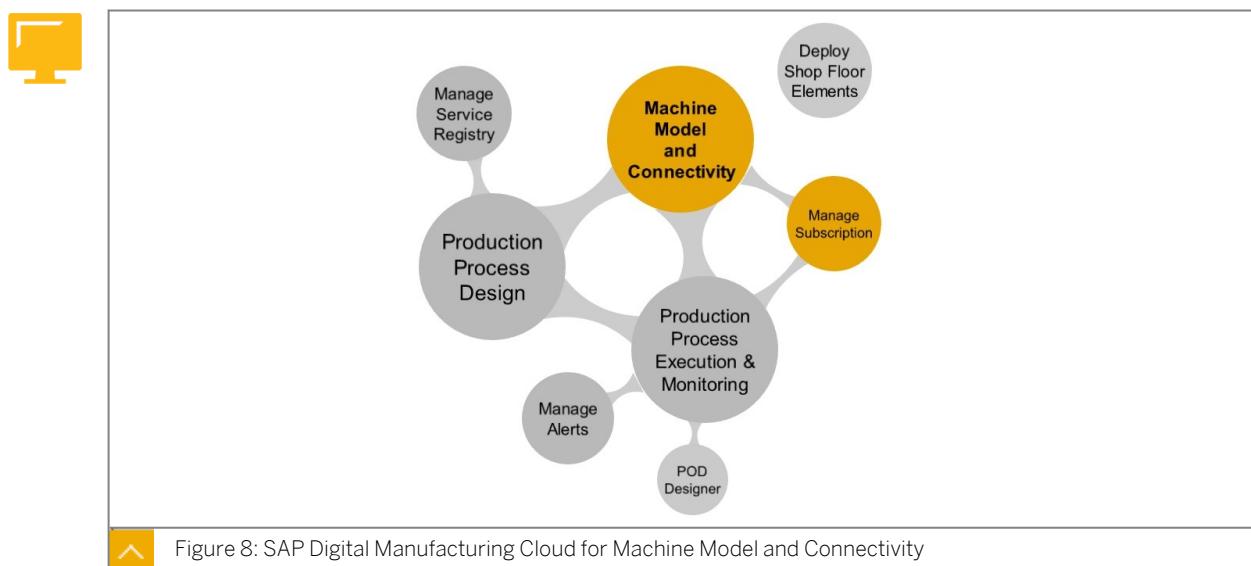
- Implement top-floor to shop-floor scenarios to achieve rapid return-on-investment through out-of-the-box integration to SAP solutions
- Utilize intuitive user interfaces (UI) for production operators and transform to paperless production
- Dispatch and sequence operations to reflect the real world in the short term
- Monitor the entire manufacturing process to optimize resources and execution
- React quickly to unexpected events



### Key Capabilities

- Gain insights on performance and productivity across different levels of the enterprise hierarchy (i.e. across regions, plants, work centers, resources, etc.)
- Take informed decisions by combining and utilizing data from shop floor systems, execution systems, along with contextual information from business sources (i.e. ERP)

- Use pre-delivered interactive dashboards filled with standardized key performance indicators (KPI) based on harmonized data
- Incorporate data from non-SAP sources, build customized KPI's and personalize your dashboards & reports
- Perform root cause analysis, drill -down and -up across different levels of the enterprise hierarchy



#### Key Capabilities

- Create and maintain equipment model as the digital twin of the physical device
- Design, deploy and monitor production process to enable shop floor automation
- Manage and consume 3rd party services
- Subscribe for automatic process execution

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# Unit 1

## Exercise 1

# Navigate Digital Manufacturing Cloud

You have recently started a new role as a Manufacturing Engineer which requires you to work extensively in the Digital Manufacturing Cloud solution. As part of your onboarding process you are provided access to the system and need to verify that you are able log in and execute a few different apps you will be using.

### Task 1: Logging In

1. Connect to the Digital Manufacturing Cloud system

### Task 2: Selecting a Plant

1. Access your user settings

### Task 3: Accessing an Application

1. Open an app by scrolling through the Fiori Launchpad
2. Open an app by selecting the tile group
3. Open an app by searching for the app name

### Task 4: Adding Your User to Work Centers

1. Open the *Manage User Assignments* app and assign all work centers to your user DMC300-##

# Unit 1

## Solution 1

# Navigate Digital Manufacturing Cloud

You have recently started a new role as a Manufacturing Engineer which requires you to work extensively in the Digital Manufacturing Cloud solution. As part of your onboarding process you are provided access to the system and need to verify that you are able log in and execute a few different apps you will be using.

### Task 1: Logging In

1. Connect to the Digital Manufacturing Cloud system
  - a) Open the browser.
  - b) Enter the URL <https://<hostname>/cp.portal/site#Shell-home>



Note:

Use the DMC access URL provided by the instructor

- c) Enter the username and password as provided to you by your course instructor
- d) Click the *Log On* button.

You should now be logged in to Digital Manufacturing Cloud at the home screen.

### Task 2: Selecting a Plant

1. Access your user settings
  - a) In the top right corner of your browser, click the Plant icon of a person to open your user menu
  - b) On the pop up, select *DMC300*
  - c) Click Save to save the record.

### Task 3: Accessing an Application

1. Open an app by scrolling through the Fiori Launchpad
  - a) From the home screen, scroll down until you find the *Manage Plants* app.
  - b) Click on the *Manage Plants* app to open it.
  - c) Click the *Back* icon at the top left to go back to the home screen.
2. Open an app by selecting the tile group
  - a) From the home screen, select the *More Groups* icon (looks like a down arrow) from the top right of the screen.  
A drop-down list of all the tile groups should appear.

- b) Select the group *Manufacturing Configuration*.  
This will bring you directly to the group in the Fiori Launchpad.
- c) Click on the *Manage Plants* app to open it.
- d) Click the *Back* icon at the top left to go back to the home screen.
3. Open an app by searching for the app name
- From the home screen, click on the magnifying glass icon in the top right to open up the search field.
  - In the search field, enter **Manage Plants**.
  - The app for *Manage Plants* will show up in a list below the search field.
  - Click on the app in the list to go straight into the *Manage Plants* app.

#### Task 4: Adding Your User to Work Centers

- Open the *Manage User Assignments* app and assign all work centers to your user DMC300-##
  - From the home screen, scroll down until you find the *Manage User Assignment* app.
  - Click on the *Manage User Assignment* app to open it.
  - Find the user ID that has been assigned to you for the training (for example, DMC300-##) and click on the record to go to the details.
  - On the details screen that appears on the right side of the app, go to the *Work Center* section, and click *Add*.
  - Select all the work centers and click *Select*.
  - Click on the *Save* button at the bottom of the app to save your user record.



## LESSON SUMMARY

You should now be able to:

- Describe the benefits that come with Digital Manufacturing Cloud for Execution, Insights, Network and Machine and Process Orchestration

# Plant Connectivity Overview (Source System, Agent Instances, Destination Systems, Notifications)



## LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Describe the Concepts of Plant Connectivity

## Plant Connectivity

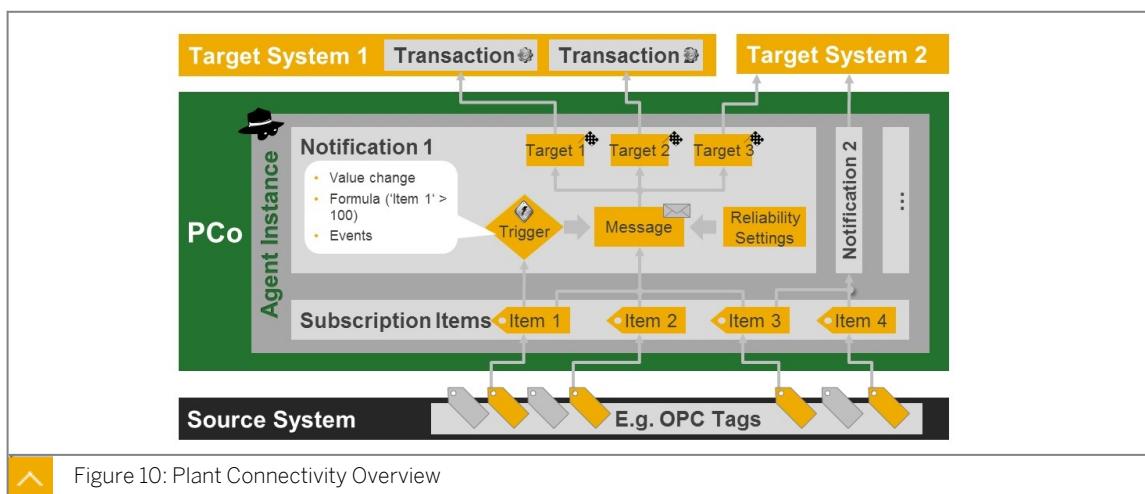


SAP Plant Connectivity (PCo) is a manufacturing automation software which provides fast data exchange between SAP systems and manufacturing sources such as PLC controls, plant historian systems, statistical process control (SPC) software, and more.

PCo provides connectivity services for the manufacturing industry, in particular unsolicited data notification services: In this way it enables the manufacturing integration between real-time manufacturing systems and SAP applications. PCo is a highly extensible infrastructure on which to build manufacturing applications.



Figure 9: What is SAP Plant Connectivity



The basic components of PCo are:

- **Source System:** A source system refers to a specific data source from which data is to be queried. You need to make an entry in the PCo console for the computer or control device from which you want to query data.
- **Destination System:** A destination system is the instance to which notifications are sent from an agent perspective. A destination system provides the technical means to connect

to external systems such as SAP MII, SAP ME, or Business suite systems .Destination systems are not only required in a notification and the destination Systems Calls with Response Processing communication Pattern. Once a destination system has been configured, it can be re-used in multiple agent instances and notifications.

- Agent Instance: Agent instances are the central components of PCo. They establish the data flow between the data source and PCo and enable the processing and forwarding of notification messages. Moreover they process queries and method calls. The Functions of the agent instance are:
  - Control the data and information flow between the data source and the various destinations
  - Provide a Query interface for queries from external systems such as MII or SAP NetWeaver-based applications
  - Event logging for error analysis
- Notification: You use notifications to define under which circumstances, with which data, and to which destination you want PCo to send information when a specific event occurs. The functions of the notification are:
  - Filtering of tag values (for example, only react to tag value changes, trigger conditions)
  - Modification of tag values (for example, output expressions)
  - Provide message queuing for notification communications including retry functionality and error handling)

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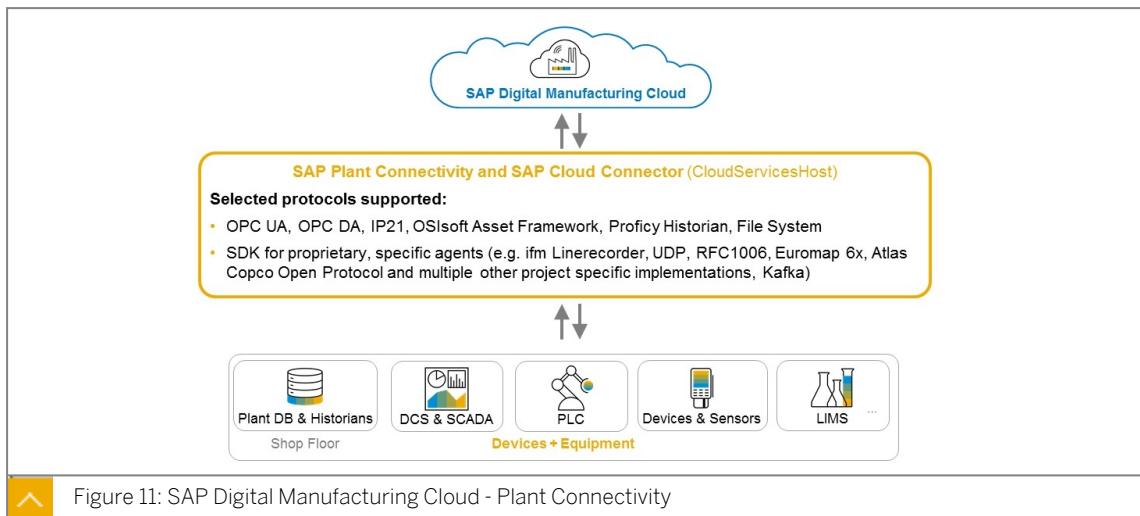


Figure 11: SAP Digital Manufacturing Cloud - Plant Connectivity

The integration between DMC and plant connectivity enables the exchange of data between Information Technology (SAP Systems) and Operational Technology (Logic Controllers, Devices, Plant Historian Systems) in a manufacturing environment.

- Bi-Directional data exchange
- High Performance Interoperability
- Machine Protocol conversion and secure communication with SAP DMC
- Configurable process sequences; orchestration of independent Machine Units
- OPC UA Client and flexible WebService invocation (REST)

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- Web Server, OPC UA Server (Methods)
- Bundling and buffering of notifications; notification delivery retry; rule framework
- Open for customer specific enhancements via SDK (proprietary protocols and complex processing logic)

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## Unit 1 Exercise 2

# (Optional) Setup and Manage Plant Data Collection

You have previously installed SAP Plant Connectivity (PCo) on a new Microsoft Windows PC on the shop floor. Now you want to perform a quick check to make sure the installation was successful.

### Task 1: Log on to the training system using Remote Desktop Connection

1. Log on to the training landscape server <>server name<> with your user provided by the instructor.

### Task 2: Start the PCo Management Console

1. In the lower left corner of the screen, choose the Windows Start button and look for SAP Plant Connectivity → Management Console.
2. If the PCo Management Console opens in Administrator mode, you are ready to do the exercises as described in this course.

### Task 3: Create a source system of type OPC UA Source System that connects to a tag-based OPC UA server.

1. Start the Management Console (Plant Connectivity).
2. Create a source system named **##\_OPC\_UA** of type OPC UA Source System. Assign it the description OPC UA source system.
3. Locate the endpoints of the OPC UA server using the local OPC UA discovery server.
4. Select the server endpoint `opc.tcp://localhost:51210/UA/SampleServer - [None:None:Binary]`.



Note:  
localhost is Discovery Server

5. On the Security tab, ensure that the session authentication mode is set to anonymous.
6. On the Session tab, test the connection to the server. The expected result is Connection established successfully.
7. Save your changes.
8. Create an empty folder on your Windows desktop called PCo Notifications\_##.

**Task 4: Configure a simulation destination system that simulates the database into which the tag values will be written**

1. In the PCo Management Console, create a simulation destination called ##\_SIM\_DEST.
2. Configure the simulation destination so that messages will be written into the folder you created on your Windows desktop.

**Task 5: Configure a simulation destination system that simulates the database into which the tag values will be written.**

1. Create an agent instance named ##\_UA2SIM based on the source system ##\_OPC\_UA that you created earlier.
2. Create subscription items for the following tags from the local OPC UA server: Data → Group## → Dynamic → Scalar → Int16Value Data → Group## → Static → Scalar → Int16Value  
Name the first subscription item Int16Value\_Dynamic and the second one Int16Value\_Static.

**Task 6: Configure a notification that routes the tag changes to the simulation destination system**

1. Create a static notification named ToSimDest in your agent instance ##\_UA2SIM.
2. Add two output expressions to the notification ToSimDest so that both subscription items will be written 1:1 to the simulation destination when the agent instance is running.
3. Create a third output value of data type System.Int32, called Sum. Sum shall be the sum of 'Int16Value\_Dynamic' and 'Int16Value\_Static'.
4. Assign the destination system ##\_SIM\_DEST to the notification ToSimDest.
5. Save all your changes.
6. Start your agent instance##\_UA2SIM.
7. Choose the Start Agent Instance icon. After a while, the agent instance status indicator changes to Running.
8. On your Windows desktop, look into your PCo\_Notifications\_## folder. You should see new XML documents coming in about once every second.
9. Wait about twenty seconds, then stop the agent instance.
10. On your Windows desktop, open two of the XML documents in Internet Explorer.  
When you open the XML files with Internet Explorer, you should see an XML representation of the notification messages. There should be three values in the notification message: Int16Value\_Dynamic, Int16Value\_Static, and Sum. The CDATA section contains the values of the tags.



Note:

Make sure that SUM is the sum of Int16Value\_Dynamic and Int16Value\_Static.

Furthermore, you should see that Int16Value\_Dynamic constantly changes its value, thus triggering the notifications in PCo. Int16Value\_Static does not change its value, but is written to the notification message anyway.

## (Optional) Setup and Manage Plant Data Collection

You have previously installed SAP Plant Connectivity (PCo) on a new Microsoft Windows PC on the shop floor. Now you want to perform a quick check to make sure the installation was successful.

### Task 1: Log on to the training system using Remote Desktop Connection

1. Log on to the training landscape server <<server name>> with your user provided by the instructor.
  - a) In Microsoft Windows, search for Remote Desktop Connection and run the application.
  - b) In the Computer field, enter the server name.
  - c) When prompted, enter the username and password.  
Ignore any warnings about certificates.

### Task 2: Start the PCo Management Console

1. In the lower left corner of the screen, choose the Windows Start button and look for SAP Plant Connectivity → Management Console.
2. If the PCo Management Console opens in Administrator mode, you are ready to do the exercises as described in this course.

### Task 3: Create a source system of type OPC UA Source System that connects to a tag-based OPC UA server.

1. Start the Management Console (Plant Connectivity).
  - a) Run SAP Plant Connectivity → Management Console.
2. Create a source system named **##\_OPC\_UA** of type OPC UA Source System. Assign it the description OPC UA source system.
  - a) Choose Source Systems → Add Source System.
  - b) Set the source system type to OPC UA Source System.
  - c) Enter the name **##\_OPC\_UA** and the description **OPC UA source system**.
  - d) Click **OK**.
3. Locate the endpoints of the OPC UA server using the local OPC UA discovery server.
  - a) Select the source system **##\_OPC\_UA** and open the Session tab.

- b) The input field Discovery Server displays localhost by default. Select the discovery server <><server name>> from the drop-down list.
  - c) Choose the *Start Discovery* button. The Server Endpoint field is populated with a server endpoint URL.
4. Select the server endpoint *opc.tcp://localhost:51210/UA/SampleServer – [None:None:Binary]*.



Note:  
localhost is Discovery Server

- a) Choose *Select Endpoint* and select the relevant server endpoint from the list.
- 5. On the Security tab, ensure that the session authentication mode is set to anonymous.
  - a) Open the Security tab and check the value under *Session Authentication → Authentication Mode*.
- 6. On the Session tab, test the connection to the server. The expected result is Connection established successfully.
  - a) On the Session tab, choose *Test Connection*.
- 7. Save your changes.
  - a) Choose *Save*.
- 8. Create an empty folder on your Windows desktop called PCo Notifications\_##.
  - a) On your Windows desktop, right-click and select *New → Folder*.
  - b) Rename the folder PCo Notifications\_##.

#### **Task 4: Configure a simulation destination system that simulates the database into which the tag values will be written**

1. In the PCo Management Console, create a simulation destination called ##\_SIM\_DEST.
  - a) Choose *Destination Systems → Add Destination System*.
  - b) Select the type as Simulation Destination and name it ##\_SIM\_DEST, then choose *OK*.
2. Configure the simulation destination so that messages will be written into the folder you created on your Windows desktop.
  - a) Select your destination system ##\_SIM\_DEST.
  - b) Choose *Browse for Destination Folder* (the icon next to the Destination field) and select your Windows folder PCo Notifications.  
The input field destination now reads as follows: C:\Users\SCM385-##\Desktop\PCo Notifications\_##

#### **Task 5: Configure a simulation destination system that simulates the database into which the tag values will be written.**

1. Create an agent instance named ##\_UA2SIM based on the source system ##\_OPC\_UA that you created earlier.
  - a) Right-click on your source system ##\_OPC\_UA and choose *Create Agent Instance*.

- b) Name the agent instance as **##\_UA2SIM**, then choose OK.
2. Create subscription items for the following tags from the local OPC UA server: Data → Group## → Dynamic → Scalar → Int16Value Data → Group## → Static → Scalar → Int16Value
- Name the first subscription item Int16Value\_Dynamic and the second one Int16Value\_Static.
- Select the agent instance **##\_UA2SIM**.
  - Open the Subscription Items tab and choose Browse for Tags.
  - In the Browse dialog box, choose *Browse*.
  - Navigate from the node AddressRoot to the first data tag, Data → Group## → Dynamic → Scalar → Int16Value, then choose *Add Selected Items*.
  - Do the same for the second data tag, Data → Group## → Static → Scalar → Int16Value
  - Before you close the browser dialog, you need to rename the two subscription items, to avoid duplicate names. Just click into the Name cell on the Selected Items grid and change the item names as specified in the step.
  - Close the browser dialog by choosing *OK*.  
The two subscription items Int16Value\_Dynamic and Int16Value\_Static appear in the Subscription Items grid.

#### **Task 6: Configure a notification that routes the tag changes to the simulation destination system**

- Create a static notification named ToSimDest in your agent instance **##\_UA2SIM**.
  - Select your agent instance **##\_UA2SIM**, right-click and choose *Add Notification*.
  - Set the notification type to *Static Notification*.
  - Set the notification name to *ToSimDEST* and choose *OK*.
- Add two output expressions to the notification ToSimDest so that both subscription items will be written 1:1 to the simulation destination when the agent instance is running.
  - Select the agent instance **##\_UA2SIM** and expand the agent instance node.
  - Select the notification *ToSimDest* and go to the Output tab.
  - Choose *Generate Expression*. The output expressions should read as follows:  
 Int16Value\_Dynamic: 'Int16Value\_Dynamic' Int16Value\_Static:  
 'Int16Value\_Static'.
- Create a third output value of data type System.Int32, called Sum. Sum shall be the sum of 'Int16Value\_Dynamic' and 'Int16Value\_Static'.
  - In the notification *ToSimDest*, go to the Output tab and choose *Add Expression Using Expression Editor*.
  - Change the name of the output expression from *Expression01* to *Sum*.
  - On the output expression *Sum*, double-click into the Expression cell to display the Expression Editor dialog.

- d)** Place the cursor in the Expression text field and double-click onto the subscription item 'Int16Value\_Dynamic'. Type the plus-sign (+), then double-click on the subscription item 'Int16Value\_Static'.  
The expression should now read 'Int16Value\_Dynamic' + 'Int16Value\_Static'
- e)** To close the expression editor, choose OK.
- f)** Change the data type of the output expression Sum from System.String to System.Int32.
- 4.** Assign the destination system ##\_SIM\_DEST to the notification ToSimDest.
- a)** In the notification ToSimDest, go to the Destinations tab and choose Add Destination System.
- b)** From the drop-down list, select the destination system ##\_SIM\_Dest, and type an arbitrary name for the notification destination, such as simulation.
- 5.** Save all your changes.
- a)** Choose Save.
- 6.** Start your agent instance##\_UA2SIM.
- 7.** Choose the Start Agent Instance icon. After a while, the agent instance status indicator changes to Running.
- 8.** On your Windows desktop, look into your PCo\_Notifications\_## folder. You should see new XML documents coming in about once every second.
- 9.** Wait about twenty seconds, then stop the agent instance.
- a)** After the agent instance has been running for about twenty seconds, select agent instance ##\_UA2SIM and choose Stop Agent Instance.
- 10.** On your Windows desktop, open two of the XML documents in Internet Explorer.

When you open the XML files with Internet Explorer, you should see an XML representation of the notification messages. There should be three values in the notification message: Int16Value\_Dynamic, Int16Value\_Static, and Sum. The CDATA section contains the values of the tags.



Note:

Make sure that SUM is the sum of Int16Value\_Dynamic and Int16Value\_Static.

Furthermore, you should see that Int16Value\_Dynamic constantly changes its value, thus triggering the notifications in PCo. Int16Value\_Static does not change its value, but is written to the notification message anyway.

Duplication is prohibited.

Duplication is prohibited.

# Unit 1

## Exercise 3

### (Optional) Create Agent Instance

You have created Source and destination system on Plant Connectivity and need to create a method that needs to be initiated from Digital manufacturing Cloud, which will trigger painting operation

#### **Task 1: Log on to the training system using Remote Desktop Connection.**

1. Log on to the training landscape server wdflbmt7260 with your user DMC300-## and the password initial.

#### **Task 2: Start the PCo Management Console**

1. In the lower left corner of the screen, choose the Windows Start button and look for SAP *Plant Connectivity → Management Console*
2. If the PCo Management Console opens in Administrator mode, you are ready to do the exercises as described in this course.

#### **Task 3: Create Agent Instance with Name DMC300\_DoPainting\_##**

1. Create Agent Instance with Source system: Without Source System.
2. Select Server Type as OPC UA Server and provide End point URL

Table 1:

Field	Value
End Point URL	opc.tcp://<<server>>:587##/PCoUaServer ## is the group number between 00 to 20
Security Mode	None
Security Policy	None
Encoding	Binary

#### **Task 4: Create Notification**

1. Create Notification: Painting\_##
2. Assign destination System: MCD\_Sim\_Dest\_DoPainting
3. Review Destination Tab and Destination System Calls (Don't change anything)
4. Test Configuration

#### **Task 5: Start The agent Instance**

1. Select the Agent Created DMC300\_DoPainting\_##
2. Right Click on the Agent and select Start Agent Instance

**Task 6: Stop Agent Instance**

1. Select the Agent Created DMC300\_DoPainting\_##
2. Right Click on the Agent and select Stop Agent Instance

# Unit 1

## Solution 3

### (Optional) Create Agent Instance

You have created Source and destination system on Plant Connectivity and need to create a method that needs to be initiated from Digital manufacturing Cloud, which will trigger painting operation

#### **Task 1: Log on to the training system using Remote Desktop Connection.**

1. Log on to the training landscape server wdflbmt7260 with your user DMC300-## and the password initial.
  - a) In Microsoft Windows, search for Remote Desktop Connection and run the application.
  - b) In the Computer field, enter the server name.
  - c) When prompted, enter the username and password. Ignore any warnings about certificates.

#### **Task 2: Start the PCo Management Console**

1. In the lower left corner of the screen, choose the Windows Start button and look for SAP Plant Connectivity → Management Console
2. If the PCo Management Console opens in Administrator mode, you are ready to do the exercises as described in this course.

#### **Task 3: Create Agent Instance with Name DMC300\_DoPainting\_##**

1. Create Agent Instance with Source system: Without Source System.
  - a) Go to Agent Instances and click on add Agent Instance
  - b) Select Source System as without Source System
  - c) Enter Instance Name as DMC300\_DoPainting\_##
  - d) Enter Instance description DO painting For Group ##
  - e) Click OK
2. Select Server Type as OPC UA Server and provide End point URL

Table 1:

Field	Value
End Point URL	opc.tcp://<<server>>:587##/PCoUaServer ## is the group number between 00 to 20
Security Mode	None
Security Policy	None

Field	Value
Encoding	Binary

- a) Go to Servers → Server Method Definition and select Server Type as OPC UA Server
- b) Under OPC Server UA setting click on Add button to provide Endpoint URL

Table 2:

Field	Value
End Point URL	opc.tcp://<<server>>:587##/PCoUaServer For example: opc.tcp:// wdflbmt7260.wdf.sap.corp:58710/PCoUa- Server
Security Mode	None
Security Policy	None
Encoding	Binary

- c) Click on Ok Button  
If prompted, click *Ignore Error*.
- d) Go to Server Method Definitions
- e) Click on Add Button and select Create Method definition Manually and click Next
- f) Enter Method Name Painting\_## and Click OK and Save

#### Task 4: Create Notification

1. Create Notification: Painting\_##
  - a) Select the Agent Instance DMC300\_DoPainting\_##
  - b) Right Click and select Add Notification / Click on Add Notification from tool Bar
  - c) Select Method Notification and click Next
  - d) Enter Notification Name as Painting\_##\_1
  - e) Enter Description as Painting Notification
  - f) Click on OK Button
2. Assign destination System: MCD\_Sim\_Dest\_DoPainting
  - a) Go to Destination Tab select Add Button to add destination
  - b) Select destination System as MCD\_Sim\_Dest\_DoPainting
  - c) Enter Name as Destination\_##
  - d) Enter Description as Destination for group ##
  - e) Click OK

3. Review Destination Tab and Destination System Calls (Don't change anything)
  - a) Under Destination system select the Destination with Name:  
MCD\_Sim\_Dest\_DoPainting
  - b) Review the Destination Systems Call Tab, you should see 3 steps as sequence of destination system call and one assignment Variable for wait time
4. Test Configuration
  - a) Goto Agent Instance
  - b) Select the Notification DMC300\_DoPainting\_## --> Painting\_##\_1
  - c) Go to *Destination* tab and click on *Navigate to Destination System* (the arrow button)
  - d) You will see the same configuration what you saw in Destination system configuration
  - e) Select the Test Configuration 

Click Save if there is unsaved data

  - f) Click on Run/Continue to End Button 
  - g) Review the log messages.

#### **Task 5: Start The agent Instance**

1. Select the Agent Created DMC300\_DoPainting\_##
2. Right Click on the Agent and select Start Agent Instance

#### **Task 6: Stop Agent Instance**

1. Select the Agent Created DMC300\_DoPainting\_##
2. Right Click on the Agent and select Stop Agent Instance



## LESSON SUMMARY

You should now be able to:

- Describe the Concepts of Plant Connectivity

# Unit 1

## Lesson 4

## Integration Scenarios



### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Explain scenarios for Shop Floor Integration

### Integration Scenarios



- Digital Twin Configuration
- Machine Data Integration
- Production Process Configuration
- Production Process Execution

Figure 12: Integration Scenarios

**Digital Twin Configuration:** A digital twin is a virtual representation that serves as the real-time digital counterpart of a physical object or process. You use the machine model to configure and manage the equipment and service providers to establish connectivity to the shop floor. The model helps you configure the digital twins of the machines in the shop floor.

**Machine Data Integration:** You can create service providers that help you connect machine model to tags from external data sources and also services from various external and internal sources.

**Production Process Configuration:** You can use the shop floor designer to model production processes and translate the shop floor designs into configurations by deploying them to SAP Plant Connectivity.

**Production Process Execution:** SAP Plant Connectivity executes the production processes as configured and transmits data between the machines and SAP Digital Manufacturing Cloud.



You can create a digital twin of an equipment by the following methods:

- Manage Equipment application
- Manage Templates application
- Onboarding Equipment into Machine Model wizard

Digital Twin Configuration



Figure 13: Digital Twin Configuration

Using machine model, you can configure and manage the equipment and service providers to establish connectivity to the shop floor. The model helps you configure the digital twins of the machines in the shop floor. You can configure the equipment with its constant properties,



- In Digital Manufacturing Cloud Machine Data Integration uses service Provider. Service provider in the machine/equipment model is a server that provides and endpoint with which you can access to data and functions of the machine.



↗ Figure 14: Machine Data Integration

With the help of a service provider, you can model objects, services, and tag information in the machine/ equipment model.

#### Service Providers:

**Data source:** You can connect an external data source, such as an OPC UA server, and define all the properties of the data source here. The data source provides tags.

**External server (type: OPC UA server):** You can connect an external OPC UA server that provides methods.

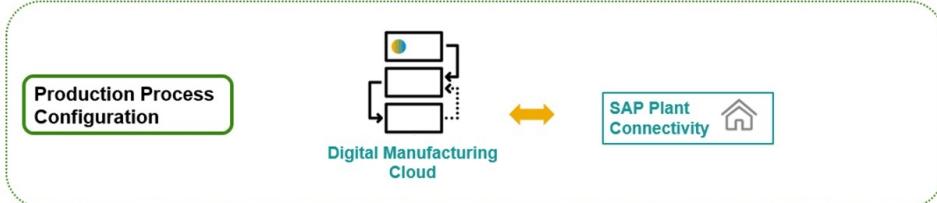
**Internal server (type: OPC UA server):** You can define an OPC UA server that is created automatically in the PCo. You can define the methods here in the configuration of the service provider.

**Internal server (type: Web server):** You can define a PCo Web server that is created automatically in PCo. You can define the Web services here in the configuration of the service.

**Execution in SAP Manufacturing Cloud:** You can connect a Digital Manufacturing Execution service offered in the SAP Digital Manufacturing Cloud to the machine model. The manufacturing services allow you, for example, to start or complete an SFC.



- You can model the production processes that control the execution of the production using the services provided by SAP Digital Manufacturing Cloud.

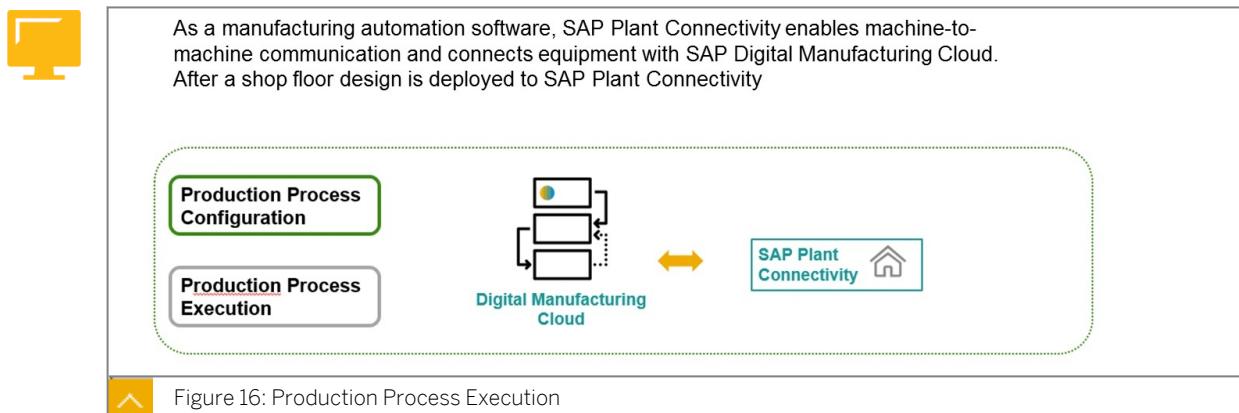


↗ Figure 15: Production Process Configuration

The process models created in a shop floor design correspond to certain configuration elements in an SAP Plant Connectivity (PCo) system

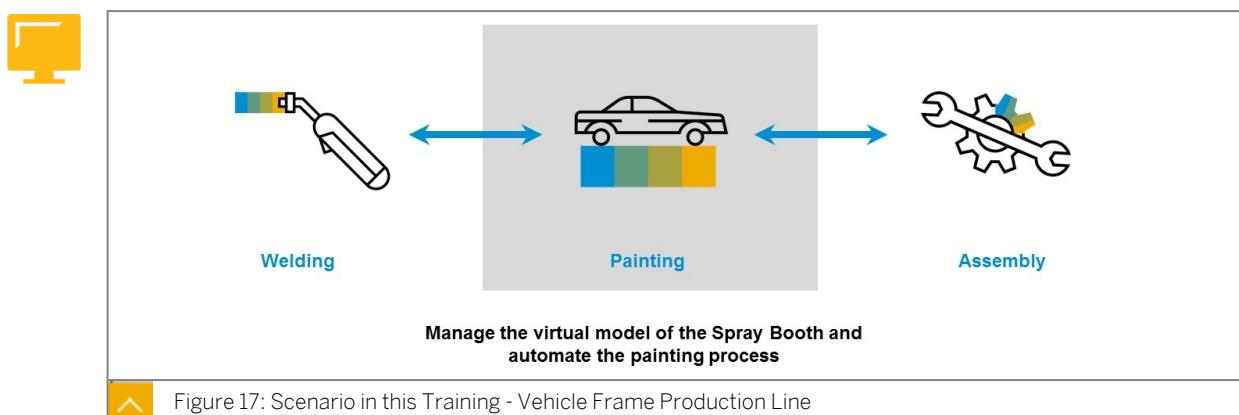
- Design production process with detailed equipment's working flows with service parameters defined
- Create machine communication model according to machine model information

- Design message flow to define SAP Plant Connectivity notification (PCo)



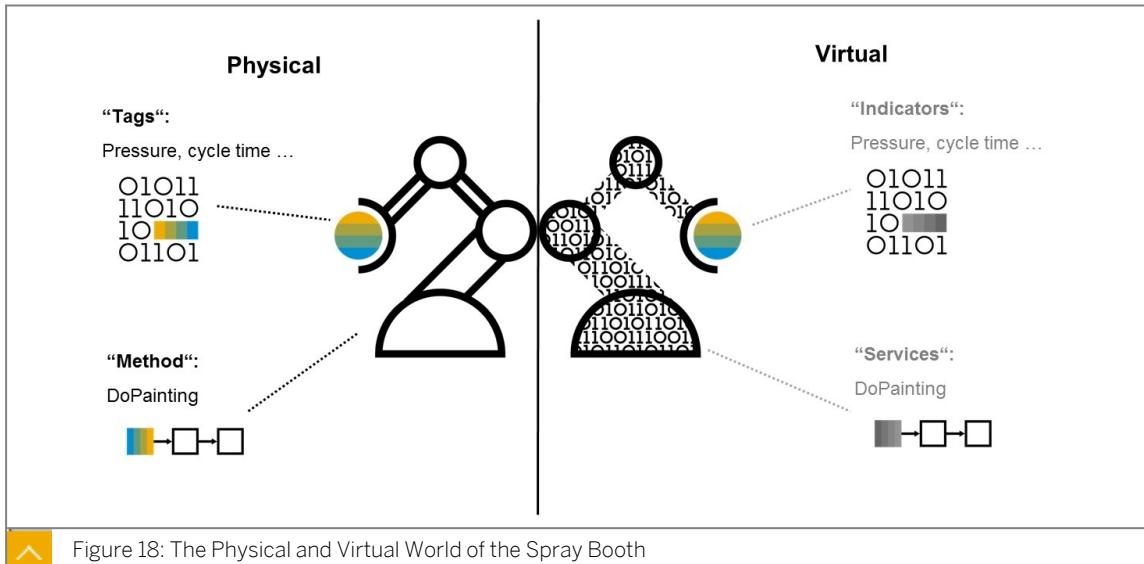
Production process execution responsible for

- Execute automation configured by shop floor designs
- Call services in SAP Digital Manufacturing Cloud when tag values change
- Write values that are passed from SAP Digital Manufacturing Cloud into tags on equipment
- Read tag values from equipment and pass them on to SAP Digital Manufacturing Cloud

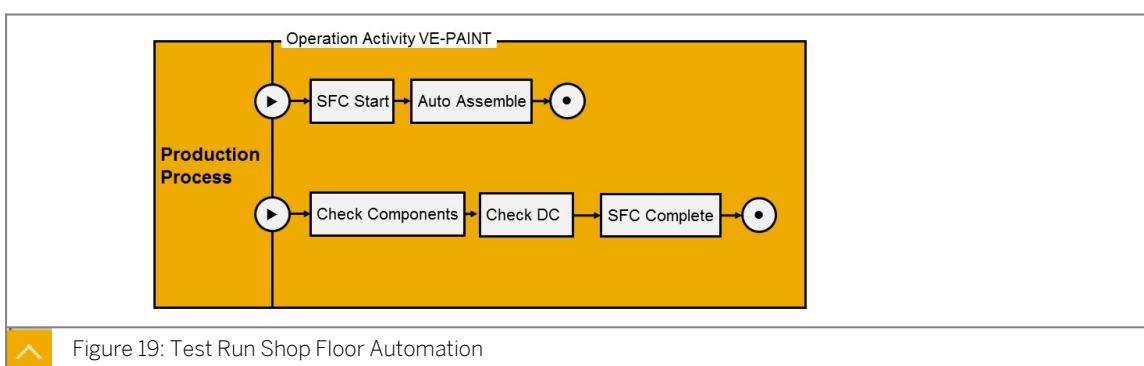


This training will demonstrate how to leverage DMC machine model and connectivity to automate the vehicle frame production.

The routing consists of 3 operations: welding, painting and assembly. You will learn to build a digital twin of the painting machine (the spray booth) and automate the painting operation.



DMC enables you to create and manage the virtual model of the physical machine. With the connection between physical world and digital twin, the machine model takes care that any action on the digital twin side is executed in the physical world and vice versa. E.g. you can consume the data or services from the physical machine by interacting with the virtual model. The physical world and its digital twin are always in synch.



This figure shows the shop floor automation scenario for vehicle painting. You will test this scenario in Exercise 4.

For the operation VE-PAINT, by clicking the SFC Start on the production operation dashboard, the automatic assembly is triggered, the components to be assembled will be automatically consumed. Then the default process calls an automation sequence for the spray booth to execute the painting action.

By clicking the SFC Complete, the components to be assembled and data collection will be checked. The SFC can only be completed if all the required components are assembled and the required parameters are collected.

# Unit 1

## Exercise 4

# Test Run Shop Floor Automation

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. A test shop floor automation is already configured, Carson is tasked with testing the result.

### Task 1: Log on to Digital Manufacturing Cloud and open the DMC300\_OPERATION\_POD app

1. Log on to Digital Manufacturing Cloud
2. Open the app DMC300\_OPERATION\_POD



#### Note:

In case you don't find the app, please publish DMC300\_OPERATION\_POD via POD Designer app > Go > Select DMC300\_OPERATION\_POD > Click Publish> Click Publish on the pop-up window. Please DO NOT change any configuration on DMC300\_OPERATION\_POD

### Task 2: Check Component Lists before SFC Start

1. On the app DMC300\_OPERATION\_POD, select the operation VE-PAINT, resource SMOOTH-## and find the available SFCs
2. Select one of the SFC from the shop order ORD\_VEHICLE-ASSY\_INIT## (the SFC number starts with ORD\_VEHICLE-ASSY\_INIT##) and with status in Queue, note down the SFC number.



#### Note:

For the later tasks in this exercise, please work on this SFC only!

3. Check the Component List for the selected SFC
4. Start the SFC you noted down

### Task 3: Check Component Lists after SFC Start and remove one of the components

1. Check the component list, what happens after SFC starts?
2. For the selected SFC, remove the component FRAME-ROOF-FRONT / ERP001 from the component list

### Task 4: Complete SFC with missing component or without data collection

1. Find the SFC you noted down

2. Complete the selected SFC, what will happen?
3. Assemble the missing component
4. Complete the selected SFC, what will happen now?



Note:

The messages `component.checkFailed` and `DC parameter [CYCLETIME]` is missing show up, because the check components and check data collection services are triggered by SFC complete. If the components are not assembled, or if the data is not collected as required, SFC complete will not be allowed.

In this exercise you tested a simplified shop floor automation. In the later exercises you will learn the configuration, as well as other shop floor automation functions such as machine integration.

**Task 5: Collect the required data field**

1. Find the SFC you noted down
2. Collect the data field CYCLETIME by giving any integer value between 20 and 50

**Task 6: Complete SFC**

1. Find the SFC you noted down
2. Complete the selected SFC

# Unit 1

## Solution 4

## Test Run Shop Floor Automation

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. A test shop floor automation is already configured, Carson is tasked with testing the result.

### Task 1: Log on to Digital Manufacturing Cloud and open the DMC300\_OPERATION\_POD app

1. Log on to Digital Manufacturing Cloud
  - a) Login into DMC with the user assigned to you by the course instructor
2. Open the app DMC300\_OPERATION\_POD

 Note:

In case you don't find the app, please publish DMC300\_OPERATION\_POD via POD Designer app > Go > Select DMC300\_OPERATION\_POD > Click Publish> Click Publish on the pop-up window. Please DO NOT change any configuration on DMC300\_OPERATION\_POD

- a) Navigate to the section *Manufacturing Execution* → *DMC300\_OPERATION\_POD*, or on the DMC home page, search for the app *DMC300\_OPERATION\_POD*

### Task 2: Check Component Lists before SFC Start

1. On the app *DMC300\_OPERATION\_POD*, select the operation *VE-PAINT*, resource *SBOOTH-##* and find the available SFCs
  - a) In the app *DMC300\_OPERATION\_POD*, select the operation *VE-PAINT*
  - b) Select the resource *SBOOTH-##*  
For example, participant 05 should select *SBOOTH-05*
  - c) Click *Go*
  - d) The SFC work list displays
2. Select one of the SFC from the shop order *ORD\_VEHICLE-ASSY\_INIT##* (the SFC number starts with *ORD\_VEHICLE-ASSY\_INIT##*) and with status in Queue, note down the SFC number.

 Note:

For the later tasks in this exercise, please work on this SFC only!

- a) \_\_\_\_\_
3. Check the *Component List* for the selected SFC

- a) Click on *Activities*
  - b) Select *Component List*
  - c) There should be two components which are **not** assembled (the *Assemble* button is enabled)
4. Start the SFC you noted down
- a) Click *Main* on the top left corner of the screen to go to the POD main screen
  - b) Make sure you select the SFC with the number that you noted down
  - c) Click *Start*
  - d) A message *SFC Production process P\_SMOOTH\_PAINTING\_SAMPLE\_1\_0StartSFC call succeeded* shows up

### **Task 3: Check Component Lists after SFC Start and remove one of the components**

1. Check the component list, what happens after SFC starts?
  - a) In the app *DMC300\_OPERATION\_POD*, click on *Activities*
  - b) Select *Component List*
  - c) The two components should be assembled (you should see Remove button for each component)
2. For the selected SFC, remove the component *FRAME-ROOF-FRONT / ERP001* from the component list
  - a) For the component *FRAME-ROOF-FRONT / ERP001*, click *Remove*
  - b) On the *Disassemble Component* pop-up, click *Remove*

### **Task 4: Complete SFC with missing component or without data collection**

1. Find the SFC you noted down
  - a) Open the app *DMC300\_OPERATION\_POD*
  - b) Select the operation *VE-PAINT*
  - c) Select the resource *SMOOTH-##*
  - d) Click *Go*
  - e) Select the SFC you noted down
2. Complete the selected SFC, what will happen?
  - a) Click *Complete*
  - b) An error message *component.checkFailed* shows up, the SFC is not allowed to be completed
3. Assemble the missing component
  - a) Click *Activities*
  - b) Select *Component List*
  - c) For the component *FRAME-ROOF-FRONT / A*, click *Assemble*

- d) Leave the data fields as it is and click *Add*
- e) A message *1 components added* shows up
4. Complete the selected SFC, what will happen now?
- Click *Main* on the top left corner to go back to the POD
  - Select the SFC you noted down
  - Click *Complete*
  - A message *DC parameter [CYCLETIME] is missing* shows up, the SFC failed to be completed
- 

**Note:**

The messages *component.checkFailed* and *DC parameter [CYCLETIME] is missing* show up, because the check components and check data collection services are triggered by SFC complete. If the components are not assembled, or if the data is not collected as required, SFC complete will not be allowed.

In this exercise you tested a simplified shop floor automation. In the later exercises you will learn the configuration, as well as other shop floor automation functions such as machine integration.
- ### Task 5: Collect the required data field
- Find the SFC you noted down
    - Open the app *DMC300\_OPERATION POD*
    - Select the operation *VE-PAINT*
    - Select the resource *SBOOTH-##*
    - Click *Go*
    - Select the SFC you noted down
  - Collect the data field CYCLETIME by giving any integer value between 20 and 50
    - Click *Activities*
    - Select *Data Collection List*
    - Click *Collect*
    - Enter any integer value between **20** and **50**
    - Click *Save*
    - Click *Main* and go back to the POD main page
- ### Task 6: Complete SFC
- Find the SFC you noted down
    - Login into DMC with the user assigned to you by the course instructor
    - Navigate to *Manufacturing Execution* → *DMC300\_OPERATION POD*

- c) Select the operation *VE-PAINT*
  - d) Select the resource *SBOOTH-##*
  - e) Click Go
  - f) Select the SFC you noted down
2. Complete the selected SFC
- a) Click *Complete*
  - b) A message *SFC Production process P\_SBOOTH\_PAINTING\_SAMPLE\_1\_0CompleteSFC call succeeded.* shows up, the SFC was completed successfully



## LESSON SUMMARY

You should now be able to:

- Explain scenarios for Shop Floor Integration

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## Learning Assessment

1. Digital Manufacturing Cloud and SAP Manufacturing On-Premise Products cannot be used together as part of a harmonized solution.

*Determine whether this statement is true or false.*

- True
- False

2. Digital Manufacturing Cloud for Execution contains functionality for Process Manufacturing?

*Determine whether this statement is true or false.*

- True
- False

3. Which of the following are part of the Digital Manufacturing Cloud for Execution solution?

*Choose the correct answers.*

- A Manufacturing Execution
- B Resource
- C Shop Floor Designer
- D Predictive Quality

4. What methods do you use to configure Digital Twin?

*Choose the correct answer.*

- A Mange Equipment template
- B Mange Model template
- C Onboard Machine Model into Equipment Model
- D All the above

## Learning Assessment - Answers

1. Digital Manufacturing Cloud and SAP Manufacturing On-Premise Products cannot be used together as part of a harmonized solution.

*Determine whether this statement is true or false.*

- True  
 False

Correct. Digital Manufacturing Cloud and SAP Manufacturing On-Premise Products can be used together as part of a harmonized solution.

2. Digital Manufacturing Cloud for Execution contains functionality for Process Manufacturing?

*Determine whether this statement is true or false.*

- True  
 False

Correct. Digital Manufacturing Cloud for Execution contains functionality for Process Manufacturing.

3. Which of the following are part of the Digital Manufacturing Cloud for Execution solution?

*Choose the correct answers.*

- A Manufacturing Execution  
 B Resource  
 C Shop Floor Designer  
 D Predictive Quality

Correct. Manufacturing Execution, Resource Orchestration and Shop Floor Designer are part of Digital Manufacturing Cloud for Execution solution.

4. What methods do you use to configure Digital Twin?

*Choose the correct answer.*

- A Mange Equipment template
- B Mange Model template
- C Onboard Machine Model into Equipment Model
- D All the above

Correct. You need to use Mange Equipment template, Manage Model template and onboard Machine Model into Equipment Model all together to configure Digital Twin.

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## UNIT 2

# Machine Model and Connectivity

### Lesson 1

SAP Cloud Connector and Pco Integration	50
Exercise 5: Navigate Machine Model and Connectivity	61

### UNIT OBJECTIVES

- Describe the system landscape for the integration of SAP Digital Manufacturing Cloud and SAP Plant Connectivity
- Explain the SAP Digital Manufacturing Cloud and SAP Plant Connectivity integration configuration
- Explain the integration scenarios

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## Unit 2

### Lesson 1

# SAP Cloud Connector and Pco Integration

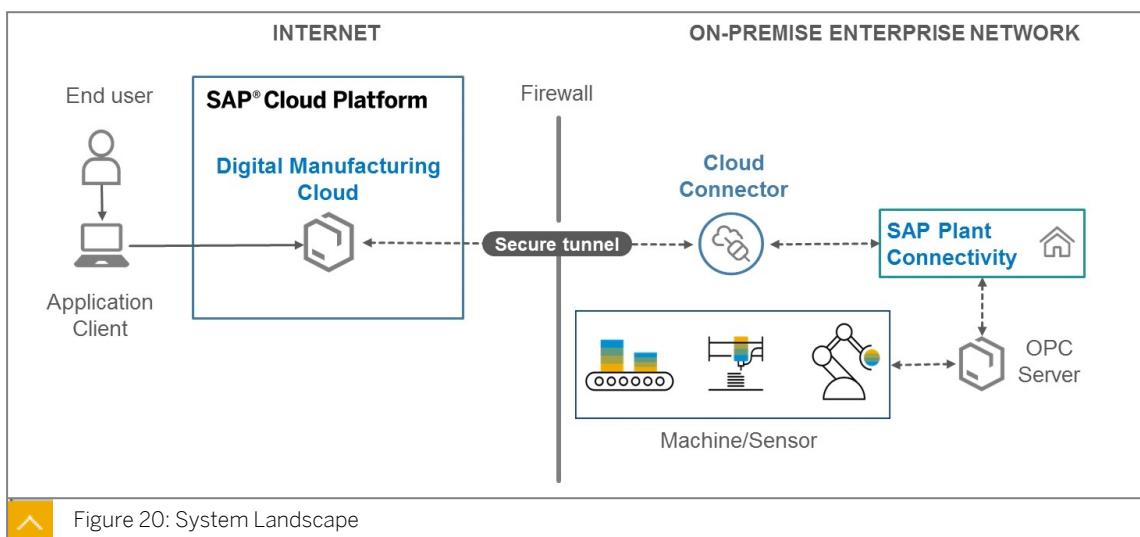


#### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Describe the system landscape for the integration of SAP Digital Manufacturing Cloud and SAP Plant Connectivity
- Explain the SAP Digital Manufacturing Cloud and SAP Plant Connectivity integration configuration
- Explain the integration scenarios

#### System landscape for the integration of SAP Digital Manufacturing Cloud and SAP Plant Connectivity



A machine/sensor is connected to SAP Plant Connectivity through an OPC (Open Platform Communications) server. SAP Plant Connectivity is the connectivity layer between SAP Digital Manufacturing Cloud and the shop floor. As SAP Plant Connectivity is installed on the customer's premises, a cloud connector is required for the communication from SAP Digital Manufacturing Cloud to SAP Plant Connectivity. In addition, the communication needs to be secured by valid certificates.

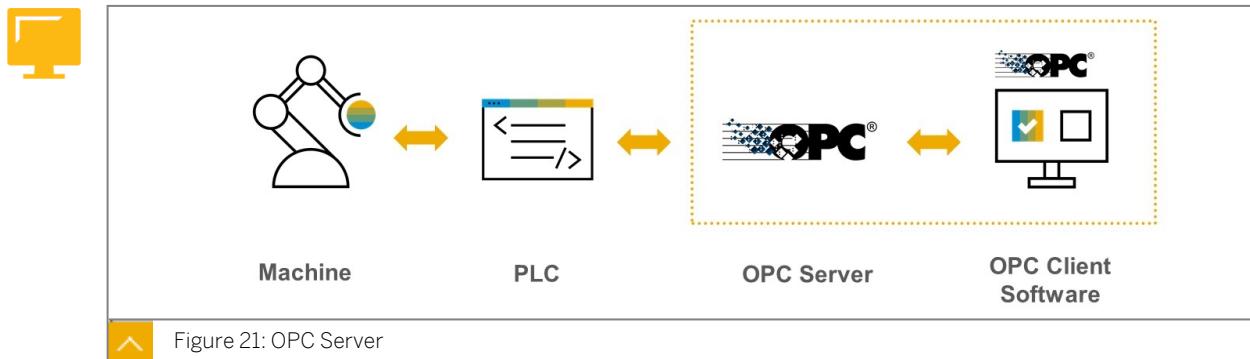
With Digital Manufacturing Cloud, the following source systems are supported:

- Asset Framework
- File System
- IP21

- OPC DA
- OPC UA
- OPC HDA
- Proficy Historian

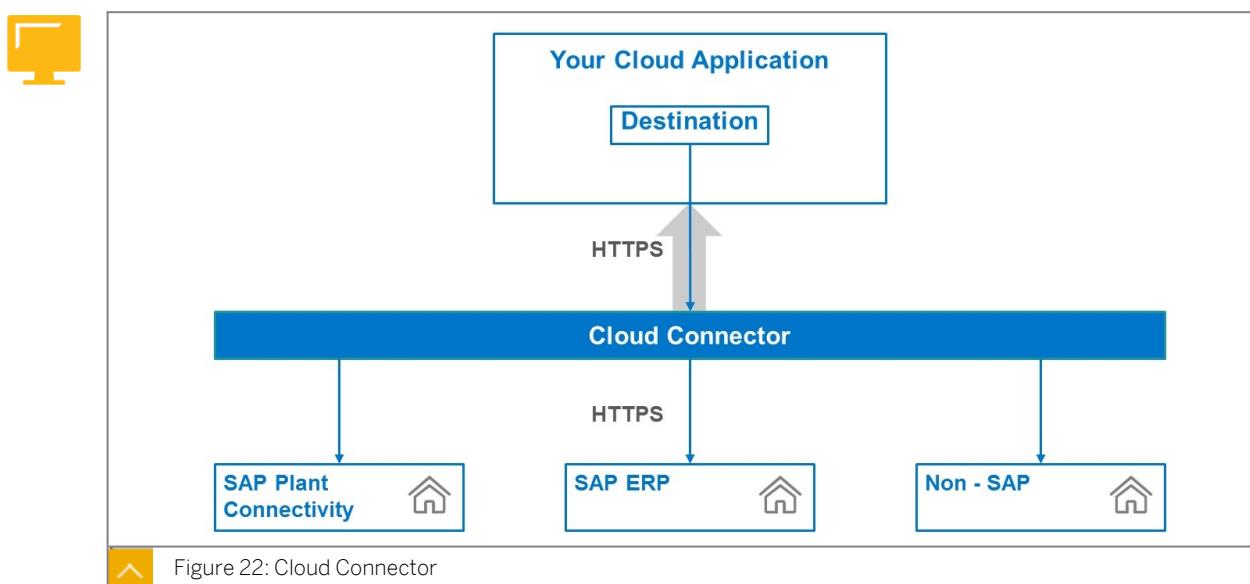
In this training scenario, the spray booth used for vehicle painting is connected to SAP PCo through an OPC UA server.

### OPC Server



OPC is implemented in server/client pairs. The OPC server is a software program that converts the hardware communication protocol used by a PLC (Programmable Logical Controller, a small industrial computer which controls the hardware devices) into the OPC protocol. The OPC client software is any program that needs to connect to the hardware, such as an HMI (Human-Machine Interface). The OPC client uses the OPC server to get data from or send commands to the hardware.

### Cloud Connector

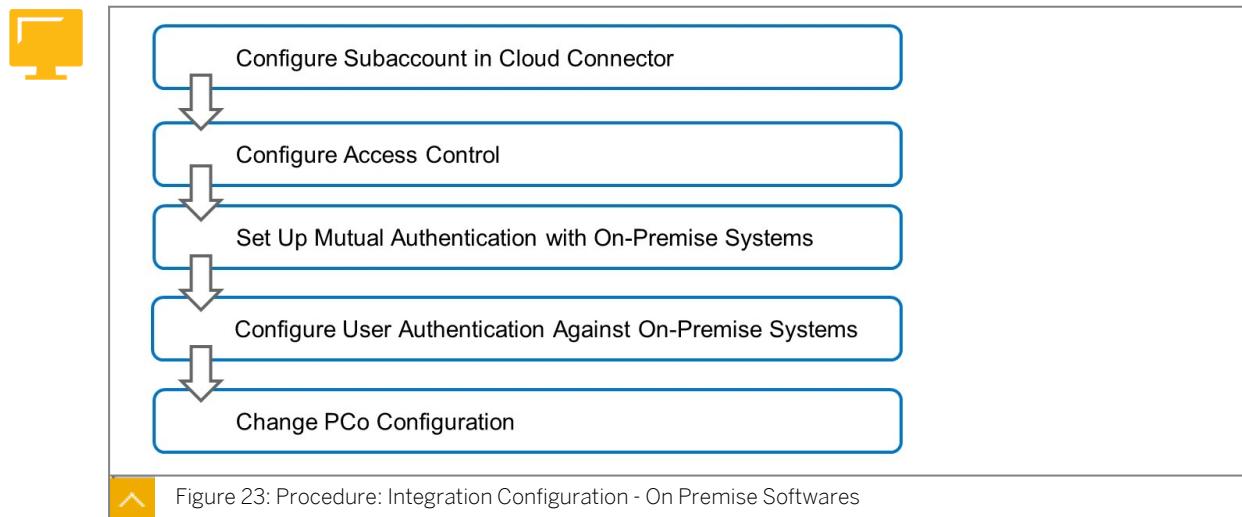


The Cloud Connector:

- Serves as a link between SAP Business Technology Platform applications and on-premise systems:

- Combines an easy setup with a clear configuration of the systems that are exposed to the SAP Business Technology Platform.
- Lets you use existing on-premise assets without exposing the entire internal landscape.
- Runs as on-premise agent in a secured network:
  - Acts as a reverse invoke proxy between the on-premise network and SAP Business Technology Platform.
- Provides fine-grained control over:
  - On-premise systems and resources that can be accessed by cloud applications.
  - Cloud applications using the Cloud Connector.
- Lets you use the features that are required for business-critical enterprise scenarios:
  - Recovers broken connections automatically.
  - Provides audit logging of inbound traffic and configuration changes.
  - Can be run in a high-availability setup.

#### Procedure: Integration Configuration - On Premise Softwares



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## Configure Subaccount in Cloud Connector



Add Subaccount

*Region:	<input type="text"/>
*Subaccount:	<input type="text"/>
Display Name:	<input type="text"/>
*Subaccount User:	<input type="text"/>
*Password:	<input type="password"/>
Location ID:	<input type="text"/> Enter location ID to overwrite default
Description:	<input type="text"/>

Save Cancel

Figure 24: Configure Subaccount in Cloud Connector

For each SAP Business Technology Platform subaccount that you want to connect with an on-premises system, configure a tenant / customer subaccount in the cloud connector.

### Prerequisites

- A subaccount user is needed for establishing the connection between the SAP Business Technology Platform subaccount and the cloud connector. For the Cloud Foundry and Neo environments, the requirements are different for the user.
- For a subaccount in the Cloud Foundry environment, the subaccount user must be a security administrator of the subaccount.
- For a subaccount in the Neo environment, the subaccount user must have the manageSCCTunnels scope. You can assign the user to the predefined role Cloud Connector Admin or Administrator, or assign the user to a custom role that includes the scope.
- You have configured an HTTP proxy for the cloud connector to reach the Internet. Besides, the proxy server must support SSL communication.

### Procedure

1. In a Web browser, log on to the cloud connector by accessing `https://<hostname>:<port>` as Administrator.
2. Choose Connector -> Add Subaccount.
3. In the Add Subaccount window, enter the following information:

Region: Select the data center in which the relevant SAP Business Technology Platform subaccount is hosted.

Subaccount [Cloud Foundry]: Enter the technical name of the subaccount.

[Neo]: Enter the technical name of the subaccount.

Login E-Mail [Relevant to Cloud Foundry Only]: Enter the email address a subaccount user uses to log in in the SAP Business Technology Platform cockpit.

Subaccount User [Relevant to Neo only]: Enter the P- or S- ID of a subaccount user.

**Password:** Enter the password that the subaccount user uses to log in the SAP Business Technology Platform cockpit.

**Location ID:** If you use more than one cloud connector to connect to the same subaccount, define a unique location ID per cloud connector for the subaccount.

1. Save the subaccount.
2. On the Subaccount Dashboard, in the Actions column, choose Connect this subaccount for this subaccount.

## Configure Access Control

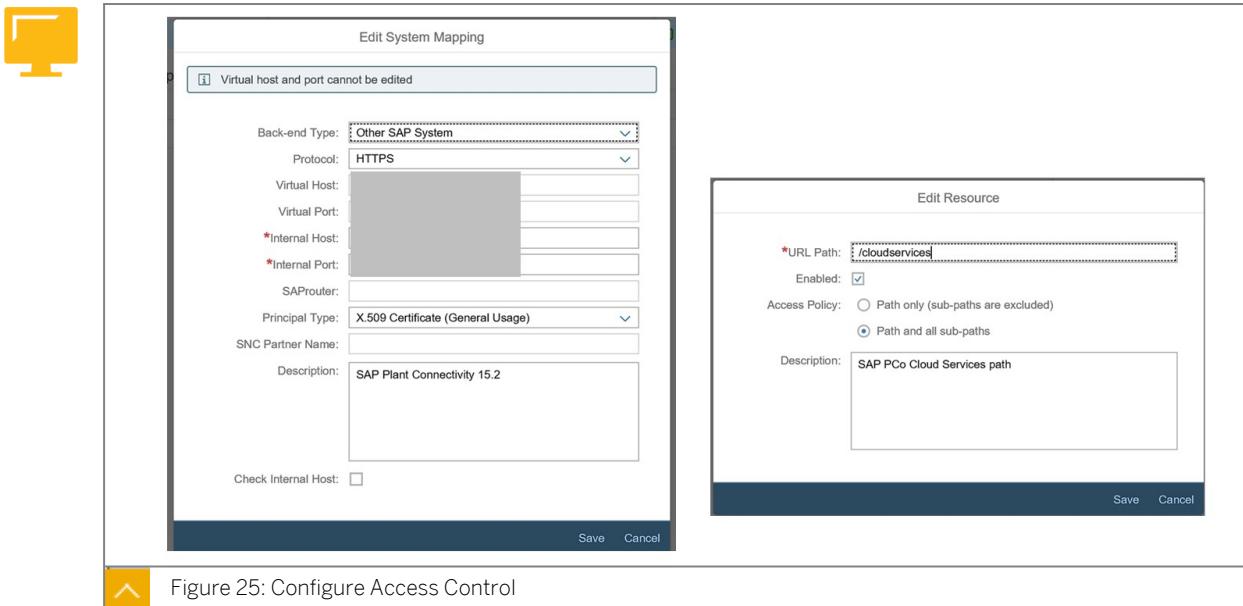


Figure 25: Configure Access Control

Expose the on-premise systems to the cloud and specify the resources accessible from the cloud. To expose an on-premise system, create a virtual system in the cloud connector and map it to an internal on-premise system. When making the configuration, you need to define a virtual host and a virtual port for the virtual system. The virtual host and port will be used for identifying the on-premise systems when creating destinations in the corresponding SAP Business Technology Platform subaccount.

In addition, you must specify the resources accessible from the cloud. This step is required even if you do not limit the access to resources; in other words, you need to explicitly specify that all resources are accessible.

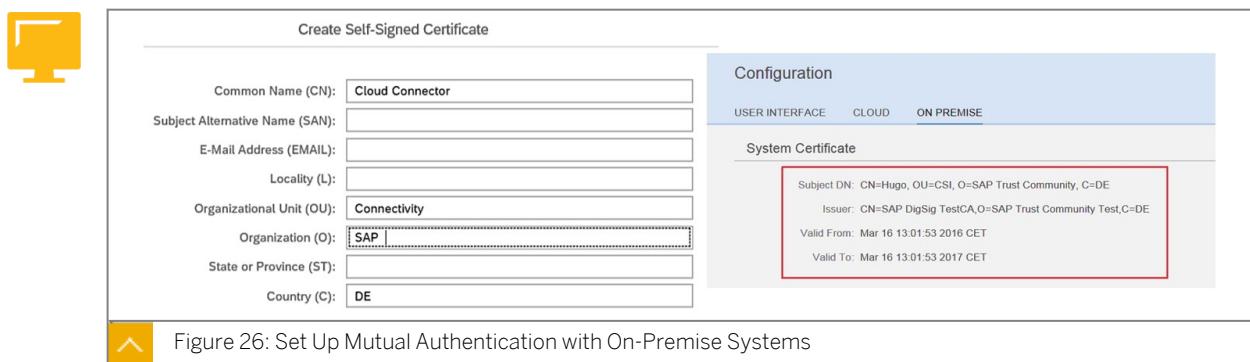
### Procedure

1. In the cloud connector administration console, choose <Subaccount> -> Cloud To On-Premise -> ACCESS CONTROL.
2. In the Mapping Virtual To Internal System section, choose Add.
3. Enter the information according to the protocol used for communication and the specific on-premise system. For the SFD/Insights/MM2PCo scenario related to this training, enter the following data:

Backend Type Other SAP Systems

Protocol Type: X.509 Certificate (General Usage) or X.509 Certificate (Strict Usage)

1. To specify resources that are accessible from the cloud, add the resources for the system and give the following data:
  - URL Path: /cloudservices
  - Enabled: Select the checkbox
  - Access Policy: Select Path and all sub-paths



### Installation of a System Certificate for Mutual Authentication

In order to set up a mutual authentication between the Cloud Connector and any back-end system it connects to, you can import an X.509 client certificate into the Cloud Connector. The Cloud Connector will then use the so-called "system certificate" for all HTTPS requests to back-ends that request or require a client certificate. This means, that the CA, which signed the Cloud Connector's client certificate, needs to be trusted by all back-end systems to which the Cloud Connector is supposed to connect.

This system certificate needs to be provided as PKCS#12 file containing the client certificate, the corresponding private key and the CA root certificate that signed the client certificate (plus potentially the certificates of any intermediate CAs, if the certificate chain is longer than 2). Via the file upload dialog, this PKCS#12 file can be chosen from the file system. Its password also needs to be supplied for the import process.

As of version 2.10 there is a third option - generating a self-signed certificate. It might be of use if no CA is needed, for example, in a demo setup or if you want to use a dedicated CA. For this option, press Create and import a self-signed certificate and enter the data.

If a system certificate has been imported successfully, its distinguished name, the name of the issuer, and the validity dates are displayed.



## Configure User Authentication Against On-Premise Systems

The screenshot shows a user interface for configuration. At the top, there is a navigation bar with tabs: USER INTERFACE, CLOUD, ON PREMISE (which is underlined), REPORTING, and ADVANCED. Below this, a section titled 'CA Certificate' is displayed. Inside this section, a red box highlights the following certificate information:

CA Certificate Type: Local CA  
Subject DN: CN=CloudConnector, OU=Connectivity, O=SAP, C=DE  
Issuer: CN=CloudConnector, OU=Connectivity, O=SAP, C=DE  
Valid From: Feb 13 11:03:16 2018 CET  
Valid To: Feb 13 11:13:16 2019 CET

Figure 27: Configure User Authentication Against On-Premise Systems

For the SFD/Insights/MM2PCo scenario related to this training:

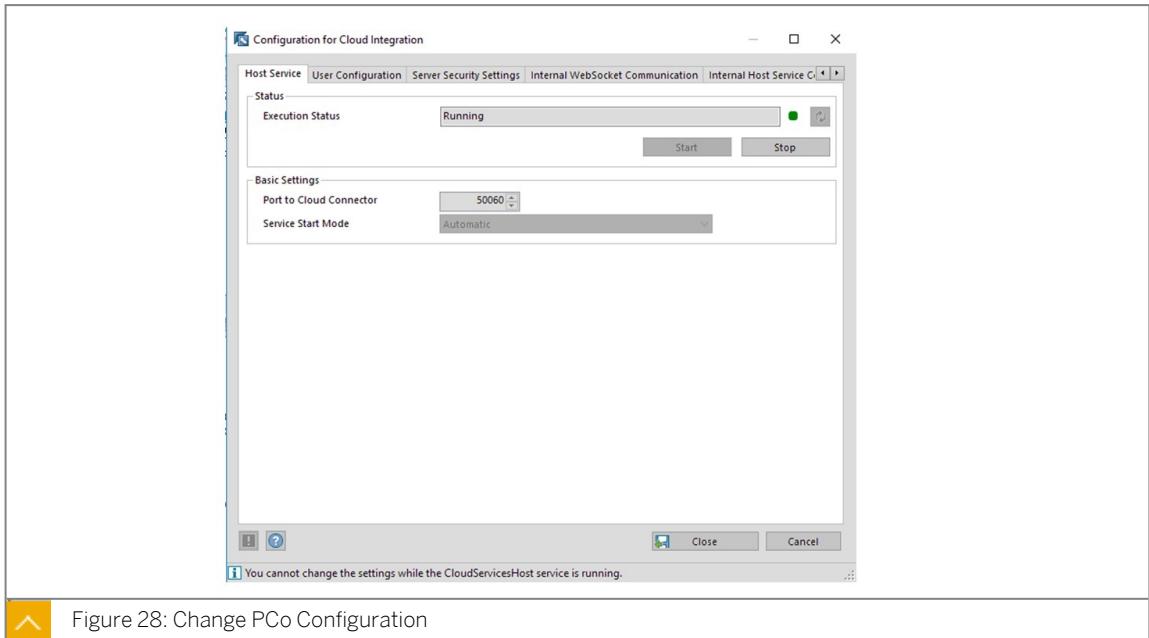
- Principal propagation using an X.509 CA certificate.
- The certificate must be issued for the fully qualified domain name (FQDN) of the computer where the cloud connector is installed.

There are 3 options to install a local CA certificate:

- Option 1: Choose the PKCS#12 file from the file system, using the file upload dialog. For the import process, you must also provide the file password.
- Option 2: Start a Certificate Signing Request (CSR) procedure like for the UI certificate.
- Option 3: (As of version 2.10) Generate a self-signed certificate, which might be useful in a demo setup or if you need a dedicated CA. In particular for this option, it is useful to export the public key of the CA via the button Download certificate in DER format.

If you use a self-signed certificate, be sure to place the public key in the Trusted store location in the filesystem of the SAP Plant Connectivity server: C:\ProgramData\SAP\PCo\certificateStores\CloudServicesHost\Trusted\certs. You can obtain the public key via the button Download certificate in DER format.

## SAP Digital Manufacturing Cloud and SAP Plant Connectivity integration configuration

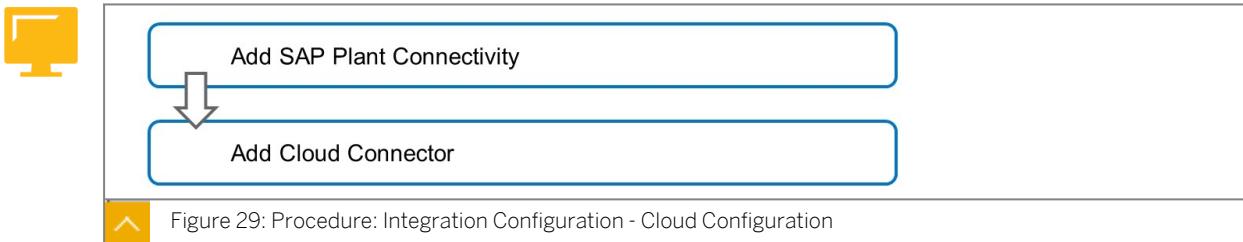


In SAP Plant Connectivity, you need to change the cloud integration configuration in order to enable the communication from Cloud to SAP Plant Connectivity:

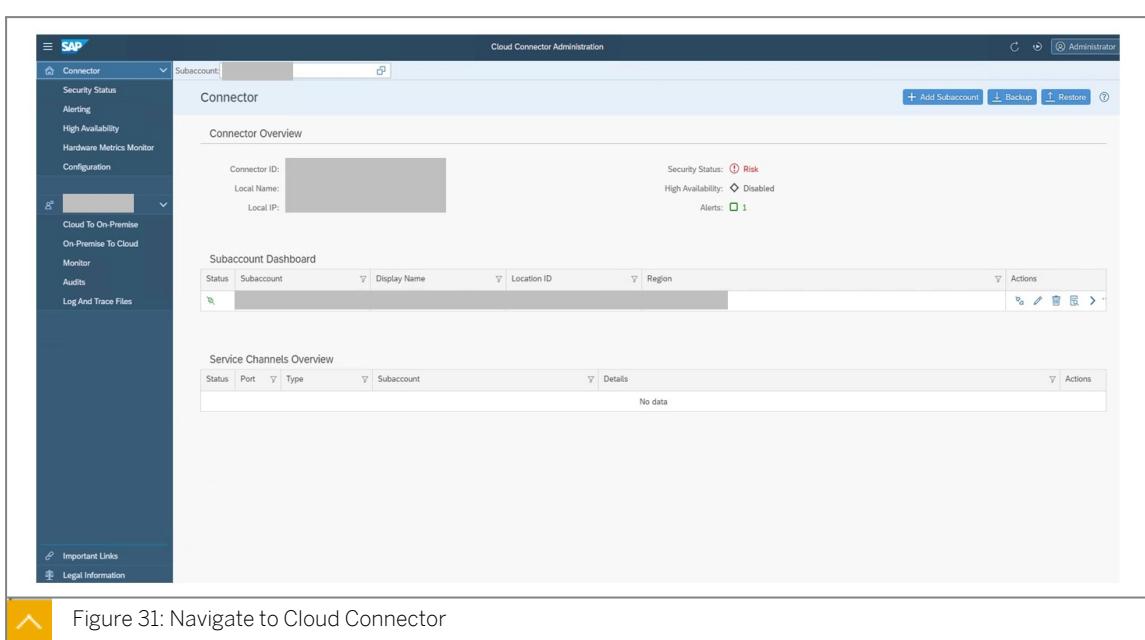
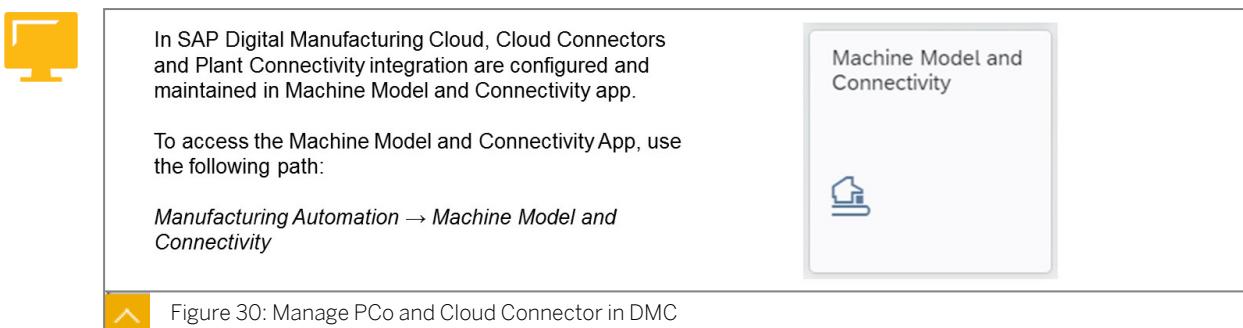
Procedure:

1. Start the PCo Management Console.
2. Navigate to Tools -> Cloud Integration.
3. On the Host Service tab, in the Status section, choose Stop.
4. Select tab User Configuration.
5. Add users for the communication between SAP Plant Connectivity and the Cloud, the user ID should be the DMC user ID.
6. Select tab Server Security Settings.
7. For Authentication Mode Select Principal Propagation and Certificate.
8. For Certificate.Server Certificate, select the certificate issued for the hostname of the local computer.
9. To start the Windows service CloudHostService, on the Host Service tab, in the Status section, choose Start.

### Procedure: Integration Configuration - Cloud Configuration



To establish communication between a PCo system (an on-premise system) and the Digital Manufacturing Cloud, you need to configure the Plant Connectivity and Cloud Connector. This communication is required for integrating with SAP Plant Connectivity, creating service providers, mapping tags, and configuring subscription.

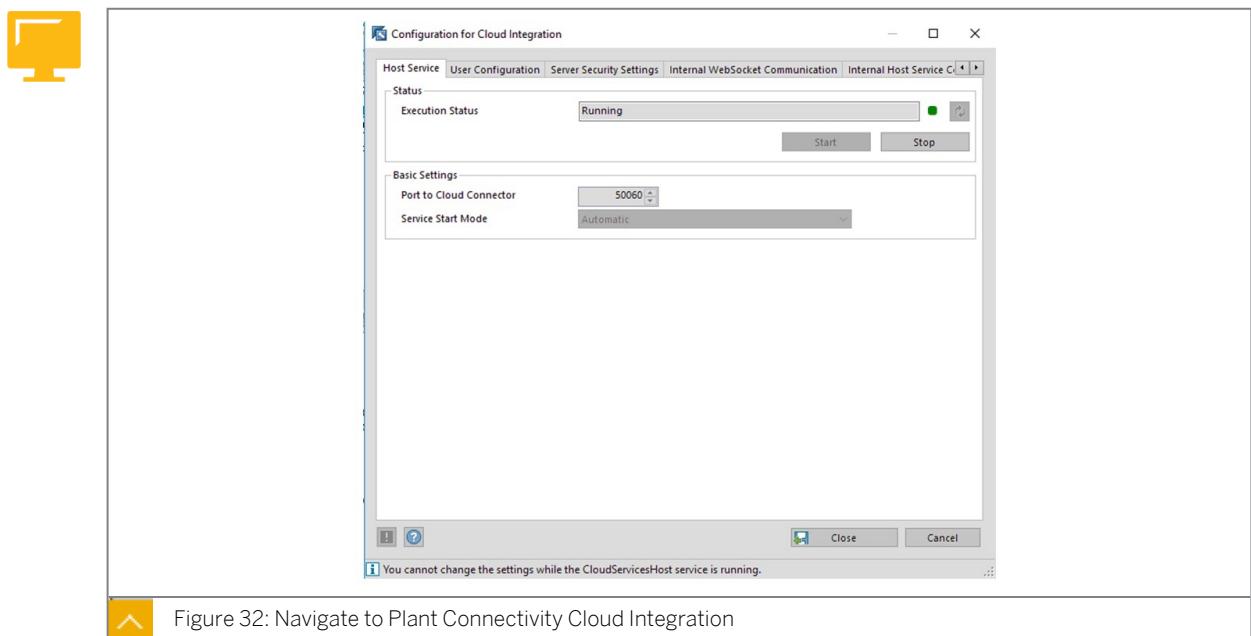


For Instructor only!

Demonstrate the cloud connector and explain the configuration:

1. Open the cloud connector with the link: <https://localhost:8443/>.
2. Enter the user and password.

3. Navigate to Connector. Show subaccount information. You need to configure a tenant / customer subaccount in the cloud connector, for each SAP Business Technology Platform subaccount that you want to connect with an on-premises system. For the DMC - PCo integration, the subaccount is maintained in the Cloud Foundry environment, the subaccount user must be a security administrator of the subaccount.
4. Navigate to <Subaccount>. The status is connected.
5. Navigate to <Subaccount> -> Cloud To On-Premise -> Access Control. Here you expose the on-premise systems to the cloud and specify the resources accessible from the cloud.
6. Expose an on-premise system: Create a virtual system in the cloud connector and map it to an internal on-premise system. When making the configuration, you need to define a virtual host and a virtual port for the virtual system. The virtual host and port will be used for identifying the on-premise systems when creating destinations in the corresponding SAP Business Technology Platform subaccount.
7. Specify the resources accessible from the cloud. The scenario for DMC -Pco integration is SFD/Insights/MM2PCo.
8. Navigate to Configuration -> Configuration -> On Premise. Here you configure the System Certificate for Mutual Authentication. The cloud connector will then use this so-called "system certificate" for all HTTPS requests to back-ends (to which the Cloud Connector is supposed to connect) that request or require a client certificate. The CA (client authentication), which signed the Cloud Connector's client certificate, needs to be trusted by all back-end systems to which the Cloud Connector is supposed to connect.



For Instructor only!

Demonstrate the PCo cloud integration configuration:

1. Start the Pco Management Console.
2. Choose Tools -> Cloud Integration -> Host Service. Here you can start or stop the host service for cloud integration.

3. Navigate to tab User Configuration. Here you give the permissions for DMC users to access SAP PCo.
4. Navigate to tab Server Security Setting. The authentication mode is "Principal Propagation" and "Certificate". Server Certificate is either the signed CA or the self-signed certificate.

### **Integration scenarios**

- Digital Twin Configuration

You use the machine model to configure and manage the digital twins of the machines in the shop floor.

- Machine Data Integration

You can connect machine model to tags from external data sources and also services from various external and internal sources.

- Production Process Configuration

You can use the shop floor designer to model production processes and translate the shop floor designs into configurations by deploying them to SAP Plant Connectivity.

- Production Process Execution

SAP Plant Connectivity executes the production processes as configured and transmits data between the machines and SAP Digital Manufacturing Cloud.

## Unit 2

### Exercise 5

# Navigate Machine Model and Connectivity

Carson is a consultant with the high-tech ABC Company. The company is considering connecting DMC to shop floor in order to automate the production. Carson is tasked with reviewing the integration configuration in DMC.

#### Task 1: Review Cloud Connector

1. Log on to DMC and open the app Machine Model and Connectivity
2. Check Cloud Connector DMC300\_CC.



Note:  
DO NOT change any configuration!

#### Task 2: Review Plant Connectivity

1. Log on to DMC and open the app Machine Model and Connectivity
2. Check Plant Connectivity DMC300\_PCo.



Note:  
DO NOT change any configuration!

## Unit 2 Solution 5

# Navigate Machine Model and Connectivity

Carson is a consultant with the high-tech ABC Company. The company is considering connecting DMC to shop floor in order to automate the production. Carson is tasked with reviewing the integration configuration in DMC.

### Task 1: Review Cloud Connector

1. Log on to DMC and open the app Machine Model and Connectivity
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to the section *Manufacturing Automation*
  - c) Open the app *Machine Model and Connectivity*
2. Check Cloud Connector DMC300\_CC.



Note:  
DO NOT change any configuration!

- a) Select Machine Model Object *DMC300\_CC*
- b) Review the *Location ID* and *Assigned PCo Systems*
- c) Click *Go Back*

### Task 2: Review Plant Connectivity

1. Log on to DMC and open the app Machine Model and Connectivity
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to the section *Manufacturing Automation*
  - c) Open the app *Machine Model and Connectivity*
2. Check Plant Connectivity DMC300\_PCo.



Note:  
DO NOT change any configuration!

- a) Select *Plant Connectivity* tab
- b) Select Machine Model Object *DMC300\_PCo*
- c) Review the *PCo Cloud Connector* and *PCo Virtual URL*
- d) Review the *Certificates* and the *validation date*

e) Click Go Back

Duplication is prohibited.

Duplication is prohibited.



## LESSON SUMMARY

You should now be able to:

- Describe the system landscape for the integration of SAP Digital Manufacturing Cloud and SAP Plant Connectivity
- Explain the SAP Digital Manufacturing Cloud and SAP Plant Connectivity integration configuration
- Explain the integration scenarios

# Learning Assessment

1. What are the functionalities of SAP Cloud Connector?

*Choose the correct answers.*

- A Serves as a link between SAP Business Technology Platform applications and on-premise systems
- B Runs as on-premise agent in a secured network
- C Provides control over on-premise systems that can be accessed by cloud applications
- D Connects on-premise systems to non-SAP Business Technology Platform

# Learning Assessment - Answers

1. What are the functionalities of SAP Cloud Connector?

*Choose the correct answers.*

- A Serves as a link between SAP Business Technology Platform applications and on-premise systems
- B Runs as on-premise agent in a secured network
- C Provides control over on-premise systems that can be accessed by cloud applications
- D Connects on-premise systems to non-SAP Business Technology Platform

Correct. Cloud Connector is not used to connect to non-SAP Business Technology Platform.

## Lesson 1

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## UNIT OBJECTIVES

- Describe the types of service providers and use cases
- Describe the concept of deployment and activation

Duplication is prohibited.

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## Managing Service Provider



### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Describe the types of service providers and use cases
- Describe the concept of deployment and activation

### Service Provider



A service provider is a server in the machine model that provides tags or services. You can use the service provider to model the following:

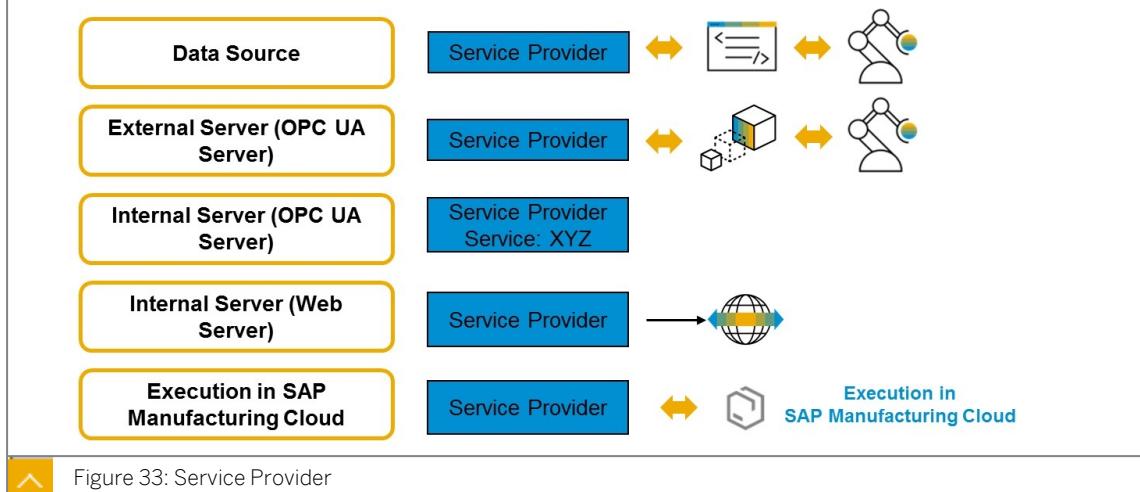


Figure 33: Service Provider

- Data source

You can connect an external data source, such as an OPC UA server, and define all the properties of the data source here. The data source provides tags.

- External server (type: OPC UA server)

You can connect an external OPC UA server that provides methods.

- Internal server (type: OPC UA server)



#### Note:

This is no longer needed after 2105 release

You can define an OPC UA server that is created automatically in the PCo. You can define the methods here in the configuration of the service provider.

- Internal server (type: Web server)



Note:

This is no longer needed after 2105 release

You can define a PCo Web server that is created automatically in PCo. You can define the Web services here in the configuration of the service.

- Execution in SAP Manufacturing Cloud

You can connect a Digital Manufacturing Execution service offered in the SAP Digital Manufacturing Cloud to the machine model. The manufacturing services allow you, for example, to start or complete an SFC.

The first three types of service providers will be covered in this training.



In SAP Digital Manufacturing Cloud, service providers are created and maintained in Manage Service Providers app.

To access the Manage Service Providers App, use the following path:

*Manufacturing Automation → Manage Service Providers*

Manage Service Providers



Figure 34: Manage Service Provider in DMC



You have configured SAP Plant Connectivity and Cloud Connector using the Machine Model and Connectivity app.

For more information, see Unit 2 Machine Model and Connectivity.

Figure 35: Prerequisites to Create Service Provider

## Shop Floor Automation Configuration



### Digital Manufacturing Cloud

#### Manage Service Provider

SBOOKH\_DataSource  
SP Type: External  
PCo Usage Type: DataSource  
Data Source Type: OPCUA

#### SBOOKH\_SP

SP Type: External  
PCo Usage Type: OPCUAServer

#### SBOOKH\_Int\_SP

SP Type: Internal  
PCo Usage Type: OPCUAServer

### OPC Server

SFC: String	Material: String
Resource: String	Operation: String
Pressure: Double	CycleTime: Double

### SAP Plant Connectivity

#### SBOOKH\_DataSource

SBOOKH\_Simulator  
Service: DoPainting

#### SBOOKH\_SP

SBOOKH\_Int\_SP  
Service: TriggerPainting

Call

Relationship

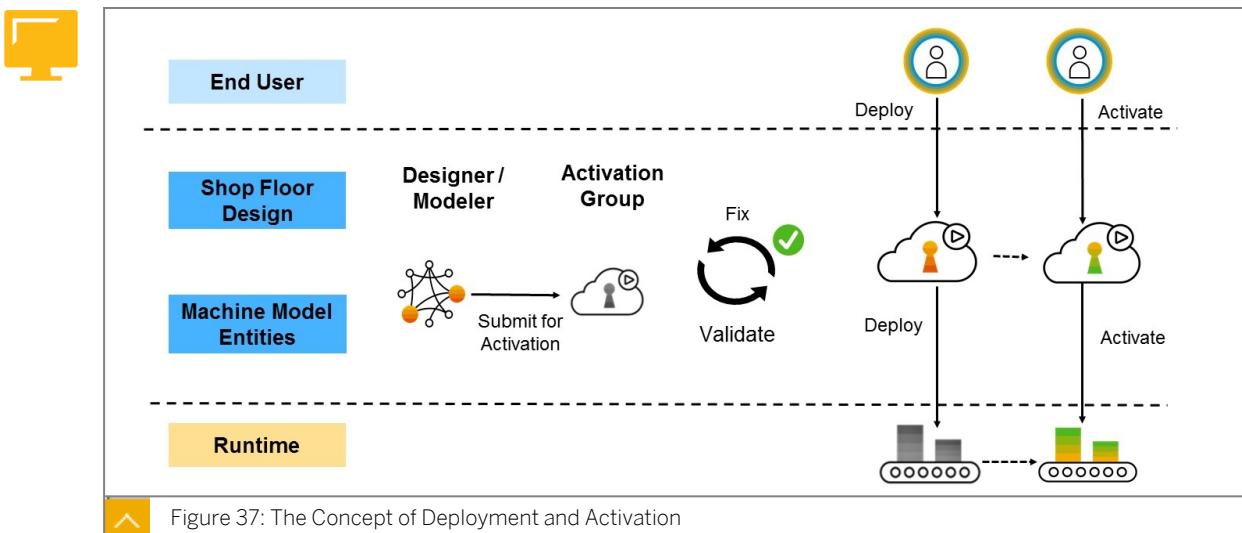
Figure 36: Shop Floor Automation Configuration

Duplication is prohibited.

The service provider in Digital Manufacturing Cloud corresponds to the agent instance in SAP Plant Connectivity. The figure shows the configuration of service providers for a spray booth automation scenario.

- SBOOTH\_DataSource: A data source service provider which connects to the OPC tag server. This service provider enables tag reading and write for the spray booth machine
- SBOOTH\_SP: An external service provider which connects to the SBOOTH\_Simulator, an agent which is the OPC UA Server of the spray booth on PCo. This service provider enables the automation execution from cloud to the shop floor. By calling the method "DoPainting", the spray booth executes the operation.
- SBOOTH\_Int\_SP: An internal service provider which defines the service "TriggerPainting" internally inside of the service provider. The method is used to trigger the production process with the pre-defined condition.

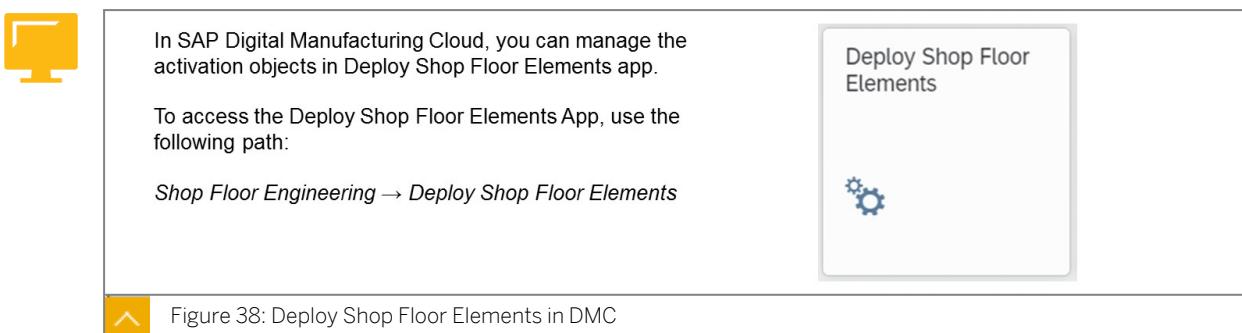
## Deployment and Activation



Manage activation of the manufacturing process and machine model entities (service providers, services, client proxies) in a centralized way to SAP PCo and SAP Digital Manufacturing Cloud runtime:

- Central deployment and activation by activation group
- Simplified deployment and activation process
- Harmonized status control among manufacturing processes and machine model entities

## Deploy Shop Floor Elements in DMC



An activation object is a design or a model that is going to be published to the runtime environment and activated for use in the production, including manufacturing process and machine model entities (service providers, services, client proxies).

An activation object or a child object has the following deployment status:

- New: The object is newly created
- Deployed: The object has been deployed to the runtime environment (Plant Connectivity)
- Failed: Deployment failed and you need to try again to deploy it
- Marked for Deletion: The object is submitted for deletion, but will be deleted after the deletion activation group is deployed
- Deleted: The object has been deleted from the runtime environment

An activation object or a child object has the following activation status:

- Inactive: The object is deployed in the run time environment but is not active
- Active: The object is activated in the runtime environment and is ready to be triggered
- Failed: Activation failed and you need to try again to activate it

### Service Provider Status



Status	Trigger Action	Actions
Draft		Service provider with 'Draft' status can be edited, saved as draft, submitted for deployment and deleted
Submitted	Assign to Activation Group	User cannot delete service providers with this status
Deployed	Deploy (in activation group)	Deletion can be done: 1. Assign this service provider to a new or existing activation group 2. Service provider status should be changed to 'Marked for Deletion'
Marked for Deletion	Delete	Deletion is done after the deletion is deployed in an activation group

Figure 39: Service Provider Status

- You can delete a service provider only if it is in the Draft status. After you have chosen the Delete action, the status of the service provider changes to Marked for Deletion status. You can no longer edit the service provider details.
- You can deploy a service provider only if it is in the Submitted status.
- You can edit a service provider only if it is in the Draft status. If you want to edit a service provider that is in the Submitted status, you must first remove the service provider from the activation group.

### Mapping Between Process Models and PCo Configurations



Object in Digital Manufacturing Cloud	Object in Plant Connectivity
Service Provider	Agent Instance
Client Proxy	Destination System
Production Process	Multiple call destination system
PCo Subscription	Method Notifications
Indicator	Tag

Figure 40: Mapping Between Process Models and PCo Configurations

When you configure the service provider, you define the service provider type (internal or external) and the usage of the object in SAP Plant Connectivity (PCo). The corresponding elements are then deployed to PCo using the activation flow through the Deploy Shop Floor Elements app. The table shows which objects (that you configure in the machine/equipment model) correspond to which configuration elements in PCo.

# Unit 3

## Exercise 6

### Create OPC UA Data Source

#### Task 1: Create OPC UA Data Source

1. Logon to Digital Manufacturing Cloud and open the app Machine Model and Connectivity
2. Create new OPC UA Server and enter the following data in section Header and Connections

Field	Value
Name	DataSource-##
Description	DataSource-##
Connected To	DMC300_PCo

3. Enter the following data in section OPC Server Settings

Field	Value
OPC Server Endpoint URL	opc.tcp://wdflbmt7260:51210/UA/SampleServer
	 Note: Ensure there is no space in the URL.
Message Security	none
Security Policy	none
Binary Encoding	Yes
Certificate Type	None
Authentication Mode	Anonymous

4. Assign the OPC UA server to deployment group DataSource\_AG\_##

#### Task 2: Deploy OPC UA Data Source

1. Login to DMC and open the app Deploy Shop Floor Elements
2. Deploy and activate the deployment group DataSource\_AG\_##

#### Task 3: Start the OPC UA Data Source

1. Log on to the training landscape server using Remote Desktop Connection
2. Start the PCo Management Console

3. Start the OPC UA data source DataSource-##
4. Logon to Digital Manufacturing Cloud and open the app Machine Model and Connectivity
5. Check if the agent instance status is synchronized with PCo

Duplication is prohibited.

Duplication is prohibited.

# Unit 3

## Solution 6

### Create OPC UA Data Source

#### Task 1: Create OPC UA Data Source

1. Logon to Digital Manufacturing Cloud and open the app Machine Model and Connectivity
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Machine Model and Connectivity*
2. Create new OPC UA Server and enter the following data in section Header and Connections

Field	Value
Name	DataSource-##
Description	DataSource-##
Connected To	DMC300_PCo

- a) Choose the tab Shop Floor Systems
  - b) Choose *Create* → *OPC UA Server* → *Create OPC UA Server*
  - c) Enter the data provided in the table in section Header and Connections
3. Enter the following data in section OPC Server Settings

Field	Value
OPC Server Endpoint URL	opc.tcp://wdflbmt7260:51210/UA/ SampleServer
	 Note: Ensure there is no space in the URL.
Message Security	none
Security Policy	none
Binary Encoding	Yes
Certificate Type	None
Authentication Mode	Anonymous

- a) Enter the data provided in the table in section OPC Server Settings
  - b) Click Create and Submit

4. Assign the OPC UA server to deployment group DataSource\_AG\_##
  - a) Click the "+" icon to create a new deployment group
  - b) Enter the deployment group name DataSource\_AG\_##
  - c) Click Save

### Task 2: Deploy OPC UA Data Source

1. Login to DMC and open the app Deploy Shop Floor Elements
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Deploy Shop Floor Elements*
2. Deploy and activate the deployment group DataSource\_AG\_##
  - a) From the list of existing activation groups, select DataSource\_AG\_##



Note:

You can also navigate to the deployment group from the page where you create the OPC UA data source

- b) Click Validate
- c) Click Deploy
- d) Click Activate

### Task 3: Start the OPC UA Data Source

1. Log on to the training landscape server using Remote Desktop Connection
  - a) Log on to the training landscape server with your user DMC300-## and the password
2. Start the PCo Management Console
  - a) Run *SAP Plant Connectivity* → *Management Console*
3. Start the OPC UA data source DataSource-##
  - a) Click Refresh to update PCo
  - b) Check whether the agent instance DataSource-## is started. If not, select the agent instance DataSource-## and click the button Start Agent Instance
4. Logon to Digital Manufacturing Cloud and open the app Machine Model and Connectivity
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Machine Model and Connectivity*
5. Check if the agent instance status is synchronized with PCo
  - a) Choose tab Shop Floor Systems
  - b) Select the OPC UA data source DataSource-##
  - c) The default agent instance should be in status Started



Note:

You could also turn off the agent by selecting the agent instance and clicking Stop. On the PCo Management Console, after refreshing, the agent status should be synchronized

Duplication is prohibited.

Duplication is prohibited.

## Unit 3

### Exercise 7

# Create Service Provider for External OPCUA Server

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked with creating the server which provides tags or services, in order to establish the connectivity between the equipment which is modeled in Digital Manufacturing Cloud and SAP Plant Connectivity.

#### Task 1: Create Service Provider for External OPCUA Server

1. Logon to Digital Manufacturing Cloud and open the app Manage Service Providers
2. Create new service provider enter the following data in tab Details:

Table 3:

Field	Value
Name	Ext_SP##
Short Description	OPCUA Server ##
Destination Type	Plant Connectivity
Service Provider Type	External
Plant Connectivity	DMC300_PCo
Plant Connectivity Usage Type	OPCUAServer

3. Enter the following data in tab Data Source Properties:

Table 4:

Field	Value
Data Source Type	OPCUA
Data Source Description	Spray Booth Simulator ##
Protocol	OpcTcp

Field	Value
Endpoint URL	opc.tcp://<server>:58710/UA/Sample-Server For example: opc.tcp://wdflbmt7260:58710/UA/SampleServer
	 Note: The port has to be 58710. The url is different from the previous exercise
Message Security	none
Security Policy	none
Binary Encoding	true

4. Enter the following data in tab Security:

Table 5:

Field	Value
Application Certificate	Personal → SAP PCo OPC UA Server SMOOTH_Simulator
Authentication Mode	Anonymous
Store for Trusted Server Certificates	Store Type: Microsoft Certificate Store Folder: UA Applications
Store for Rejected Server Certificates	Store Type: Microsoft Certificate Store Folder: Untrusted Certificates
Store for Trusted Issuer Certificates	Store Type: Microsoft Certificate Store Folder: UA Trusted Issuers

5. Assign the service provider to a deployment group Ext\_SP\_AG\_##

### Task 2: Deploy the Service Provider

1. Open the app Deploy Shop Floor Elements
2. Deploy the deployment group Ext\_SP\_AG\_##

### Task 3: Create Service

1. Open the app Manage Service Providers
2. Select the service provider Ext\_SP-##

3. Create a service group Ext\_SP\_SG-##
4. Create service and enter the following data.

Table 6:

Field	Value
Remote Service	Destination -> DoPainting
Name	DoPainting-##

5. Submit the service to deployment group Ext\_SP\_AG\_service\_##

#### Task 4: Create Client Proxy

1. Open the app Manage Service Providers
2. Find the service DoPainting-## in service provider Ext\_SP-##
3. Create the client proxy DoPainting\_CP\_## by giving the following data:

Table 7:

Field	Value
Name	DoPainting_CP_##
Maximum Retry Attempts	3
Retry Interval	30

4. Submit the client proxy to deployment group Ext\_SP\_AG\_service\_##

#### Task 5: Deploy the Service Provider

1. Open the app Deploy Shop Floor Elements
2. Deploy and activate the deployment group Ext\_SP\_AG\_service\_##

#### Task 6: Start the Service Provider

1. Log on to the training landscape server using Remote Desktop Connection
2. Start the PCo Management Console
3. Start the Service Provider Ext\_SP-##
4. Log on to Digital Manufacturing Cloud and open the app Manage Service Providers
5. Find the service provider Ext\_SP-## and check the status

# Unit 3

## Solution 7

# Create Service Provider for External OPCUA Server

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked with creating the server which provides tags or services, in order to establish the connectivity between the equipment which is modeled in Digital Manufacturing Cloud and SAP Plant Connectivity.

### Task 1: Create Service Provider for External OPCUA Server

1. Logon to Digital Manufacturing Cloud and open the app Manage Service Providers
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation → Manage Service Providers*
2. Create new service provider enter the following data in tab Details:

Table 3:

Field	Value
Name	Ext_SP-##
Short Description	OPCUA Server ##
Destination Type	Plant Connectivity
Service Provider Type	External
Plant Connectivity	DMC300_PCo
Plant Connectivity Usage Type	OPCUAServer

3. Enter the following data in tab Data Source Properties:

Table 4:

Field	Value
Data Source Type	OPCUA
Data Source Description	Spray Booth Simulator ##
Protocol	OpcTcp

Field	Value
Endpoint URL	opc.tcp://<server>:58710/UA/Sample-Server For example: opc.tcp://wdflbmt7260:58710/UA/SampleServer
	 Note: The port has to be 58710. The url is different from the previous exercise
Message Security	none
Security Policy	none
Binary Encoding	true

Duplication is prohibited.

Duplication is prohibited.

- a) Navigate to the tab Data Source Properties and enter the data provided in the table
4. Enter the following data in tab Security:

Table 5:

Field	Value
Application Certificate	Personal → SAP PCo OPC UA Server SBOOTH_Simulator
Authentication Mode	Anonymous
Store for Trusted Server Certificates	Store Type: Microsoft Certificate Store Folder: UA Applications
Store for Rejected Server Certificates	Store Type: Microsoft Certificate Store Folder: Untrusted Certificates
Store for Trusted Issuer Certificates	Store Type: Microsoft Certificate Store Folder: UA Trusted Issuers

- a) Navigate to the tab Security and enter the data provided in the table
- b) Choose Save
- c) Click Save and choose *Submit for Deployment*
5. Assign the service provider to a deployment group Ext\_SP\_AG\_##
- a) Click the + icon to create a new deployment group
- b) Enter the deployment group name *Ext\_SP\_AG\_##*
- c) Click Save

### Task 2: Deploy the Service Provider

1. Open the app Deploy Shop Floor Elements
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Deploy Shop Floor Elements*
2. Deploy the deployment group Ext\_SP\_AG\_##
  - a) From the list, select *Ext\_SP\_AG\_##*
  - b) Click *Validate*
  - c) Click *Deploy*

### Task 3: Create Service

1. Open the app Manage Service Providers
  - a) Login into DMC with the user assigned to you by the course instructor
2. Select the service provider Ext\_SP-##
3. Create a service group Ext\_SP\_SG-##
  - a) Select Services.  
Click + to create new Service Groups
  - b) Enter the name **Ext\_SP\_SG-##**
  - c) Click *OK*
4. Create service and enter the following data.

Table 6:

Field	Value
Remote Service	Destination -> DoPainting
Name	DoPainting-##

- a) Click the service group Ext\_SP\_SG-##
- b) On the new pop-up, click + to create new service
- c) Click on the browse icon in the Remote Service data field
- d) Choose Destination -> DoPainting
- e) Enter the name **DoPainting-##**
- f) Click *OK*
5. Submit the service to deployment group Ext\_SP\_AG\_service\_##
  - a) Click *Submit for Deployment*
  - b) Create a new deployment group Ext\_SP\_AG\_service\_##
    - c) Click *Submit for Deployment*

### Task 4: Create Client Proxy

1. Open the app Manage Service Providers
  - a) Login into DMC with the user assigned to you by the course instructor
2. Find the service DoPainting-## in service provider Ext\_SP-##
  - a) Select the service provider Ext\_SP-##
  - b) Select the tab Services
  - c) Select the service DoPainting-## and select the service group Ext\_SP\_SG-##.
3. Create the client proxy DoPainting\_CP\_## by giving the following data:

Table 7:

Field	Value
Name	DoPainting_CP_##
Maximum Retry Attempts	3
Retry Interval	30

- a) Click *Client Proxy Configuration*
- b) Click the add button +
- c) Enter the data provided in the table
- d) Choose Save
4. Submit the client proxy to deployment group Ext\_SP\_AG\_service\_##
  - a) Click Submit for Deployment
  - b) Select the deployment group Ext\_SP\_AG\_service\_##
  - c) Click OK to submit for deployment

### Task 5: Deploy the Service Provider

1. Open the app Deploy Shop Floor Elements
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Deploy Shop Floor Elements*
2. Deploy and activate the deployment group Ext\_SP\_AG\_service\_##
  - a) From the list, select Ext\_SP\_AG\_service\_##
  - b) Click *Validate*



Note:

If the Validation Error pops up, choose Show Report. If the error message is "Dependencies are still active in the runtime environment. Please deactivate the dependencies first", click Deactivate and click Validate again

- c) Click *Deploy*

- d) Click Activate

#### Task 6: Start the Service Provider

1. Log on to the training landscape server using Remote Desktop Connection
  - a) Log on to the training landscape server <server> with your user DMC300-## and the password
2. Start the PCo Management Console
  - a) Run SAP Plant Connectivity → Management Console
3. Start the Service Provider Ext\_SP-##
  - a) Click Refresh to update PCo
  - b) Check whether the agent instance Ext\_SP-## is started. If not, select the agent instance Ext\_SP-## and click Start Agent Instance
4. Log on to Digital Manufacturing Cloud and open the app Manage Service Providers
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to Manufacturing Automation → Manage Service Providers
5. Find the service provider Ext\_SP-## and check the status
  - a) Select the service provider Ext\_SP-##, the agent status should be Started



Note:

You can start and stop the service provider from DMC, the status is synchronized with the PCo agent instance.

With the external service provider, you can consume the DoPainting method in production process. This will be introduced later in [Shop Floor Designer](#).

## Unit 3 Exercise 8

# (Optional) Create Service Provider for File System Monitor



Note:

In this exercise, you will create another service provider in type File System Monitor. The aim is to get familiar with more service provider types, but this service provider will not be used in any of the later exercises

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked with creating the server which to monitor a folder which stores the machine data.

### Task 1: Create Files

1. Log on to the training landscape server using Remote Desktop Connection
2. Create two folders Folder1 and Folder2 on desktop
3. In Folder2, create a text file MachineData.txt. Enter the file content  
`<status>PRODUCTIVE</status>`

### Task 2: Create Service Provider for File System Monitor

1. Logon to Digital Manufacturing Cloud and open the app Manage Service Providers
2. Create new service provider enter the following data in tab Details:

Table 8:

Field	Value
Name	FileMonitor_SP##
Short Description	File Monitor ##
Destination Type	Plant Connectivity
Service Provider Type	External
Plant Connectivity	DMC300_PCo
Plant Connectivity Usage Type	Data Source

3. Enter the following data in tab Data Source Properties:

Table 9:

Field	Value
Data Source Type	File System
Data Source Description	File System ##
Folder to Monitor	\...\Desktop\Folder1 For example: C:\Users\SCM385-02\Desktop\Folder1
Text Encoding	1252
Action	Move
Destination Folder	\...\Desktop\Folder2 For example: C:\Users\SCM385-02\Desktop\Folder2

4. Assign the service provider to a deployment group FileMonitor\_AG\_##

### Task 3: Deploy the Service Provider

1. Open the app Deploy Shop Floor Elements
2. Deploy and activate the deployment group FileMonitor\_AG\_##

### Task 4: Start and Test the Service Provider

1. Log on to the training landscape server using Remote Desktop Connection
2. Start the PCo Management Console
3. Start the Service Provider FileMonitor\_SP-##
4. Log on to DMC and open the app Manage Service Providers
5. Check the status of the service provider FileMonitor\_SP-##
6. Log on to the training landscape server. Move the file MachineData.txt from Folder2 to Folder1. What will happen in those two folders?

## (Optional) Create Service Provider for File System Monitor



Note:

In this exercise, you will create another service provider in type File System Monitor. The aim is to get familiar with more service provider types, but this service provider will not be used in any of the later exercises

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked with creating the server which to monitor a folder which stores the machine data.

### Task 1: Create Files

1. Log on to the training landscape server using Remote Desktop Connection
  - a) Log on to the training landscape server <server> with your user and the password
2. Create two folders Folder1 and Folder2 on desktop
  - a) On the Windows desktop, right click and select New -> Folder
  - b) Rename the new folder Folder1
  - c) Repeat the process for Folder2
3. In Folder2, create a text file MachineData.txt. Enter the file content  
`<status>PRODUCTIVE</status>`

### Task 2: Create Service Provider for File System Monitor

1. Logon to Digital Manufacturing Cloud and open the app Manage Service Providers
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation → Manage Service Providers*
2. Create new service provider enter the following data in tab Details:

Table 8:

Field	Value
Name	FileMonitor_SP-##
Short Description	File Monitor ##
Destination Type	Plant Connectivity

Field	Value
Service Provider Type	External
Plant Connectivity	DMC300_PCo
Plant Connectivity Usage Type	Data Source

- a) Click the + icon in the top right corner
- b) Enter the data provided in the table in the tab Details
3. Enter the following data in tab Data Source Properties:

Table 9:

Field	Value
Data Source Type	File System
Data Source Description	File System ##
Folder to Monitor	\...\Desktop\Folder1 For example: C:\Users\SCM385-02\Desktop\Folder1
Text Encoding	1252
Action	Move
Destination Folder	\...\Desktop\Folder2 For example: C:\Users\SCM385-02\Desktop\Folder2

- a) Navigate to the tab Data Source Properties and enter the data provided in the table, leave the rest of the data field as default



Note:

Copy the file path from window file explorer and paste in the data field

- b) Choose *Submit for Deployment*
4. Assign the service provider to a deployment group FileMonitor\_AG\_##
- a) Click the + icon to create a new deployment group
- b) Enter the deployment group name FileMonitor\_AG\_##
- c) Click Save

### Task 3: Deploy the Service Provider

1. Open the app Deploy Shop Floor Elements

- a) Login into DMC with the user assigned to you by the course instructor
- b) Navigate to *Manufacturing Automation* → *Deploy Shop Floor Elements*
2. Deploy and activate the deployment group FileMonitor\_AG\_##
  - a) From the list of existing activation groups, select FileMonitor\_AG\_##
  - b) Click *Validate*
  - c) Click *Deploy* and click *Deploy* on pop up.
  - d) Click *Activate*

#### **Task 4: Start and Test the Service Provider**

1. Log on to the training landscape server using Remote Desktop Connection
  - a) Log on to the training landscape server with your user DMC300-## and the password
2. Start the PCo Management Console
  - a) Run SAP Plant Connectivity → *Management Console*
3. Start the Service Provider FileMonitor\_SP-##
  - a) Click Refresh to update PCo
  - b) Check whether the agent instance FileMonitor\_SP-## is started. If not, select the agent instance FileMonitor\_SP-## and click Start Agent Instance
4. Log on to DMC and open the app Manage Service Providers
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Manage Service Providers*
5. Check the status of the service provider FileMonitor\_SP-##
  - a) Select the service provider FileMonitor\_SP-##
  - b) Click Refresh Status, the agent status should be Started



**Note:**

You could also turn off the agent by clicking the toggle switch and change it to Stopped. On the PCo Management Console, after refreshing, the agent status should be synchronized

6. Log on to the training landscape server. Move the file MachineData.txt from Folder2 to Folder1. What will happen in those two folders?
  - a) Log on to the training landscape server with your user DMC300-## and the password
  - b) Make sure the agent FileMonitor\_SP-## is started. Move the file MachineData.txt from Folder2 to Folder1.
  - c) Few seconds later, the file MachineData.txt is removed from Folder1 and appears in Folder2.  
This behaviour corresponds to the Move action that you configured in the service provider FileMonitor\_SP-##



### LESSON SUMMARY

You should now be able to:

- Describe the types of service providers and use cases
- Describe the concept of deployment and activation

# Learning Assessment

1. In which status the service provider could be edited?

*Choose the correct answer.*

- A Draft
- B Submitted
- C Deployed
- D Marked as Deletion

2. What is the Service Provider type to connect to an OPC UA Server that provides methods?

*Choose the correct answer.*

- A Internal, type: OPC UA Server
- B External, type: OPC UA Server
- C External, type: Data Source
- D Internal, type: Web Server

## Learning Assessment - Answers

1. In which status the service provider could be edited?

*Choose the correct answer.*

- A Draft
- B Submitted
- C Deployed
- D Marked as Deletion

Correct. Only Service Provider in draft status can be edited.

2. What is the Service Provider type to connect to an OPC UA Server that provides methods?

*Choose the correct answer.*

- A Internal, type: OPC UA Server
- B External, type: OPC UA Server
- C External, type: Data Source
- D Internal, type: Web Server

Correct. External service provider in type OPC UA Server is used to connect to an OPC UA Server that provides methods.

## UNIT 4

# Machine Model Core Components

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Duplication is prohibited.

### UNIT OBJECTIVES

- Explain the concept of Machine Model and connectivity
- Describe the concept of Managing Template
- Describe the correlation among class, subclass, indicators and model template
- Manage models
- Manage equipments

Duplication is prohibited.

## Managing Templates

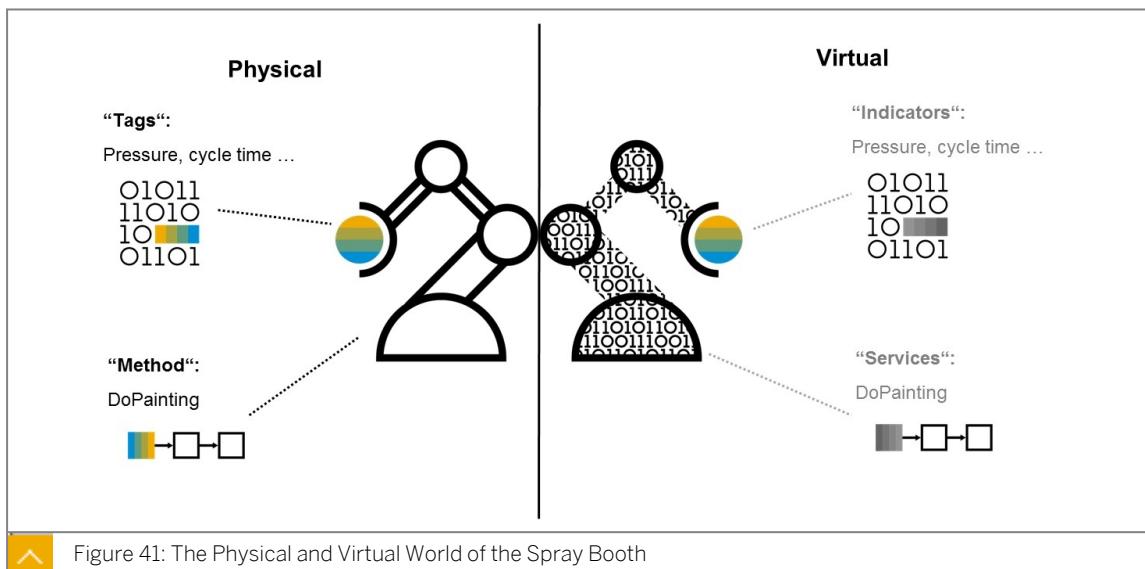


### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Explain the concept of Machine Model and connectivity
- Describe the concept of Managing Template
- Describe the correlation among class, subclass, indicators and model template

### Machine Model



Duplication is prohibited.

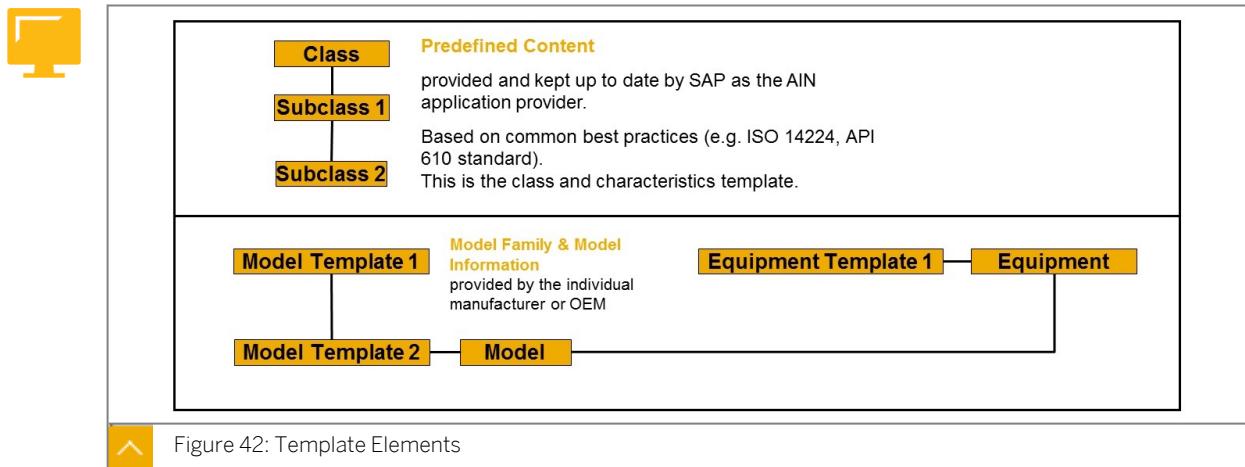
With respect to Digital Manufacturing Cloud, the machine model reflects all aspects of the physical counter part which are necessary to describe and run shop floor process:

- Attributes - Static properties (Such as Manufacturing Specifications)
- Indicators - Change Values automatically (Such as measurement points)
- Properties for target values of an indicator (Such as set points)

Using machine model production engineers and operators can work with the applications in the same way as if they would handle physical machine.

For example: from DMC, the operator could read the pressure of the equipment (spray booth) . He could also change the pressure by writing indicator.

Duplication is prohibited.



**Class:** Provided by SAP based on Industry standards. The class level can be considered as the top-node of the classification. A class does not have a parent object, but can have multiple subclasses as child objects.

**Subclasses:** The child objects of a class. It is possible to model multiple subclasses under the top-level subclass. Each child subclass will inherit attributes or attribute groups from its parent objects, that is, class and subclasses. Class/subclass can have attributes/attribute groups which will be inherited to the child object.

**Template:** A template is a format to maintain metadata, that is, attributes and attribute groups, related to a model, equipment, location, system, or spare part. A template inherits metadata from its parent objects, for example, parent subclass templates or other parent templates, and can have additional attribute groups and attributes.

**Model Template:** Usually provided by manufacturer. Each model template can have attributes/attribute groups which will be inherited to child object Models. It is possible to have multiple model templates under the top-level model template. Each child model template will inherit attribute or attribute groups from its parent objects, that is, class and subclasses and model templates. When creating a model, you do this with reference to a model template.

**Equipment Templates:** Created by operators - are used to provide equipment-specific attributes or attribute groups. You can use equipment templates as only reference for an equipment or in combination with the templates coming via a model.

Example:

- Class: Transformer
- Subclass 1: Power Transformer, would inherit from Class (Transformer)
- Subclass 2: Dry-type Transformer, would inherit from Subclass 1 (Power transformer) and Class (Transformer)
- Model Template 1 (SDT) - Small dry type transformer, would inherit from Subclass 2 (Dry-type transformer), Subclass 1 (Power transformer), and Class (Transformer)
- Model Template 2 (SDT-100x) - Small dry type transformer series 100x, would inherit from Model Template 1 (SDT), Subclass 2 (Dry-type transformer), Subclass 1 (Power transformer), and Class (Transformer)
- Model would be created with reference to Model Template 2 (SDT-100x), and therefore the Model would have all attributes or attribute groups coming from the model template itself as well as the ones inherited.

- Equipment was created in reference to Model, and therefore this equipment would have all attributes /attribute groups associated with the model, that is, inherit from Model Template 2 (SDT-100x), Model Template 1 (SDT), Subclass 2 (Dry-type transformer), Subclass 1 (Power transformer), and Class (Transformer). Since Equipment was also created in reference to Equipment Template, this equipment would additionally have all attributes or attribute groups associated with the equipment template.

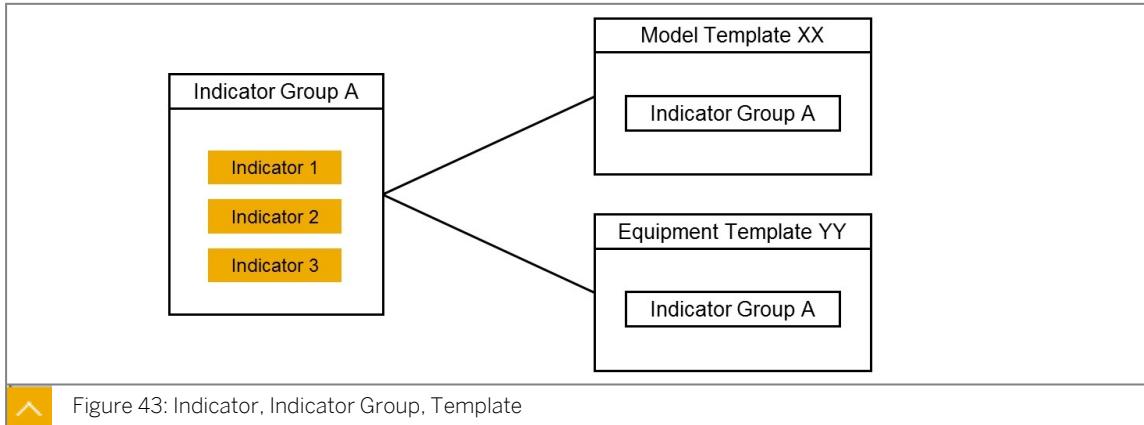


Figure 43: Indicator, Indicator Group, Template

The Indicators are dynamic properties of the equipment. The Indicator Group is the logical grouping of the related indicators.

You can assign indicator group to Model template and Equipment Template.

## Managing Templates

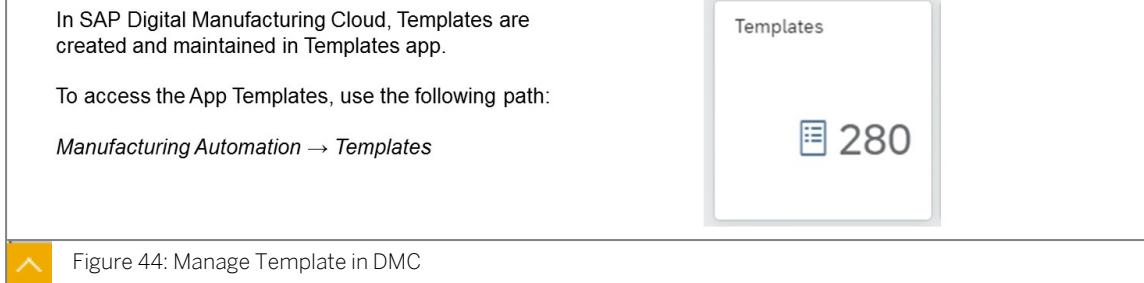
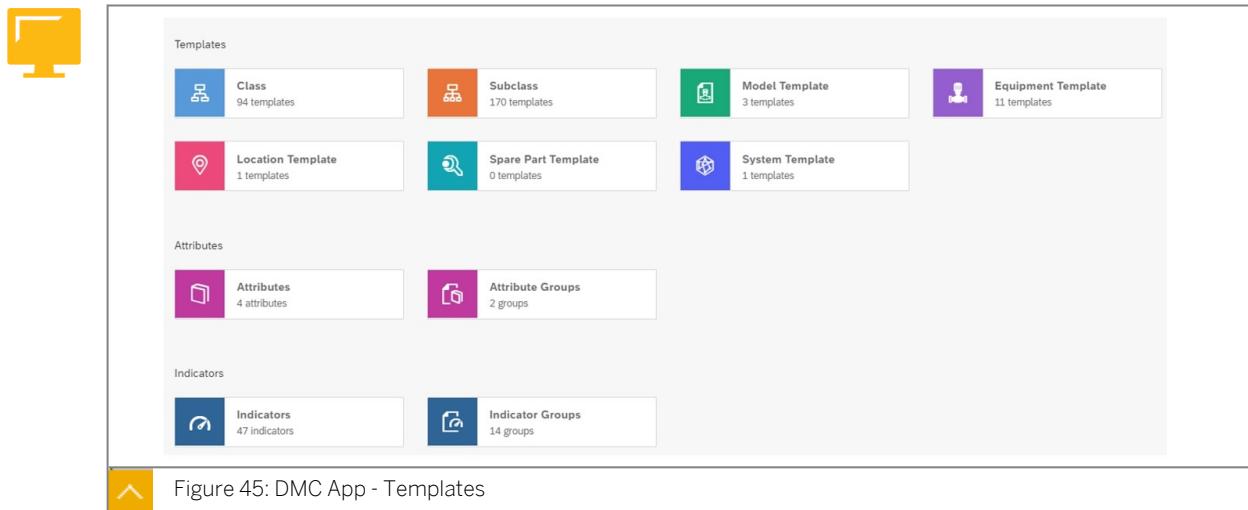


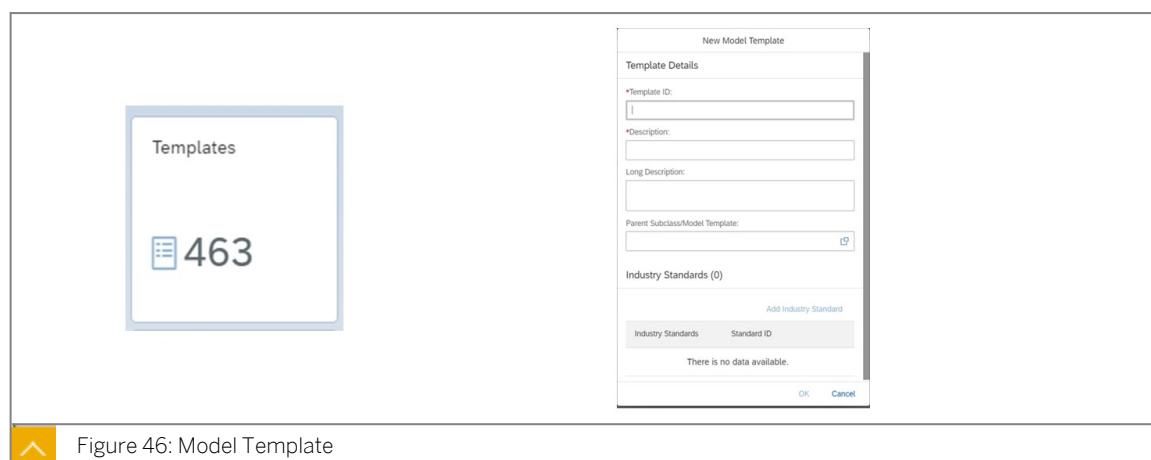
Figure 44: Manage Template in DMC

Besides the Model and Equipment Template, you can also maintain Class, Subclass, Attributes (Group), Indicators (Group) in the app Templates.



You use the Templates app to work with a template. You can perform the following operations using the Templates app:

- Create Indicators, indicator groups, attributes and attribute groups.
- Create a model template to define the attributes and attribute groups related to a model.
- Create an equipment template to include equipment-specific attributes and attribute groups.
- View details of a template and update the existing template with new information, or update the incorrect information.



To create Model Template, enter the following data:

- Template ID - This is Unique ID for Model
- Description - Short description about Model
- Parent Subclass / Model Template - Select a subclass template, or another model template

Duplication is prohibited.



## Indicators

Figure 47: Create Indicators

To create new indicator, enter the following data:

- ID - Name of the Indicator
- Description - Short description about Indicator
- Data Type - Indicator Data Type (Date / String / Numeric / Numeric Flexible)
- Indicator Type - Define indicator type (Measured / Calculated / Assessed)



Figure 48: Create Indicator Group

You create Indicator Group to group the related Indicators.

Duplication is prohibited.

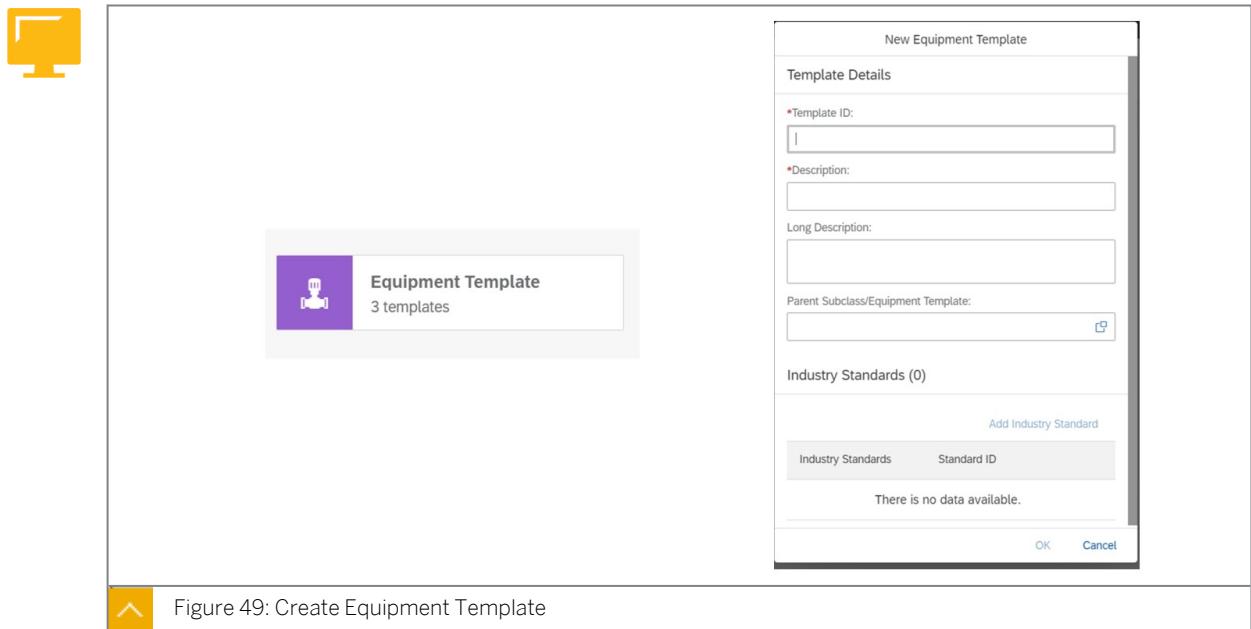


Figure 49: Create Equipment Template

To create Equipment Template, enter the following data:

- Template ID- Unique ID for the equipment template
- Description- Short description of template
- Parent Subclass/Equipment Template- Select a subclass template, or another equipment template as parent template

Equipment template can be associated with Attribute Group and/or Indicator Group.

Duplication is prohibited.

Duplication is prohibited.

# Unit 4

## Exercise 9

### Create Template

John is from an Equipment Manufacturing company and he needs to create a Model template that can be used by his customers with similar equipment's, which will allow him to maintain the customer equipment's by monitoring defined indicators.

#### Task 1: Log on to Digital Manufacturing tenant.

1. Login into DMC with the user assigned to you by the course instructor

#### Task 2: Create Indicators

1. Open the app *Template*
2. Create New Indicator

Indicator ID	Description	Data Type	Indicator Type
SFC-300-##	SFC for Group ##	String	Assessed
MATERIAL-300-##	Material for Group ##	String	Assessed
OPERATION-300-##	Operation for Group-##	String	Assessed
RESOURCE-300-##	Resource for group ##	String	Assessed
PRESSURE-300-##	Pressure for group ##	Numeric	Measured
CYCLETIME-300-##	Cycle time for group-##	Numeric	Measured
STATUS-300-##	Status for group-##	String	Measured

#### Task 3: Create Indicator group with Name: IG-300-## and assign Indicators to the group

1. Create Indicator Group
2. Assign Indicators to Indicator Group

#### Task 4: Create Model template with Name: MODELTEMP-300-##

1. Enter the data provided in the table.

Field	Value
Template ID	MODELTEMP-300-##

Field	Value
Description	Model template for group ##

**Task 5: Assign Indicator group IG-300-## to Model template MODELTEMP-300-##**

1. Open Model template MODELTEMP-300-##
2. Assign Indicator Group: IG-300-##

Duplication is prohibited.

Duplication is prohibited.

# Unit 4

## Solution 9

### Create Template

John is from an Equipment Manufacturing company and he needs to create a Model template that can be used by his customers with similar equipment's, which will allow him to maintain the customer equipment's by monitoring defined indicators.

#### Task 1: Log on to Digital Manufacturing tenant.

1. Login into DMC with the user assigned to you by the course instructor

#### Task 2: Create Indicators

1. Open the app *Template*
  - a) On DMC Home page go to *Manufacturing Automation* and click on the *Template* app.
  - b) Open *Indicators* app to create new indicators
2. Create New Indicator

Indicator ID	Description	Data Type	Indicator Type
SFC-300-##	SFC for Group ##	String	Assessed
MATERIAL-300-##	Material for Group ##	String	Assessed
OPERATION-300-##	Operation for Group-##	String	Assessed
RESOURCE-300-##	Resource for group ##	String	Assessed
PRESSURE-300-##	Pressure for group ##	Numeric	Measured
CYCLETIME-300-##	Cycle time for group-##	Numeric	Measured
STATUS-300-##	Status for group-##	String	Measured

- a) Click *New*
- b) On New Indicator popup enter the following information

Field	Value
ID	SFC-300-##
Description	SFC for Group ##
Data Type	String

Field	Value
Dimension	None
Expected Behaviour	None
Indicator Type	Assessed

- c) Click OK
- d) Repeat Step a to Step c for other Indicators

**Task 3: Create Indicator group with Name: IG-300-## and assign Indicators to the group**

1. Create Indicator Group
  - a) On DMC Home page go to *Manufacturing Automation* and click on the *Template* app.
  - b) Open *Indicator Groups* app to create new indicator Group
  - c) Click New
  - d) On New Indicator Group popup enter the following information.

Field	Value
Name	IG-300-##
Description	Indicator Group for ##

- e) Click OK
2. Assign Indicators to Indicator Group
  - a) On DMC Home page go to *Manufacturing Automation* and click on the *Template* app.
  - b) Open Indicator Groups app
  - c) Click IG-300-##
  - d) Click Edit
  - e) Go to *Indicators* tab and click Add
  - f) Select the Indicators created in Task 2 (7 Indicators)



Note:

You can search for the indicators by entering **300-##** in search bar

- g) Click Save

**Task 4: Create Model template with Name: MODELTEMP-300-##**

1. Enter the data provided in the table.

Field	Value
Template ID	MODELTEMP-300-##

Field	Value
Description	Model template for group ##

- a) On DMC Home page go to *Manufacturing Automation* and click on the *Templateapp*.
- b) Open *Model Template*
- c) Click *New* and enter the data provided in the table.

Field	Value
Template ID	MODELTEMP-300-##
Description	Model template for group ##

- d) Click *OK*

#### **Task 5: Assign Indicator group IG-300-## to Model template MODELTEMP-300-##**

1. Open Model template MODELTEMP-300-##
  - a) On DMC Home page go to *Manufacturing Automation* and click on the *Templateapp*.
  - b) Open *Model Template*
  - c) Click MODELTEMP-300-##
2. Assign Indicator Group: IG-300-##
  - a) Click *Add* and select *Indicator Groups*
  - b) Select the Indicator Group IG-300-##
  - c) Click *OK*



## LESSON SUMMARY

You should now be able to:

- Explain the concept of Machine Model and connectivity
- Describe the concept of Managing Template
- Describe the correlation among class, subclass, indicators and model template

# Unit 4

## Lesson 2

## Managing Models



### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Manage models

### Managing Models



Figure 50: Manage Model

A model is based on a template and allows users to add values to the definitions used in the underlying template.

A model maintains maintenance information using the following business entities:

Instruction:

An instruction is a collection of steps from the manufacturer that make up a procedure on how to carry out a service by an operator. An instruction consists of information that help the operator to maintain the equipment better. There are five types of instructions: Planned Maintenance Instruction, Troubleshooting and Breakdown Instruction, Installation Instructions, Operations Instructions, and Disposal Instructions.

Parts:

A part is a single piece of an equipment. A manufacturer provides a list of parts used in the model along with the visual representation of each one of them. An operator can select a specific part of the model from the list to view the manufacturer details, spare part number, and the quantity of the part used in the model and use these details for procurement purposes.

Documentation:

A document is a material of reference provided by the manufacturer and contains information relevant to a specific phase in the life cycle of the model.

A model can be in any of the following states:

- Unpublished

- In Revision
- Published

Using Manage models app you can perform following operations:

- Create Model
- Update Model
- Publish Model
- Deleting Model

**Create Model:** Create model and assign business entities such as documents, structure and parts, information of the model, Indicators, Time line.

While creating a New Model, Manufacturer should select the Tracking:

- Serial number tracking at model level: As a manufacturer, you want to track an item of equipment within a model using a unique serial number. An operator uses the unique serial number while creating an item of equipment.
- Serial number tracking at manufacturer level: As a manufacturer, you want to track all items of equipment using a unique serial number. An operator uses the unique serial number while creating an item of equipment.
- Batch number tracking at batch level.

**Update Model:** Which will allow users to view the existing model and update existing model.

View all the indicators associated with the models under the indicator section under monitoring. You can define, model and edit additional properties of the indicators and their thresholds using the Edit option in the indicators section.

**Delete Model:** Allow users to clean up the data that is not required to be on the network.

**Publish Model:** Once the model is ready, this model can be published for use.

### Create Model



Models
  
15

New Model

Type:	<input type="text" value="For Equipment"/>
Model ID:	<input type="text"/>
Description:	<input type="text"/>
Long Description:	<input type="text"/>
Tracking:	<input type="text" value="Serial Number Tracking at Model Level"/>
Parent Subclass/Model Template:	<input type="text"/>
Manufacturer:	<input type="text"/>

Figure 51: Create Model

Model will be created from Model template. Model can be created:

- For Equipment
- For System

Model can be used by other customers with in the Manufacturer network.

To create new model, go to the *Models* app.

Manage Model app can be accessed Machine/Equipment Model and orchestration → Manage Equipment.

For Creating New Model,

Manage Model app can be accessed Machine/Equipment Model and orchestration → Manage Equipment → New.

In the New Model popup enter required information.

- Type - Select the model that is relevant to Equipment or system.
- Model ID - Unique ID for Model.
- Description - Enter short description of the Model.
- Tracking - How the Associated equipment manufacturer would like to Track ( Serial number tracking at model level/ Serial number tracking at manufacturer level/Batch Number).
- Parent SubClass/Model template - SubClass / Model Template for a model. As a manufacturer, you want to track all items of equipment.
- Manufacturer - Select the manufacturer name.

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# Unit 4

## Exercise 10

### Create Models

John is from an Equipment Manufacturing company and he needs to create a Model for an equipment using a Model template and serial number tracking, that will allow him to maintain the customer equipment's by serial Number

#### Task 1: Create a Model using Model Template

1. Open an app to create Template
2. Create New Model

Field	Value
Type	For Equipment
Model ID	MODEL-300-##
Description	Model for group ##
Tracking	Serial Number Tracking at Model Level
Parent Subclass/Model template	MODELTEMP-300-##
Manufacturer	<<select any available manufacturer>>

#### Task 2: Review the Model: MODEL-300-##

1. Review the Model: MODEL-300-##

#### Task 3: Publish Model: MODEL-300-##

1. Publish Model: MODEL-300-##

# Unit 4

## Solution 10

### Create Models

John is from an Equipment Manufacturing company and he needs to create a Model for an equipment using a Model template and serial number tracking, that will allow him to maintain the customer equipment's by serial Number

#### Task 1: Create a Model using Model Template

1. Open an app to create Template
  - a) On DMC homepage go to *Manufacturing Automation* and click the *Models* app
2. Create New Model

Field	Value
Type	For Equipment
Model ID	MODEL-300-##
Description	Model for group ##
Tracking	Serial Number Tracking at Model Level
Parent Subclass/Model template	MODELTEMP-300-##
Manufacturer	<<select any available manufacturer>>

- a) Click New
- b) On New Model pop-up enter the provided information

#### Task 2: Review the Model: MODEL-300-##

1. Review the Model: MODEL-300-##
  - a) On DMC homepage go to *Manufacturing Automation* and click the *Models* app
  - b) Select the Model MODEL-300-##
  - c) Click on the Model and go to the *Monitoring* tab and review the Indicators assigned to your Model

#### Task 3: Publish Model: MODEL-300-##

1. Publish Model: MODEL-300-##
  - a) On DMC homepage go to *Manufacturing Automation* and click the *Models* app
  - b) Open Model Template: MODEL-300-##
  - c) Click Publish
  - d) Click No (Do you want to create an announcement)



Note:

When you create an Equipment using Model ID , you can maintain serial number for that equipment while creating an equipment in DMC .

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## LESSON SUMMARY

You should now be able to:

- Manage models

## Managing Equipments



### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Manage equipments

### Managing Equipments

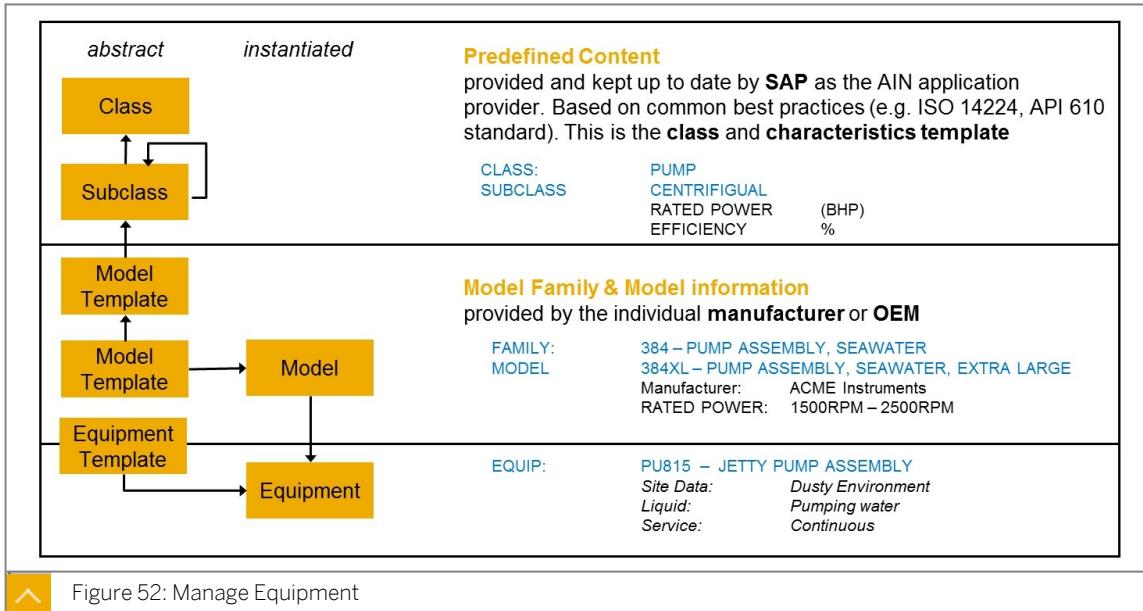


Figure 52: Manage Equipment

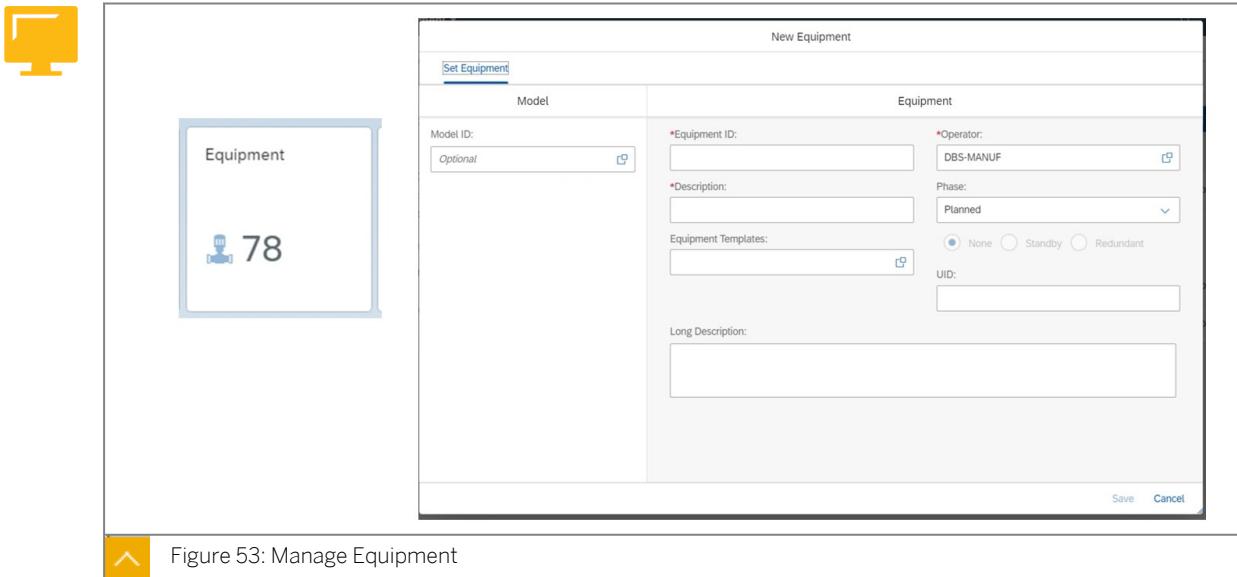
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Equipment can be created based on existing Model or Equipment Template and add additional information such as operator, equipment installation information, equipment location information, and assign documents relevant to the equipment.

The Equipment is created for:

- Operation purpose
- Another customer



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Using the Equipment app, you can create, view, update, and delete an equipment. An equipment is a physical instance of a model. An operator maintains additional information specific to an item of an equipment such as the following:

- Installation information: An operator maintains installation information related to an equipment such as serial number of the equipment, tag number of the equipment, installation date of the equipment, and build date of the equipment.
- Installation location: An operator maintains geographical coordinates of the item of an equipment to locate the location of an item of an equipment.
- Documents: An operator maintains some best practices information while using the item of an equipment using unstructured documents.

An equipment can be in any of the following states:

- Unpublished
- In Revision
- Published

Manage Equipment app can be accessed Machine/Equipment Model and orchestration → Manage Equipment.

To create an new equipment Click on new button.

In the Create new Equipment popup,

- Equipment can be created using Manufacturer created model.
- Equipment can be created using Equipment template.
- Equipment can be created with out model and Equipment template.

If Equipment created using Model or Equipment template all the associated equipment template or model information will be auto assigned.

Model ID - Select the Model ID which is published (Optional).

Equipment ID - Unique Name for an item of equipment.

Description - Short description of an item of equipment.

Equipment Template - Select the Equipment template (optional).

Operator - Enter the operator for the equipment, As a company this can be selected with default value.

Phase - Status of the equipment (Planned/Fully operational/partially operational/Not operational).

In order to use this equipment in further processes this need to be published. In order Edit/Add information use manage functionality/Edit by selecting to equipment.

- Add Equipment Components
- Add Location
- Add or maintain Structure and Parts
- Add or maintain Documentation
- Add Monitoring information (Indicators)
- Add Maintenance and Service

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## Unit 4 Exercise 11

# Create Equipment with Equipment Template

Tony is a supervisor for a company ABC and need to create an equipment using an equipment Template to maintain the equipment data and assign indicators that need to be integrated into the production process.

### Task 1: Log on to Digital Manufacturing tenant

1. Login into DMC with the user assigned to you by the course instructor

### Task 2: Create an Equipment Template

1. Open the app Template to create an equipment template EQUIPTEMP-SBOOTH-##

### Task 3: Assign Indicator Group to Equipment template

1. Assign Indicator Group IG-300-## to Equipment Template EQUIPTEMP-SBOOTH-##

### Task 4: Create Equipment with Equipment Template

1. Create Equipment with Name: EQUIP-SBOOTH-## and equipment template EQUIPTEMPSBOOTH-##

Table 10:

Field	Value
Equipment ID	EQUIP-SBOOTH-##
Operator	<>select any available operator>>
Description	SBOOTH Equipment for ##
Phase	Fully Operational
Equipment Templates	EQUIPTEMP-SBOOTH-##

2. Review Indicators assigned for EQUIP-SBOOTH-##
3. Publish the Equipment
4. Go to the Manage Resource app and assign Equipment EQUIP-SBOOTH-## to Resource SBOOTH-##

### Task 5: Assign Equipment to Plant

Field	Value
Plant	DMC300
Equipment ID	EQUIP-SBOOTH-##

1. From DMC homepage go to *Manufacturing Automation* → *Manage Equipment Connectivity*
2. Select the Equipment EQUIP-SBOOTH-##
3. Click on the Assign Plant
4. Select the plant from List DMC300
5. You can see the assigned plant for this equipment in the Header



Note:

When Equipment Created using Equipment Template, Sub Class and Model ID information will not be available. This information is available when Equipment is created with Model

## Unit 4 Solution 11

# Create Equipment with Equipment Template

Tony is a supervisor for a company ABC and need to create an equipment using an equipment Template to maintain the equipment data and assign indicators that need to be integrated into the production process.

### Task 1: Log on to Digital Manufacturing tenant

1. Login into DMC with the user assigned to you by the course instructor

### Task 2: Create an Equipment Template

1. Open the app Template to create an equipment template EQUIPTEMP-SBOOTH-##
  - a) On the DMC homepage go to *Manufacturing Automation* and click on the app *Templates* → *Equipment Template*
  - b) Click on New
  - c) On New Equipment Template popup enter the information provided in the table.

Field	Value
Template ID	EQUIPTEMP-SBOOTH-##
Description	Equipment template for SBOOTH-##

- d) Click on OK Button

### Task 3: Assign Indicator Group to Equipment template

1. Assign Indicator Group IG-300-## to Equipment Template EQUIPTEMP-SBOOTH-##
  - a) Open Equipment Template: EQUIPTEMP-SBOOTH-## from *Manufacturing Automation* → *Templates* → *Equipment Template*
  - b) Click on Equipment Template: EQUIPTEMP-SBOOTH-##
  - c) Click on Add Button and select Indicator Groups
  - d) Select IG-300-## and Click OK

### Task 4: Create Equipment with Equipment Template

1. Create Equipment with Name: EQUIP-SBOOTH-## and equipment template EQUIPTEmpsBOOTH-##

Table 10:

Field	Value
Equipment ID	EQUIP-SBOOTH-##
Operator	<<select any available operator>>
Description	SBOOTH Equipment for ##
Phase	Fully Operational
Equipment Templates	EQUIPTEMP-SBOOTH-##

- a) Go to *Manufacturing Automation* → *Equipment*
- b) Click on New
- c) On New Equipment popup, enter the data provided in the table

Table 11:

Field	Value
Equipment ID	EQUIP-SBOOTH-##
Operator	<<select any available operator>>
Description	SBOOTH Equipment for ##
Phase	Fully Operational
Equipment Templates	EQUIPTEMP-SBOOTH-##

- d) Click on Save button .
2. Review Indicators assigned for EQUIP-SBOOTH-##
- a) Open the Equipment EQUIP-SBOOTH-## from *Manufacturing Automation* → *Equipment*
  - b) Go to Monitoring tab and select Indicators
  - c) You should see the 7 Indicators that are assigned for Indicator Group IG-300-##
3. Publish the Equipment
- a) From DMC homepage go to *Manufacturing Automation* → *Equipment*. Open the Equipment EQUIP-SBOOTH-##.
  - b) Click on Publish
4. Go to the *Manage Resource* app and assign Equipment EQUIP-SBOOTH-## to Resource SBOOTH-##
- a) Open the Manage Resources app from DMC home page go to Manufacturing Master Data Management /Manage Resources
  - b) Select the Resource: SBOOTH-##

- c) Go to Machine model and from the equipment drop down select EQUIP-SBOOTH-##
- d) Click Save button

**Task 5: Assign Equipment to Plant**

Field	Value
Plant	DMC300
Equipment ID	EQUIP-SBOOTH-##

1. From DMC homepage go to *Manufacturing Automation → Manage Equipment Connectivity*
2. Select the Equipment EQUIP-SBOOTH-##
3. Click on the Assign Plant
4. Select the plant from List DMC300
5. You can see the assigned plant for this equipment in the Header

**Note:**

When Equipment Created using Equipment Template, Sub Class and Model ID information will not be available. This information is available when Equipment is created with Model



### LESSON SUMMARY

You should now be able to:

- Manage equipments

# Learning Assessment

1. Are the Attribute Groups mandatory for creating Model?

*Determine whether this statement is true or false.*

- True  
 False

2. Model needs to be created using Model Template and Each Model should have unique Model template.

*Determine whether this statement is true or false.*

- True  
 False

# Learning Assessment - Answers

1. Are the Attribute Groups mandatory for creating Model?

*Determine whether this statement is true or false.*

True

False

Correct. The attribute group is optional to create model.

2. Model needs to be created using Model Template and Each Model should have unique Model template.

*Determine whether this statement is true or false.*

True

False

Correct. Model needs to be created using Model Template, but different Models can be created from the same Model Template.

# UNIT 5

# Manage Equipment Connectivity

## Lesson 1

Managing Equipment Connectivity

130

Exercise 12: Manage Equipment Connectivity

133

### UNIT OBJECTIVES

- Manage Equipment Connectivity

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## Managing Equipment Connectivity

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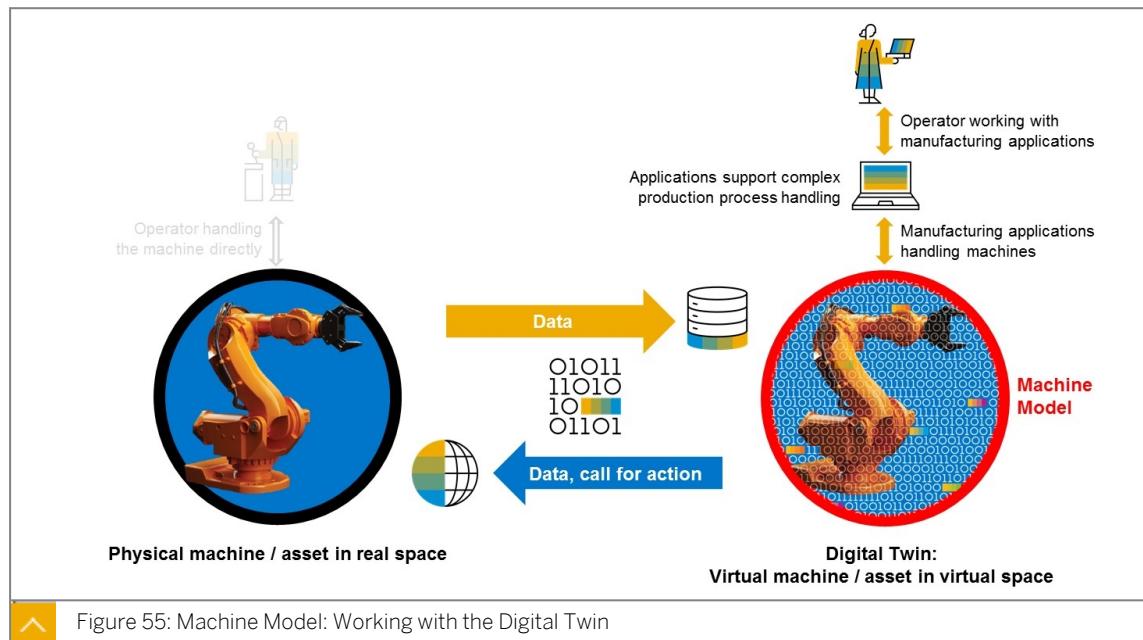
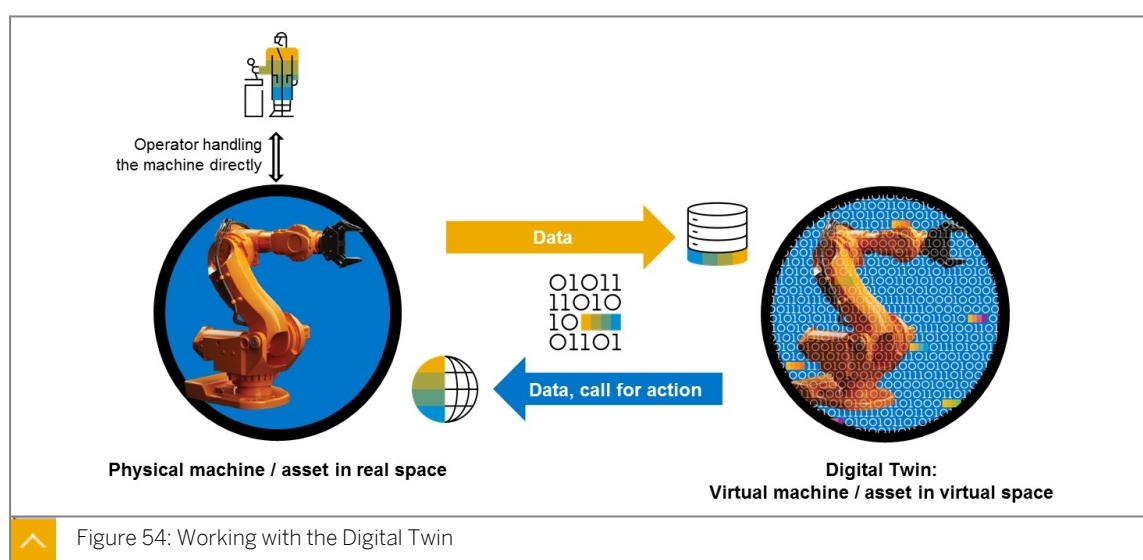


### LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Manage Equipment Connectivity

### Managing Equipment Connectivity



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From the application's point of view, the machine model with its digital twins replaces the physical world.

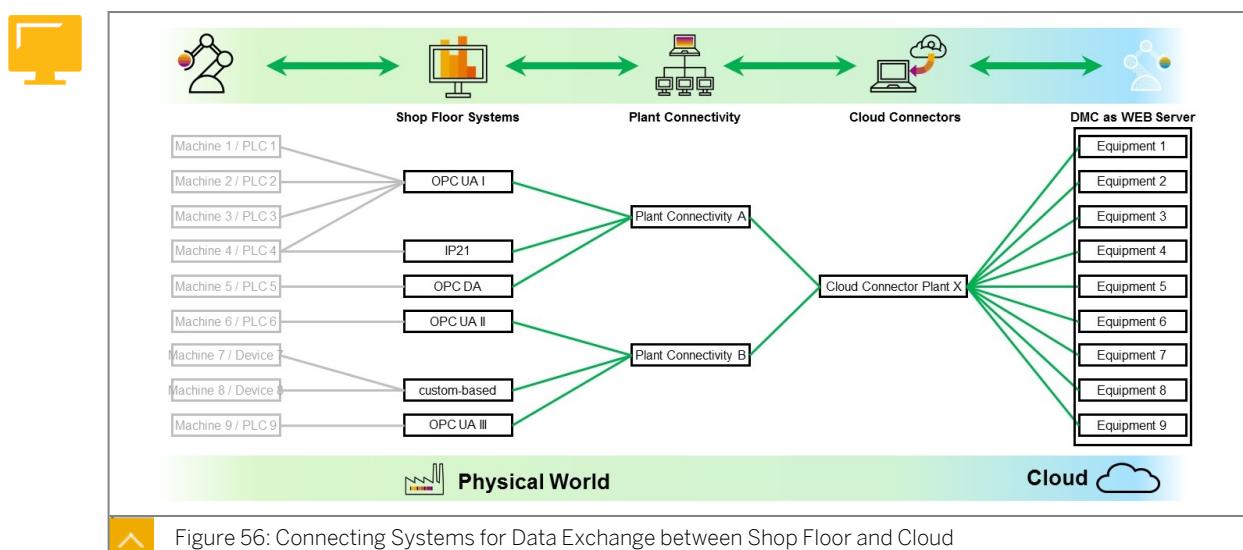
The applications do not care about the technical integration into the shop floor.

The applications work with the digital twins of the machine model in the same way as the workers did with the machines directly:

- As the worker reads a measurement from a display, the application runs a Read\_Value function on the digital twin.
- As the worker sets any target value on the machine control, the application runs a Write\_Value function on the digital twin.
- As the worker starts an activity or process by turning a switch on the machine, the application calls a service of the machine model.

With the connection between physical world and digital twin, the machine model takes care that any action on the digital twin side is executed in the physical world and vice versa.

That is, physical world and its digital twin are always in synch.



With the Service Provider as Data Source, you establish the connection from Shop Floor Systems - Plant Connectivity - Cloud Connector and DMC. To map the digital twin to the shop floor system, create Equipment Model in DMC and assign the service provider to the equipment model.



Equipment ID	Model ID	Plant	Status
EQUIP-SBOOTH-99	MODEL-300-00		Published
MODEL-300-0-Equipment			Unpublished
SBOOTH-300-00	MODEL-300-00		Unpublished
SBOOT_300			Unpublished

Figure 57: Manage Equipment Connectivity

Use the app Manage Equipment Connectivity to establish mapping between the equipment model indicators and the tags from shop floor system.

Prerequisites for using Management Equipment Connectivity:

- Equipment templates are configured using app Templates
- Indicator group is assigned to Equipment Template
- Equipment is created
- Service Providers are created (in type data source)



Name	Description	Usage Type	Data Source Type
SBOOTH_DataSource		DataSource	OPCUA

Figure 58: Select Service Providers

Service Provider - Go to Service provider tab and Choose + to add service providers.

Indicator Groups - Indicator groups associated with the Equipment will be displayed. Choose the indicator group -> indicator, select service provider and browse for tag from the tag list.

Use Assign Plant to assigned the equipment to a specific Plant. Only the equipment assigned to the plant can be added to the plant hierarchy node.

# Unit 5

## Exercise 12

## Manage Equipment Connectivity

Carson is an Engineer and need to map Digital Manufacturing Cloud Equipment indicators with Equipment sensor data by utilizing the service provider.

### Task 1: Assign service provider to equipment

1. Login into DMC and open the app Manage Equipment Connectivity
2. Assign the service provider to the equipment according to the information provided in the following table

Table 12:

Field	Value
Service Provider	SBOOTH_DataSource SBOOTH_SP
Equipment ID	EQUIP-SBOOTH-##

### Task 2: Assign Tags to Indicators

Table 13:

Indicator	Tag
SFC-300-##	Data/Group##/Static/Scalar/SFC
OPERATION-300-##	Data/Group##/Static/Scalar/OPERATION
MATERIAL-300-##	Data/Group##/Static/Scalar/MATERIAL
RESOURCE-300-##	Data/Group##/Static/Scalar/RESOURCE
CYCLETIME-300-##	Data/Group##/Static/Scalar/CYCLETIME
PRESSURE-300-##	Data/Group##/Static/Scalar/PRESSURE
STATUS-300-##	Data/Group##/Static/Scalar/StringValue

1. From Manage Equipment Connectivity select the Equipment EQUIP-SBOOTH-##
2. Go to INDICATORS GROUPS tab
3. Select the indicator Group IG-300-## available in the list  
You should see the Indicators that are assigned to the selected Indicator Group
4. Click Manage Connectivity (the chain icon) available on each indicator row, click Manage Connectivity for SFC-300-##

5. On Select Tag popup select the shop floor system *SBOOTH\_DataSource*
6. Select the tag by browsing to *Data/Group##/Static/Scalar/SFC*
7. Click *Connect*
8. Repeat step 4 to 7 for remaining indicators

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# Unit 5

## Solution 12

## Manage Equipment Connectivity

Carson is an Engineer and need to map Digital Manufacturing Cloud Equipment indicators with Equipment sensor data by utilizing the service provider.

### Task 1: Assign service provider to equipment

1. Login into DMC and open the app Manage Equipment Connectivity
  - a) On DMC home page go to *Manufacturing Automation* and click on the app *Manage Equipment Connectivity*
2. Assign the service provider to the equipment according to the information provided in the following table

Table 12:

Field	Value
Service Provider	SBOOTH_DataSource SBOOTH_SP
Equipment ID	EQUIP-SBOOTH-##

- a) Select the Equipment form the Equipment ID list: EQUIP-SBOOTH-##
- b) Go to the Service Providers tab and click +
- c) Select the Service Provider Name: SBOOTH\_DataSource and SBOOTH\_SP
- d) Click Add.

### Task 2: Assign Tags to Indicators

Table 13:

Indicator	Tag
SFC-300-##	Data/Group##/Static/Scalar/SFC
OPERATION-300-##	Data/Group##/Static/Scalar/OPERATION
MATERIAL-300-##	Data/Group##/Static/Scalar/MATERIAL
RESOURCE-300-##	Data/Group##/Static/Scalar/RESOURCE
CYCLETIME-300-##	Data/Group##/Static/Scalar/CYCLETIME
PRESSURE-300-##	Data/Group##/Static/Scalar/PRESSURE
STATUS-300-##	Data/Group##/Static/Scalar/StringValue

1. From Manage Equipment Connectivity select the Equipment *EQUIP-SBOOTH-##*
2. Go to *INDICATORS GROUPS* tab
3. Select the indicator Group *IG-300-##* available in the list  
You should see the Indicators that are assigned to the selected Indicator Group
4. Click *Manage Connectivity* (the chain icon) available on each indicator row, click *Manage Connectivity* for *SFC-300-##*
5. On Select Tag popup select the shop floor system *SBOOTH\_DataSource*
6. Select the tag by browsing to *Data/Group##/Static/Scalar/SFC*
7. Click *Connect*
8. Repeat step 4 to 7 for remaining indicators



### LESSON SUMMARY

You should now be able to:

- Manage Equipment Connectivity

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# Learning Assessment

1. Equipment can use multiple service providers to retrieve sensor data to Indicators.

*Determine whether this statement is true or false.*

- True  
 False

### Learning Assessment - Answers

1. Equipment can use multiple service providers to retrieve sensor data to Indicators.

*Determine whether this statement is true or false.*

True

False

Correct. You can assign multiple service providers to the equipment and map the indicator to the tags.

**Lesson 1**

Introduction of Shop Floor Designer

143

**Lesson 2**

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**UNIT OBJECTIVES**

- Explain the fundamentals of a Shop Floor Design
- Describe the basic procedure to create Shop Floor Design
- Describe the difference between the production and test Shop Floor Design
- Describe the status of the Shop Floor Design and the allowed actions
- Describe the two types of production process
- Describe the available business services
- Describe the configuration of the production process
- Describe the relationship among production process, service provider, equipment model, Plant Connectivity and OPC UA Server

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# Introduction of Shop Floor Designer

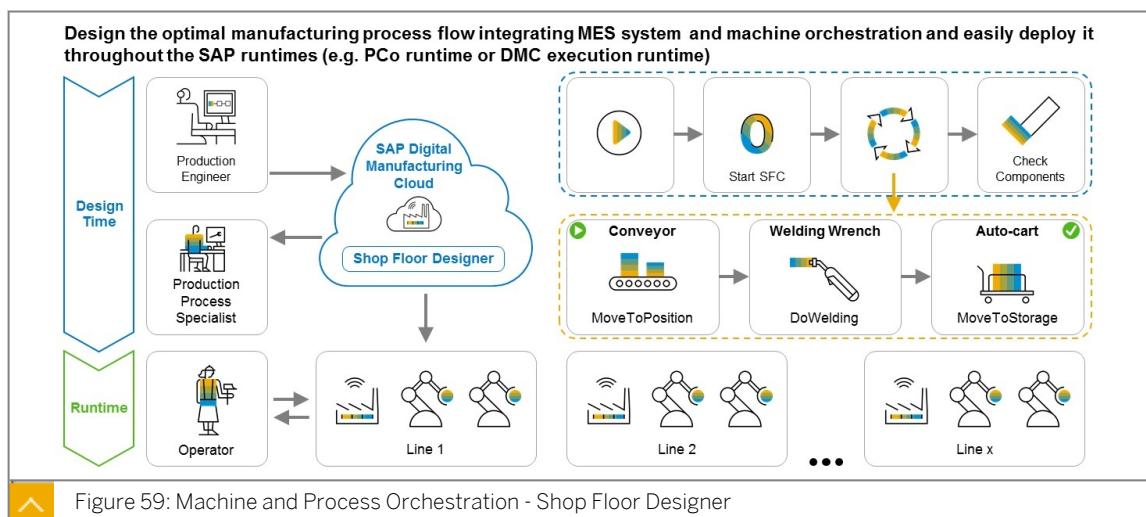


## LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Explain the fundamentals of a Shop Floor Design
- Describe the basic procedure to create Shop Floor Design
- Describe the difference between the production and test Shop Floor Design
- Describe the status of the Shop Floor Design and the allowed actions

## Fundamentals of a Shop Floor Design



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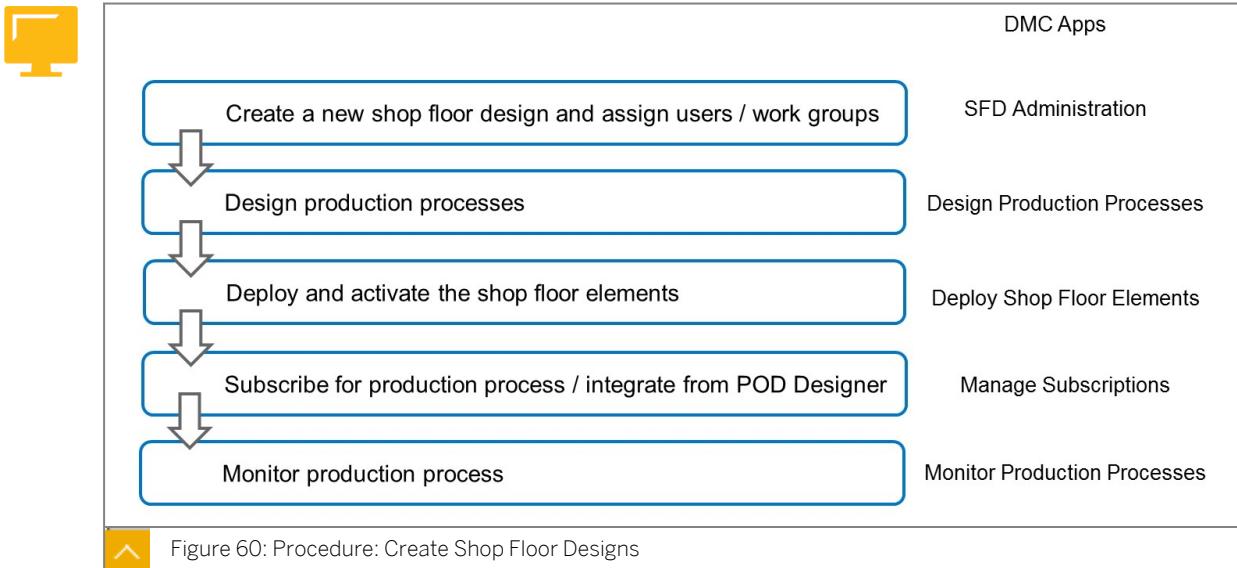
The shop floor designer helps you model various production processes and gain transparency when creating the layout of your shop floor. The production processes may define the interaction between machines or define rules, actions, and workflows that orchestrate the automation on the shop floor.

With the shop floor designer, you can:

- Model production processes in a visual designer
- Focus more on business logic instead of on programming skills
- Manage configurations centrally instead of programming each piece of equipment
- Manage different versions of configurations
- Adapt configurations easily in case the environment changes

The figure shows a scenario where the production process is automated with the shop floor designer. The production process is defined that by starting the SFC start, the conveyer moves to a certain position, welding wrench welds the components, the auto-cart moves the product to the storage and finally, the system checks whether the components are assembled as required. During the runtime, this eases the operator's work so that he/she just needs to start the SFC on the production operator dashboard and the actions will be executed automatically according to the design.

## Basic Procedure Shop Floor Design



- Create a new shop floor design and assign users / work groups: The assigned users / work groups will be able to edit the shop floor design.
- Design production processes: Design the process to orchestrate the business services, indicator services, PCo services, 3rd party services and sub-production processes.
- Deploy and activate the shop floor elements: Deploy the shop floor designer to the run time environment. The configuration on DMC will be reflected on PCo.
- Subscribe for production process / integrate from POD Designer: For the production processes to be triggered automatically, e.g. by indicator value change, configure the subscription. Otherwise configure the POD design to trigger the production process manually from POD.
- Monitor production process: Monitor the production process run time status and logs.

## Design Production Processes



In SAP Digital Manufacturing Cloud, shop floor designs are created and managed in Design Production Processes app.

To access the Design Production Processes app, use the following path:

*Shop Floor Engineering → Design Production Processes*

Design Production Processes



Figure 61: Design Production Processes in DMC

Use the Design Production Process app to create and manage shop floor designs. Each shop floor design is a collection of production processes that are based on various shop floor elements.

With the shop floor designer, you can model production processes and gain transparency when creating the layout of your shop floor. A production process can define the interaction between machines, define rules, actions, and workflows that control the execution on the shop floor, or a mixture of both.

## Status of Shop Floor Design



The statuses of the shop floor design in type production are:

- Draft
- Modified
- Awaiting Deployment
- Deployed
- Awaiting Un-deployment
- Archived
- Failed

Figure 62: Production Shop Floor Design Status

- Draft: When you first created the shop floor design, before you submit for deployment, the status is in Draft
- Modified: After the deployment, you can edit by changing the status to Modified (click the Edit button)
- Awaiting Deployment: After you submit the shop floor design for deployment, but the elements are not deployed
- Deployed: After you deployed the element
- Awaiting Un-deployment: When you submit the new version for deployment, the old version is to be un-deployed
- Archived: After the new version is deployed, the old version is archived
- Failed: During deployment when the errors are detected

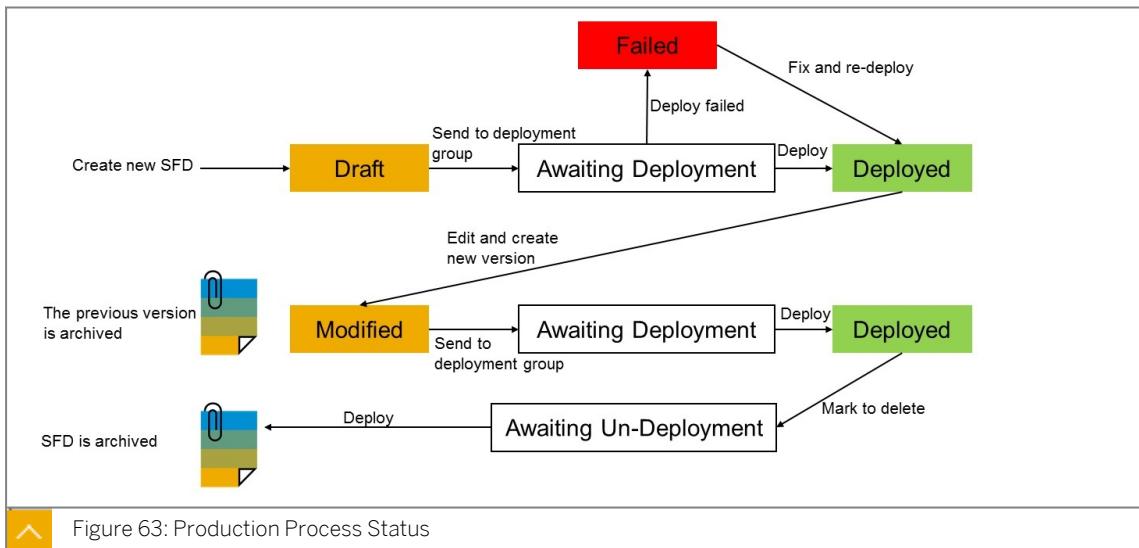


Figure 63: Production Process Status

When the user create the shop floor design (SFD), it is in status *Draft*.

After the design, the SFD is submitted to deployment group.

- If deploy OK, the status is *Deployed*. For each SFD, only 1 version can be deployed.
- If there is any error, the status is *Failed*, the user need to fix the problem and re-deploy.

To edit the deployed SFD, click *edit* and create a new version.

The new version is in status *Modified* and the previous version will become *Archived*.

To delete the deployed SFD, submit for un-deployment and the SFD will be archived.



A work group is a group of users that work collectively as a unit. With work groups, you can manage users in shop floor designs or activation groups more easily.

In SAP Digital Manufacturing Cloud, work groups are created and managed in SFD Administration app.

To access the SFD Administration App, use the following path:

*Shop Floor Engineering → SFD Administration*

SFD Administration  
Shop Floor Designer



Figure 64: Work Groups



In SAP Digital Manufacturing Cloud, the shop floor elements are submitted and activated in the run time environment with the Deploy Shop Floor Elements app.

To access the Deploy Shop Floor Elements app, use the following path:

*Shop Floor Engineering → Deploy Shop Floor Elements*

Deploy Shop Floor Elements



Figure 65: Deploy Shop Floor Elements in DMC

After completing a design or a model, you need to submit it for activation by assigning it to an activation group as an activation object. The activation objects are then deployed and, if applicable, activated from the activation group. This process ensures that the deployment to

the runtime environment follows a four-eye principle and enables centralized deployment and activation.

Before the deployment, the system validates if all the conditions are met for the activation objects to be deployed. You can also run the validation process separately by yourself using the Validate option. If any checks fail, you need to fix the errors before you can proceed with the deployment.



In SAP Digital Manufacturing Cloud, you monitor the execution of the production processes with the Monitor Production Processes app.

To access the Monitor Production Processes app, use the following path:

*Shop Floor Engineering → Monitor Production Processes*

Monitor Production Processes



Figure 66: Monitor Production Processes in DMC

You use the Monitor Production Processes app to monitor and track the execution status of all production processes and subprocesses in a specified period of time. Monitor Production Processes helps you quickly react in case of error and identify the root cause of execution failures or high defect rates.

In the Monitor Production Processes app, you either get execution result of all processes in the latest version or of one single process in a given version within a given timeframe.

### Trigger Production Process



In SAP Digital Manufacturing Cloud, you define the production process trigger conditions with the Manage Automatic Triggers app.

To access the *Manage Automatic Triggers* app, use the following path:

*Manufacturing Automation → Manage Automatic Triggers*

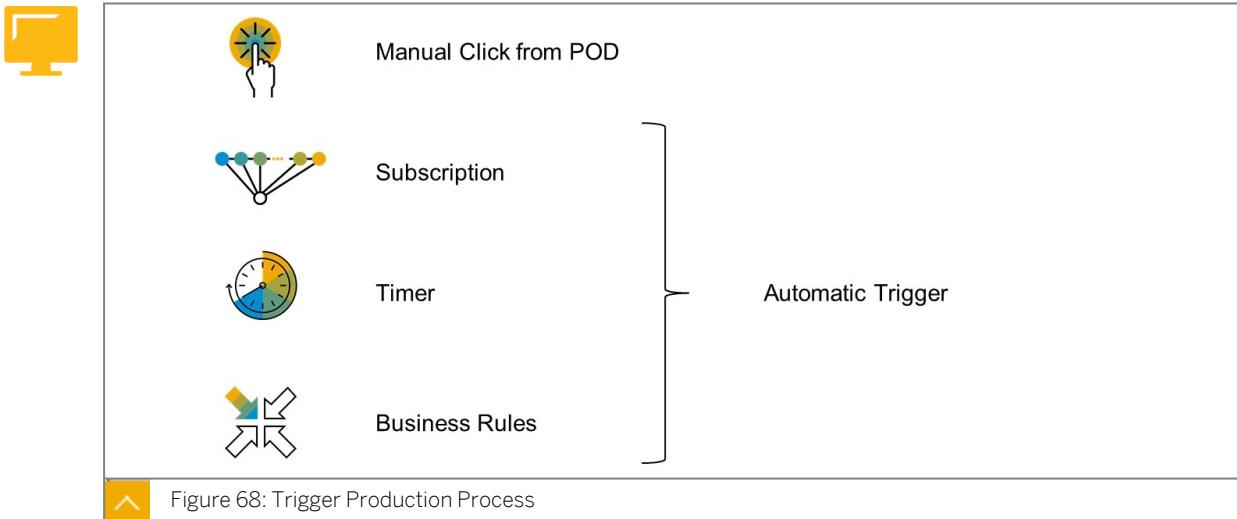
Manage Automatic Triggers



Figure 67: Manage Automatic Triggers

In *Manage Automatic Triggers* app you have the flexibility to embed production processes into business scenarios by using the following types of triggers.

- Subscription - Create a subscription to one or more indicators, you can enable an action to be triggered when certain conditions are met. The subscription needs to be deployed and activated to take effect.
- Timer - Create a timer to enable an action to be triggered in a frequency or a specific time you predefined.



DMC supports 4 ways to trigger production process:

1. Manual click from POD: Assign the production process to the POD button. Parameters can be passed from POD, such as plant, SFC, operation, order, etc.
2. Subscription: Configure an event or condition under which a service is to be started. The condition depends on shop floor measurements on one or more indicators of an equipment in the machine model. The user can define an event which is based on the measurements, such as on change of the measurement or a logical condition. User can define retention time which is the time that system waits until the condition is checked again.
3. Timer: Trigger the process in a frequency or a specific time you predefined.
4. Business Rules: By creating a business rule, you can enable an action to be triggered when a specific business event happens. The business event can be, for example, goods receipts or release order to SFC



### LESSON SUMMARY

You should now be able to:

- Explain the fundamentals of a Shop Floor Design
- Describe the basic procedure to create Shop Floor Design
- Describe the difference between the production and test Shop Floor Design
- Describe the status of the Shop Floor Design and the allowed actions

# Production Process



## LESSON OBJECTIVES

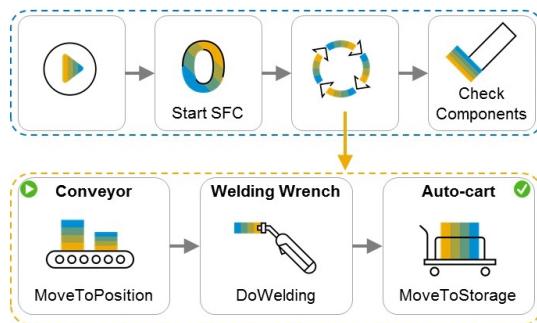
After completing this lesson, you will be able to:

- Describe the two types of production process
- Describe the available business services
- Describe the configuration of the production process
- Describe the relationship among production process, service provider, equipment model, Plant Connectivity and OPC UA Server

## Production Process



A production process is a chain of actions that aims to complete a business purpose via a series of service calls. There are two categories of production process: cloud and automation sequence.



Cloud Process

Automation Sequence

Figure 69: Production Process

- Cloud process: Focuses on the business functions such as start SFC or data collection. The process can be triggered either automatically or manually via the production operator dashboard (POD).
- Automation sequence: Focuses on the interaction between machines and between machines and systems. The automation sequence follows the Business Process Model and Notation (BPMN) standard and extends the standard to fit some special needs.

Cloud processes that are run in the cloud and automation sequences that are run by a PCo system. When creating a production process, you must first specify a runtime environment.

The different categories of production processes have different controls and services available for use.

A production process can embed other production processes for more flexible reuse. There is one limitation for the automation sequences: the parent and child (embedded) processes must be run by the same PCo system.

## Available Business Services



- Business Services
- Indicator Services
- PCo Internal Services
- PCo External Services
- Third-Party Services
- Production Processes



Figure 70: Available Services and Subprocesses

Different types of production processes use different services. Additionally, a process can embed other processes as subprocesses for more flexible reuse. Services that are available for use depends on the runtime environment of the particular process. You can always configure the service library to hide and show services to facilitate your design work.

- Business Services:
  - DMC: Public API packages and some internal services.
  - DME: These services are only available for SAP Digital Manufacturing Cloud for execution. For an automation sequence, a DME service provider must be created for the relevant PCo system so that these services are available for selection. Besides, a client proxy must be configured for each service.
- Indicator Services:
  - readIndicators: Read values from indicators on a piece of equipment.
  - writeIndicators: Write values into indicators on a piece of equipment.
- PCo Internal Services:
  - PCo Functions.
  - PCo Internal Services: These services are provided by internal service providers that are created on the selected runtime PCo system.
- PCo External Services: These services are provided by external service providers that are created on the selected runtime PCo system.
- Third-Party Services: These services are FaaS services and user-developed application on SAP Business Technology Platform or other platforms exposed as a service manually registered by customer in the Manage Service Registry app.
- Production Processes: A parent process can never nest in a subprocess. For example, Process A → Process B → Process A is not allowed.

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## Configuration of the Production Process



-  Start
-  End
-  Condition
-  Parallel
-  Error Catch
-  Error End
-  Script Task

Figure 71: Production Process Controls

Controls are visualizations of different BPMN event elements. Some controls are applicable only to the cloud process; some controls have different usages in the different categories of production processes.

- Start: A start element represents the first step in a process. Each process has only one start element. Use the start element to define process input parameters.
- End: An end element represents the last step in a process. Each process has only one end element. Use the end element to define process output parameters.
- Condition: Use a condition element to create multiple flows in a process but only one flow is executed under a given condition.
- Parallel: Use a parallel element to create multiple flows that are executed at the same time. These parallel flows must join on one element in the end.
- Error Catch: An error catch event catches errors thrown by the activity on which it is defined. Use the error catch element to create alternative flows that handle possible error states the process might run into.
- Error End: Use the error end element to define an error state of a process.
- Script Task: A script task is an activity/service defined by users in JavaScript to enhance some simple logics in shop floor designer for cloud runtime. When a production process execution arrives at the script task, the corresponding script is executed.



Variables defined within a process are used to map parameters between elements within a process. They are not inherited by subprocesses or detectable by the parent process.

Create a variable for the following purposes:

- Assign a process input parameter to a variable
- Assign an output parameter to a variable

The variables can be used to do the following:

- Define expressions for input parameters
- Define Boolean expressions for conditions that evaluate to either true or false
- Define values in arrays

Figure 72: Process Variables



By creating a subscription to one or more indicators, you can enable an action to be triggered when certain conditions are met. The subscription needs to be deployed and activated to take effect.

The subscribed indicators are provided by service providers attached to equipment and are connected to equipment tags for values like temperature and pressure. The triggered action can be any of the following:

- A service from external service provider (**PCo External Services** of automation sequences in shop floor designer)
- A production process on the same PCo system that hosts these service providers
- A production process on cloud runtime
- A FaaS service registered in the **Manage Service Registry** app (**Third-Party Services** in shop floor designer)

Figure 73: Manage Subscriptions

## Production Process, Service Provider, Equipment Model, Plant Connectivity, and OPC UA Server

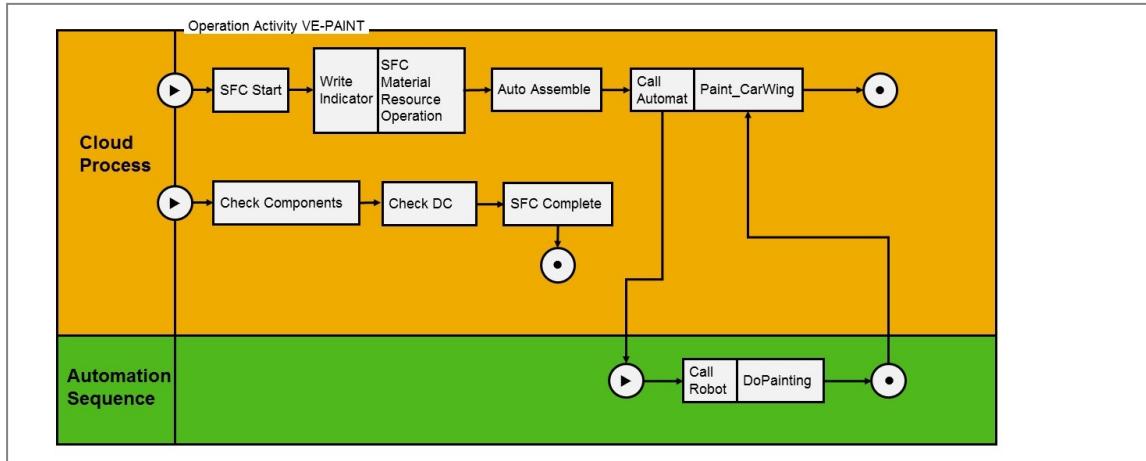


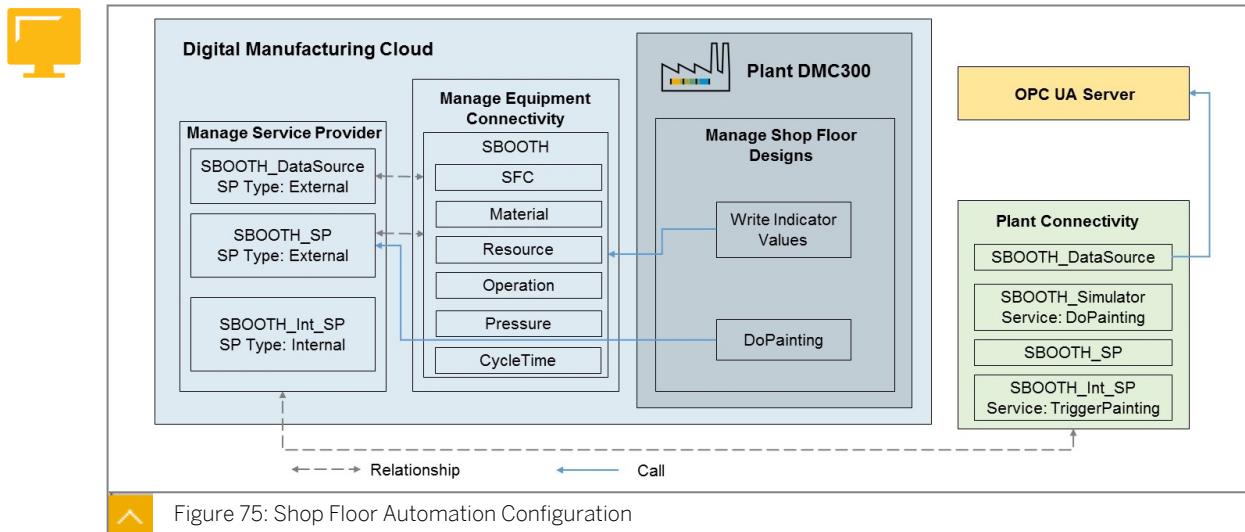
Figure 74: Shop Floor Automation for Vehicle Painting

This figure shows the shop floor automation scenario for vehicle painting. With shop floor designer, 2 cloud processes and 1 automation sequence need to be created.

For the operation VE-PAIN, by clicking the SFC Start on the production operation dashboard, the indicators SFC, material number, resource and operation will be written to the OPC tag server. The SFC start also triggers the automatic assembly, the components to be assembled in such operation will be automatically consumed. Then the default process calls an automation sequence for the spray booth to execute the painting action.

By clicking the SFC Complete, the components to be assembled and data collection will be checked. The SFC can only be completed if all the required components are assembled and the required parameters are collected.

Due to the duration limitation, this exercise of this course only include the cloud process part.



This figure shows the configuration of service provider, equipment model and shop floor design, in order to realize the vehicle painting operation in Digital Manufacturing Cloud.

To write indicator value to the OPC UA server, a service provider SBOOTH\_DataSource which connects with the OPC UA server is needed. This service provider is assigned to the equipment model SBOOTH so that by adding the equipment to the shop floor design, the data source service provider could be consumed by the production process.

To call robot action DoPainting, the service provider SBOOTH\_SP is created and connected to the PCo agent instance SBOOTH\_Simulator, which is an OPC UA server with the method DoPainting. This service provider is also assigned to the equipment and the method DoPainting could be consumed by shop floor design automation sequence. The internal service provider SBOOTH\_Int\_SP is an interface to trigger the automation sequence.

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# Unit 6

## Exercise 13

# Design Production Process

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked creating the shop floor design to integrate the machine data and method into the production process.

### Task 1: Create Work Group

1. Log on to DMC and open the app *Production Process Administration*
2. Create new work group WorkGroup-##
3. Add the user DMC300-00 and your user DMC300-## to WorkGroup-## so that the trainer can access this work group

### Task 2: Create Shop Floor Design SFD\_DMC300\_##

1. Log on to DMC and open the app *Design Production Processes*
2. Create shop floor design SFD\_DMC300\_## in type production by entering the flowing data:

Table 14:

Field	Value
Name:	SFD_DMC300_##
Description:	Shop floor design ##
Type:	Production
Version:	1.0

3. Assign work group WorkGroup-## to the shop floor design SFD\_DMC300\_##.

### Task 3: Create Cloud Production Process StartSFC\_##

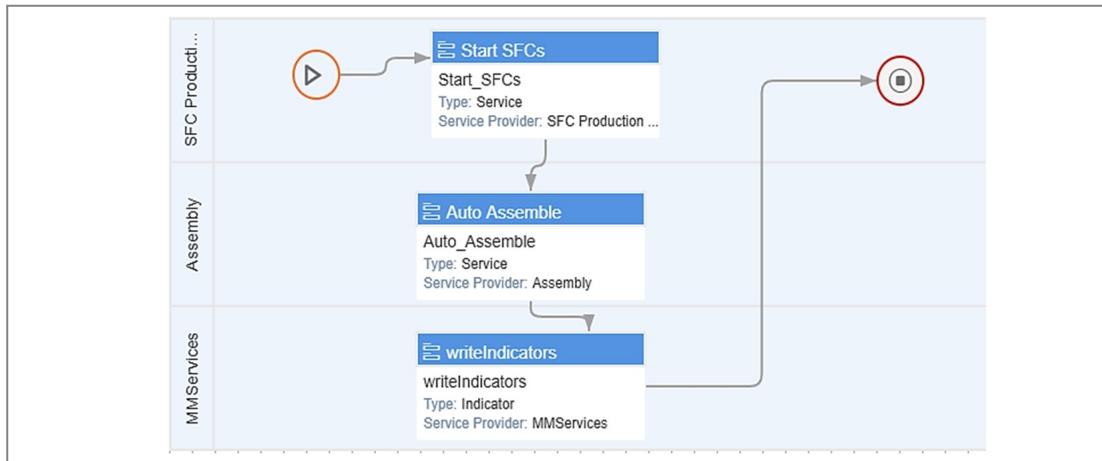
1. Log on to DMC and Open the *Design Production Processes* app
2. Create cloud process and enter the following data:

Table 15:

Field	Value
Name:	StartSFC_##
Description:	SFC Start ##

Field	Value
Runtime Environment:	Cloud

3. Add Assembly and Data Collection in the Service Library
4. Find the Controls and business services: Start SFCs, Auto Assemble, writeIndicators andEnd, from the service library, drag and drop them to the canvas, and then connect the services. The process should look like this:



#### Task 4: Configure Variables for Production Process StartSFC\_##

1. Create the production process variables according to the table below:

**Note:**  
The default value should include the quotation marks

Name	Default Value	Type
varResource		String
varPlant	"DMC300"	String
varOperation	"VE-PAINT"	String
varSFC		StringArray
varMaterial	"VEHICLE-ASSY/ERP001"	String

2. Create 2 input parameters for the control Start and assign them to the variables, according to the table and the picture:

Input Parameter	Type	Assigned Process Variable
inResource	String	'varResource'
inSFC	StringArray	'varSFC'

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Input Parameters (2)		Add
inResource (String):	'varResource'	
inSFC (String):	'varSFC'	

3. Click the service Start SFCs and assign the input parameters:

Body Parameter	Assigned Process Variable
Operation	'varOperation'
Plant	'varPlant'
Resource	'varResource'
sfc	'varSFC'

4. Click the service Auto Assemble and assign the input parameters:

Body Parameter	Assigned Process Variable
Operation	'varOperation'
Operation Version	"ERP001"
Plant	'varPlant'
Resource	'varResource'
sfc	'varSFC'

5. Click the service writeIndicators, add the equipment EQUIP-SBOOTH-##, select SBOOTH\_DataSource and assign the input parameters according to the table:

Body Parameter	Assigned Process Variable
Material	'varMaterial'
OPERATION	'varOperation'
RESOURCE	'varResource'
SFC	'varSFC[0]'

Note:  
Please type in the value with the expression editor. Please don't forget the "[0]" as it converts the StringArray to String

6. Click Save All to save the process StartSFC\_##

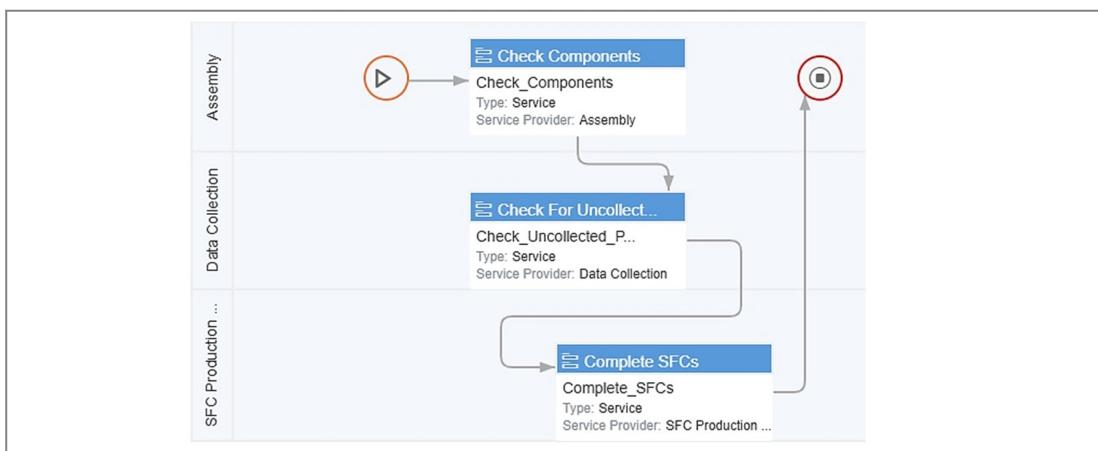
### Task 5: Create Cloud Production Process CompleteSFC\_##

- Create cloud process CompleteSFC\_## and enter the following data.

Field	Value
Name	CompleteSFC_##
Description	SFC Complete ##
Runtime Environment	Cloud

- Add Assembly and Data Collection in the Service Library

- Find the Controls and business services: Start SFCs, Check Components, Check for Uncollected DC Parameters, Complete SFCs and End, from the service library, drag and drop them to the canvas, and then connect the services. The process should look like this:



### Task 6: Configure Variables for Production Process CompleteSFC\_##

- Create the production process variables according to the table below:

Name	Default Value	Type
varResource		String
varPlant	"DMC300"	String
varOperation	"VE-PAINT"	String
varSFC		StringArray

- Create 2 input parameters for the control Start and assign them to the variables, according to the table and the picture:

Input Parameter	Type	Assigned Process Variable
inResource	String	'varResource'
inSFC	StringArray	'varSFC'

- Click the service Check Components and assign the input parameters:

Body Parameter	Assigned Process Variable
Operation	'varOperation'
Plant	'varPlant'
sfcs	'varSFC'

4. Click the service Check for Uncollected Parameters and assign the input parameters:

Body Parameter	Assigned Process Variable
currentOperationOnly	true
operation	'varOperation'
plant	'varPlant'
resource	'varResource'
sfcs	'varSFC'

5. Click the service Complete SFCs and assign the input parameters according to the table:

Body Parameter	Assigned Process Variable
operation	'varOperation'
plant	'varPlant'
resource	'varResource'
sfcs	'varSFC'

6. Click Save All to save the all the processes for SFD\_DMC300\_##.

# Design Production Process

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked creating the shop floor design to integrate the machine data and method into the production process.

### Task 1: Create Work Group

1. Log on to DMC and open the app *Production Process Administration*
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Production Process Administration*
2. Create new work group WorkGroup-##
  - a) On the *Work Groups* tab, click *Create*.
  - b) Enter the name **WorkGroup\_##**
  - c) Enter the description **Work group ##**.
3. Add the user DMC300-00 and your user DMC300-## to WorkGroup-## so that the trainer can access this work group
  - a) Navigate to *SFD Administration*
  - b) Choose the tab *Work Groups*
  - c) Choose *WorkGroup-##*
  - d) Click + (Add)
  - e) Select all the users and click *Select*
  - f) You now see the first name of the users
  - g) Except for the user DMC300-00 and DMC300-## (your DMC user), remove all the other users from the work group.

### Task 2: Create Shop Floor Design SFD\_DMC300\_##

1. Log on to DMC and open the app *Design Production Processes*
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Design Production Processes*
2. Create shop floor design SFD\_DMC300\_## in type production by entering the flowing data:

Table 14:

Field	Value
Name:	SFD_DMC300_##
Description:	Shop floor design ##
Type:	Production
Version:	1.0

- a) On the top right side of the screen, click + (Add New Tab) → Create a New Process.  
After clicking, *Create Production Process* window will appear.
  - b) Enter the data provided in the table
  - c) Click *Create*
3. Assign work group WorkGroup-## to the shop floor design SFD\_DMC300\_##
- a) On the *SFD\_DMC300\_##* overview page, choose the *Users* tab
  - b) Choose the tab *Users*
  - c) In the Work Groups section, choose *Add*
  - d) Select WorkGroup-## and choose *Select*

### Task 3: Create Cloud Production Process StartSFC\_##

1. Log on to DMC and Open the *Design Production Processes* app
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Design Production Processes*
2. Create cloud process and enter the following data:

Table 15:

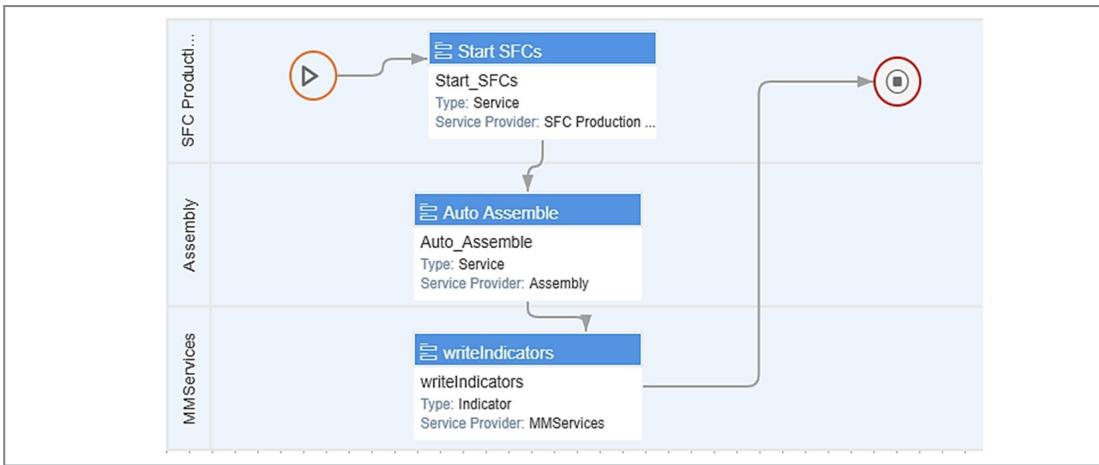
Field	Value
Name:	StartSFC_##
Description:	SFC Start ##
Runtime Environment:	Cloud

- a) Search for and choose the shop floor design named SFD\_DMC300\_##
  - b) Click + (Add New Tab) → *Create Production Process*.
  - c) On the *Create Production Process* screen, enter the data provided in the table
3. Add Assembly and Data Collection in the Service Library

- a) Click Editor (the  icon )

- b) Under Services and Processes section, click Select Services  
 c) On the Select Services screen, navigate to *DMC Cloud* → *DMC*.  
 d) Select the category *Assembly*, *SFC Production Activities*, *Data Collection*, and *Indicator Services*, click Save

4. Find the Controls and business services: Start SFCs, Auto Assemble, writeIndicators andEnd, from the service library, drag and drop them to the canvas, and then connect the services. The process should look like this:



- a) From Controls, drag and drop Start and End to the canvas  
 b) From the Services and Process section, click Expand All  
 c) Find the business services Start SFCs, Auto Assemble and writeIndicators, drag and drop them to the canvas  
 d) Connect all the elements by drawing lines between them, according to the screenshot

#### Task 4: Configure Variables for Production Process StartSFC\_##

1. Create the production process variables according to the table below:



Note:

The default value should include the quotation marks

Name	Default Value	Type
varResource		String
varPlant	"DMC300"	String
varOperation	"VE-PAINT"	String
varSFC		StringArray
varMaterial	"VEHICLE-ASSY/ERP001"	String

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- a) In the middle of the Design Cloud Process SFD\_DMC300\_## page, click Process Variables (0)
- b) Create the process variables according to the table, the default value should include the quotation marks
2. Create 2 input parameters for the control Start and assign them to the variables, according to the table and the picture:
- | Input Parameter | Type        | Assigned Process Variable |
|-----------------|-------------|---------------------------|
| inResource      | String      | 'varResource'             |
| inSFC           | StringArray | 'varSFC'                  |
- Input Parameters (2) Add

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inResource (String):

'varResource' ▼

inSFC (String):

'varSFC' ▼
- a) Click the Start Event , and under the Input Parameter section, click *Manage Parameters*, then click *Create*.
- b) Enter the Name and Data Type, for the 2 input parameters, according to the table
- c) From the drop down, select 'varResource' for input parameter inResource, and select 'varSFC' for inSFC
3. Click the service Start SFCs and assign the input parameters:
- | Body Parameter | Assigned Process Variable |
|----------------|---------------------------|
| Operation      | 'varOperation'            |
| Plant          | 'varPlant'                |
| Resource       | 'varResource'             |
| sfcs           | 'varSFC'                  |
- a) Click the service Start SFCs, an configuration panel shows up on the right side
- b) Select the process variables for the input body parameters, according to the table
4. Click the service Auto Assemble and assign the input parameters:
- | Body Parameter    | Assigned Process Variable |
|-------------------|---------------------------|
| Operation         | 'varOperation'            |
| Operation Version | "ERP001"                  |
| Plant             | 'varPlant'                |
| Resource          | 'varResource'             |

Body Parameter	Assigned Process Variable
sfc	'varSFC'

- a) Click the service Auto Assemble, then the configuration panel shows up on the right side
- b) Select the process variables for the input body parameters, according to the table
5. Click the service writeIndicators, add the equipment EQUIP-SBOOTH-##, select SBOOTH\_DataSource and assign the input parameters according to the table:

Body Parameter	Assigned Process Variable
Material	'varMaterial'
OPERATION	'varOperation'
RESOURCE	'varResource'
SFC	'varSFC[0]'

 Note:  
Please type in the value with the expression editor. Please don't forget the "[0]" as it converts the StringArray to String

- a) Click the service writeIndicators, an configuration panel shows up on the right side
- b) Click + (Add), and select Equipment EQUIP-SBOOTH-##
- c) Select the indicators MATERIAL-300-##, OPERATION-300-##, RESOURCE-300-##, and SFC-300-##
- d) Select the process variables for the input parameters, according to the table.  
Please note that you need to open the expression editor and assign the value 'varSFC[0]' for SFC
6. Click Save All to save the process StartSFC\_##

#### Task 5: Create Cloud Production Process CompleteSFC\_##

1. Create cloud process CompleteSFC\_## and enter the following data.

Field	Value
Name	CompleteSFC_##
Description	SFC Complete ##
Runtime Environment	Cloud

- a) On the Design Production Process SFD\_DMC300\_## page, click +"(Add New Tab) → Create Production Process .
- b) On the Create Production Process screen, enter the data provided in the table

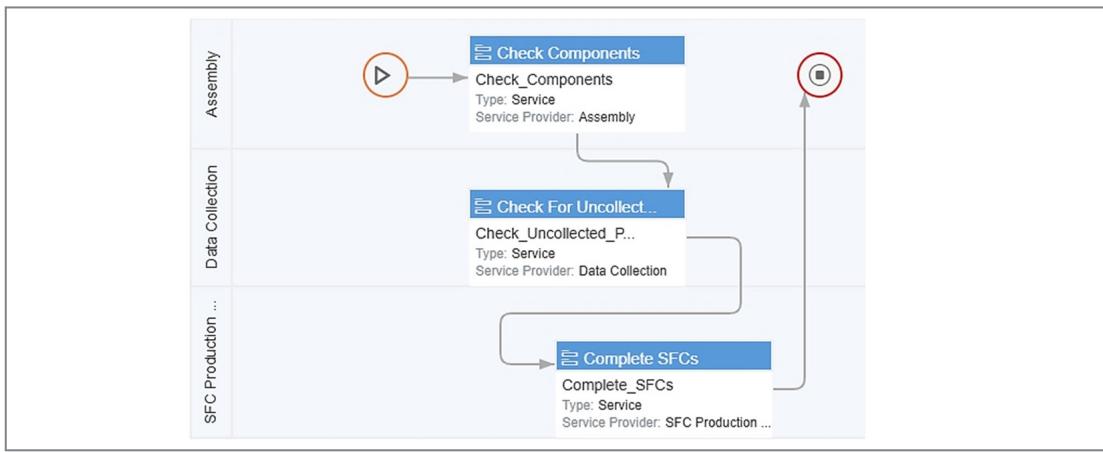
## 2. Add Assembly and Data Collection in the Service Library

- a) Click Editor (the  icon)

- b) Under Services and Processes section, select Services.

- c) On the Configure Service Library screen, under *Business Services → DMC*, select the category *Assembly, SFC Production Activities, Data Collection*, and *Indicator Services*, then click Save.

## 3. Find the Controls and business services: Start SFCs, Check Components, Check for Uncollected DC Parameters, Complete SFCs and End, from the service library, drag and drop them to the canvas, and then connect the services. The process should look like this:



- a) From Section Controls, drag and drop Start and End to the canvas  
 b) From the Services and Process section, click Expand All  
 c) Find the business services Check Components, Check for Uncollected Parameters, Complete SFCs, drag and drop them to the canvas  
 d) Connect all the elements by drawing lines between them, according to the screenshot

### Task 6: Configure Variables for Production Process CompleteSFC\_##

#### 1. Create the production process variables according to the table below:

Name	Default Value	Type
varResource		String
varPlant	"DMC300"	String
varOperation	"VE-PAINT"	String
varSFC		StringArray

- a) In the middle of the Design Cloud Process SFD\_DMC300\_## page, click Process Variables (O)  
 b) Create the process variables according to the table, the default value should include the quotation marks

2. Create 2 input parameters for the control Start and assign them to the variables, according to the table and the picture:

Input Parameter	Type	Assigned Process Variable
inResource	String	'varResource'
inSFC	StringArray	'varSFC'

- a) Click the Start Event  , and under the Input Parameter section, click *Manage Parameters*, then click *Create*
- b) Enter the Name and Data Type, for the 2 input parameters, according to the table
- c) From the drop down, select 'varResource' for input parameter inResource, and select 'varSFC' for inSFC

3. Click the service Check Components and assign the input parameters:

Body Parameter	Assigned Process Variable
Operation	'varOperation'
Plant	'varPlant'
sfc	'varSFC'

- a) Click the service Check Components, an configuration panel shows up on the right side
- b) Select the process variables for the input body parameters, according to the table

4. Click the service Check for Uncollected Parameters and assign the input parameters:

Body Parameter	Assigned Process Variable
currentOperationOnly	true
operation	'varOperation'
plant	'varPlant'
resource	'varResource'
sfc	'varSFC'

- a) Click the service Check for Uncollected Parameters, an configuration panel shows up on the right side
- b) Select the process variables for the input body parameters, according to the table

5. Click the service Complete SFCs and assign the input parameters according to the table:

Body Parameter	Assigned Process Variable
operation	'varOperation'
plant	'varPlant'

Body Parameter	Assigned Process Variable
resource	'varResource'
sfcs	'varSFC'

- a) Click the service Complete SFCs, an configuration panel shows up on the right side.
- b) Select the process variables for the input parameters, according to the table.
6. Click Save All to save the all the processes for SFD\_DMC300\_##.

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## Unit 6 Exercise 14

# Deploy, Run, and Monitor Production Process

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. After creating production process, Carson needs to deploy the process to run-time environment and run the process for a test to see the result.

### Task 1: Deploy the Shop Floor Design

1. Log on to DMC and open the app Design Production Processes
2. Submit the shop floor design SFD\_DMC300\_## for deployment and note down the deployment group name
3. Validate, deploy and activate the shop floor design SFD\_DMC300\_##, and publish the process StartSFC\_## and CompleteSFC



Hint:

To deploy the production process, you can also click *Quick Deploy*.

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### Task 2: Call Production Process from POD Designer

1. Log on to DMC and open the app POD Designer
2. Copy the POD Design DMC300\_OPERATION\_POD, and save as DMC300\_POD\_##
3. Call the production process P\_SFD\_DMC300\_##\_StartSFC\_## from the Start button.
4. Configure the action for button Start according to the table below

Data Field	Value
Response Type	Start
inResource	Variable: Resource
inSFC	Variable: SFC

5. Call the production process P\_SFD\_DMC300\_##\_1\_0CompleteSFC from the button Complete
6. Configure the action for button Complete according to the table below

Data Field	Value
Response Type	Complete
inResource Variable:	Resource

Data Field	Value
inSFC Variable:	SFC

7. Click Save to save the POD Design DMC300 POD\_##

#### Task 3: Check Tag Value and Component Lists before SFC Start

1. Open the POD Designer DMC300 POD\_##
2. Preview the POD DMC300 POD\_##, select the operation VE-PAINT, resource SBOOTH-## and find the available SFC .
3. Select one of the SFC from the shop order ORD\_VEHICLE-ASSY\_INIT## (the SFC number starts with ORD\_VEHICLE-ASSY\_INIT##) and with status in Queue, note down the SFC number and check the Component List
4. Start the OPC UA Client. Enter the URL opc.tcp://localhost:51210/UA/SampleServer - [None:None:Binary] and choose Connect

Field	Value
Protocol	opc.tcp [localhost:51210]
Security Mode	None
Security Policy	None
Message Encoding	Binary

5. Check the tag which was connected to the indicator SFC of the equipment EQUIP-SBOOTH-##, with the path Data -> Group## -> Static -> Scalar -> SFC

#### Task 4: Check Tag Value and Component Lists after SFC Start

1. Go to the POD Preview for DMC300 POD\_##
2. Start the SFC you noted down
3. Check the component list, what happens after SFC starts?
4. Go to the OPC UA client, check the tag which was connected to the indicator SFC, Operation, Resource, and Material of the equipment EQUIP-SBOOTH-##, compare the result with the Write Indicator Values configuration of the shop floor design SFD\_DMC300 ###

#### Task 5: Complete SFC

1. Go to the POD Preview for DMC300 POD\_##
2. Select operation VE-PAINT and resource SBOOTH-## and find the SFC you noted down
3. Complete the selected SFC, what will happen?
4. For the selected SFC, collect the data field CYCLETIME by giving any integer value between 20 and 50
5. Complete the selected SFC

**Task 6: Monitor Production Process**

1. Log on to DMC and open the app Monitor Production Process
2. View the process StartSFC of shop floor design SFD\_DMC300\_##
3. Click Refresh and View the process instance status



Note:  
if you get any error by calling the process from the POD designer, use this function to find out the issue

4. Repeat step 2) and 3) for process CompleteSFC

# Unit 6

## Solution 14

# Deploy, Run, and Monitor Production Process

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. After creating production process, Carson needs to deploy the process to run-time environment and run the process for a test to see the result.

### Task 1: Deploy the Shop Floor Design

1. Log on to DMC and open the app Design Production Processes
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Design Production Processes*
2. Submit the shop floor design SFD\_DMC300\_## for deployment and note down the deployment group name
  - a) Search for and choose the shop floor design named SFD\_DMC300\_##
  - b) On the top right corner of the screen, click the *Quick Deploy* drop-down and click *Select Deployment Group*
  - c) On the *Add to Deployment* Pop-up, click *Select Deployment Group*
  - d) Note down the deployment group name
3. Validate, deploy and activate the shop floor design SFD\_DMC300\_##, and publish the process StartSFC\_## and CompleteSFC



Hint:

To deploy the production process, you can also click *Quick Deploy*.

- a) On the SFD\_DMC300\_## overview page, click *Go to Deployment Group*
- b) Choose *Validate*
- c) Choose *Deploy* → *Deploy and Activate*



Note:

the status of the production process now should be Deployed and Activate. If activation failed, it might be because that the agent instance is started. If so, navigate to app Machine Model and Connectivity -> Shop Floor Systems, select SBOOTH\_DataSource, select the default agent instance and click Stop. If there are any other errors, please navigate back to the Design Production Process app, click Edit, then a new version is created and you can edit. After editing please deploy and activate again, and note down the final deployed version.

- d) Navigate back to the SFD\_DMC300\_## production process overview screen. Select process StartSFC\_##, click
- e) Click Edit Header, then turn On Publish to Service Registry
- f) Repeat Step c) and d) for process CompleteSFC\_##

### Task 2: Call Production Process from POD Designer

1. Log on to DMC and open the app POD Designer
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to Manufacturing Configuration -> POD Designer
2. Copy the POD Design DMC300\_OPERATION\_POD, and save as DMC300\_POD\_##
  - a) Click Go and select DMC300\_OPERATION\_POD
  - b) Click the icon to copy the default operation POD, enter name DMC300\_POD\_## and click OK Note: please DO NOT change DMC300\_OPERATION\_POD, please make sure that you edit only on DMC300\_POD\_##
3. Call the production process P\_SFD\_DMC300\_##\_StartSFC\_## from the Start button.
  - a) On the POD Designer for DMC300\_POD\_## page, click the Start
  - b) Click the configuration button and click the Assign Actions, delete the existing action
  - c) Add action in type Production Process, and choose Type Definition as P\_SFD\_DMC300\_##\_StartSFC\_##, click Create



Note:

If the final deployed production process is in a higher version, please select the deployed version

4. Configure the action for button Start according to the table below

Data Field	Value
Response Type	Start
inResource	Variable: Resource
inSFC	Variable: SFC

- a) On the Configure Action Button pop-up, click the Configuration icon, enter the data in the table and then click Close

5. Call the production process P\_SFD\_DMC300\_##\_1\_0CompleteSFC from the button Complete

- a) On the POD Designer for DMC300\_POD\_## page, click on the button Complete and click the configuration icon

- b) Click the button Assign Actions, delete the existing action



Note:

if the final deployed production process is in a higher version, please select the deployed version

- c) Add action in type Production Process, and choose Type Definition as P\_SFD\_DMC300\_##\_CompleteSFC\_##, click Create

if the final deployed production process is in a higher version, please select the deployed version

6. Configure the action for button Complete according to the table below

Data Field	Value
Response Type	Complete
inResource Variable:	Resource
inSFC Variable:	SFC

- a) On the Configure Action Button pop-up, click the Configuration icon, enter the data in the table and then click Close

7. Click Save to save the POD Design DMC300\_POD\_##

### Task 3: Check Tag Value and Component Lists before SFC Start

1. Open the POD Designer DMC300 POD\_##
    - a) Login into DMC with the user assigned to you by the course instructor
    - b) Navigate to Manufacturing Configuration -> POD Designer c) Click Go and select DMC300 POD\_##
  2. Preview the POD DMC300 POD\_##, select the operation VE-PAINT, resource SBOOTH-## and find the available SFC.
    - a) On the POD Designer DMC300 POD\_##, select preview  (icon)
-  Note:  
A new window opens, for convenience, please test the POD in the preview
- b) Select the operation VE-PAINT and resource SBOOTH-##
  - c) Click Go
  - d) The SFC work list displays
  3. Select one of the SFC from the shop order ORD\_VEHICLE-ASSY\_INIT## (the SFC number starts with ORD\_VEHICLE-ASSY\_INIT##) and with status in Queue, note down the SFC number and check the Component List
    - a) Select one SFC which status is in Queue
    - b) Click on Activities
    - c) Select Component List
    - d) There should be two components which are not assembled  
You see the Assemble button.
  4. Start the OPC UA Client. Enter the URL opc.tcp://localhost:51210/UA/SampleServer - [None:None:Binary] and choose Connect

Field	Value
Protocol	opc.tcp [localhost:51210]
Security Mode	None
Security Policy	None
Message Encoding	Binary

- a) In the remote access to server wdfibmt7260, navigate to the file path D:\Program Files (x86)\Opc.Ua.SampleClients\UaClient##, start Opc.Ua.SampleClient.exe
- b) Enter the link opc.tcp://localhost:51210/UA/SampleServer - [None:None:Binary]
- c) Click Connect



Note:

If the url is not shown in the list, click Connect directly

- d) On the Server Configuration pop-up, enter the information provided in the table
- e) Click OK
- f) On the Open Session pop-up, leave the information as it is
- g) Click OK
5. Check the tag which was connected to the indicator SFC of the equipment EQUIP-SBOOTH-##, with the path Data -> Group## -> Static -> Scalar -> SFC
  - a) On the OPC Client, browse for Data -> Group## -> Static -> Scalar -> SFC
  - b) Right click and choose Read -> Next
  - c) You should see the value of this tag is not the SFC you noted down

#### **Task 4: Check Tag Value and Component Lists after SFC Start**

1. Go to the POD Preview for DMC300 POD\_##
2. Start the SFC you noted down
  - a) Select the operation VE-PAINT
  - b) Select the resource SBOOTH-##
  - c) Click Go and select the SFC you noted down
  - d) Click Start, the message "Production process P\_SFD\_DMC300\_##\_1\_0StartSFC call succeeded" pops up



Note:

if you get any error during testing, to edit the production process, go to the app Design Production Process, make a new version of your SFD, edit and deploy & activate again. You also need to update the assigned action in POD designer (select latest version), and save the POD again

3. Check the component list, what happens after SFC starts?
  - a) In the app Operation Activity POD, click on Activities
  - b) Select Component List
  - c) The two components should be assembled  
You see the Remove button.
4. Go to the OPC UA client, check the tag which was connected to the indicator SFC, Operation, Resource, and Material of the equipment EQUIP-SBOOTH-##, compare the result with the Write Indicator Values configuration of the shop floor design SFD\_DMC300\_##
  - a) On the OPC Client, browse for Data -> Group## -> Static -> Scalar -> SFC

- b) Right click and choose Read -> Next
- c) You should see the value of this tag is the SFC number that you noted down
- d) Repeat step a) - c) and check the tag value for Data -> Group## -> Static -> Scalar -> OPERATION, the value should be VE-PAINT
- e) Repeat step a) - c) and check the tag value for Data -> Group## -> Static -> Scalar -> RESOURCE, the value should be SBOOTH-##
- f) Repeat step a) - c) and check the tag value for Data -> Group## -> Static -> Scalar -> MATERIAL, the value should be VEHICLE-ASSY/A

### Task 5: Complete SFC

1. Go to the POD Preview for DMC300 POD\_##
2. Select operation VE-PAINT and resource SBOOTH-## and find the SFC you noted down
3. Complete the selected SFC, what will happen?
  - a) Click Complete
  - b) A message "DC parameter [CYCLETIME] is missing" Shows up, the SFC failed to be completed
4. For the selected SFC, collect the data field CYCLETIME by giving any integer value between 20 and 50
  - a) Click Activities
  - b) Select Data Collection List
  - c) Click Collect
  - d) Enter any integer value between 20 and 50
  - e) Click Save
  - f) Click Main and go back to the POD main page
5. Complete the selected SFC
  - a) Select the SFC you noted down
  - b) Click Complete
  - c) A message "Production process P\_SFD\_DMC300\_##\_1\_0CompleteSFC call succeeded" Shows up, the SFC was completed successfully

### Task 6: Monitor Production Process

1. Log on to DMC and open the app Monitor Production Process
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation → Monitor Production Processes*
2. View the process StartSFC of shop floor design SFD\_DMC300\_##
  - a) Browse for the processes
  - b) Select shop floor design SFD\_DMC300\_##, latest version you deployed, and StartSFC
3. Click Refresh and View the process instance status

- a) Click Refresh
- b) You should see the when the process was triggered and the status
- c) Click the  icon , you should see the status of each process step



Note:

if you get any error by calling the process from the POD designer, use this function to find out the issue

4. Repeat step 2) and 3) for process CompleteSFC

# Unit 6

## Exercise 15

## Trigger Production Process Automatically

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked creating the process to automatically update the resource status when machine sends the signal.

### Task 1: Create Cloud Production Process ChangeResourceStatus\_##

1. Log on to DMC and open the app *Design Production Processes*
2. Add a cloud process to Shop Floor Design SFD\_DMC300\_## and enter the following data

Field	Value
Name	ChangeResourceStatus_##
Description	ChangeResourceStatus_##
Runtime Type	Cloud
Visible to PCo Runtime	<select>

3. Add service category Resource in the Service Library.
4. Find the Controls and business services: Start, Change\_Resource\_Status and End, drag and drop them to the canvas, and connect the services. The process should look like this:

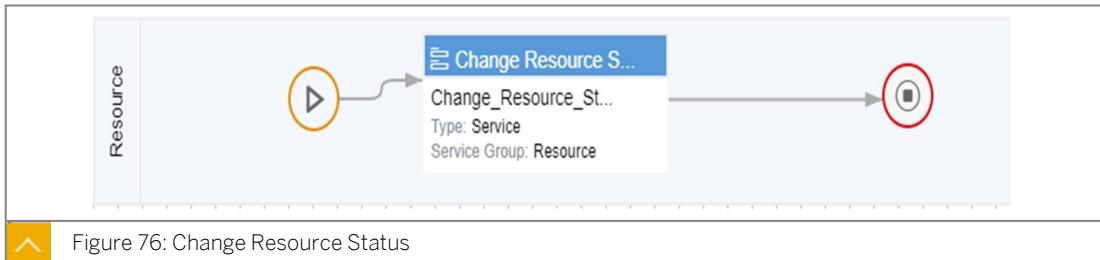


Figure 76: Change Resource Status

### Task 2: Configure Variables for Production Process ChangeResourceStatus\_##

1. Create input parameters for the control Start, according to the table:

Input Parameter	Type
inResource	String
inStatus	String

2. Click the service Change\_Resource\_Status and assign the input parameters:

Body Parameter	Assigned Process Variable
Plant	"DMC300"

Body Parameter	Assigned Process Variable
Resource	'inResource'
Status	'inStatus'
User	"P00186"

3. Click Save All to save the process ChangeResourceStatus\_##

### Task 3: Deploy and test run Production Process ChangeResourceStatus\_##

1. Quick Deploy shop floor design SFD\_DMC300\_##

 Note:

With *Quick Deploy* you do not need to navigate to *Deploy Shop Floor Elements* screen, but you will not see the deployment details. If you get any error, click Show Report, then check Activity Log on the app *Deploy Shop Floor Elements*.

2. Open the DMC app Manage Resource (in a new browser tab), check the resource status of SBOOTH-##
3. Test the production process and enter the following input parameters:

Body Parameter	Assigned Process Variable
• inResource	• SBOOTH-##
• inStatus	• PRODUCTIVE

 Note:

The allowed input for "inStatus" are: "PRODUCTIVE", "ENABLED", "SCHEDULED\_DOWN", "UNSCHEDULED\_DOWN", "DISABLED" and "UNKNOWN". You can try any input status which is different from the current resource status, in order to see the result.

4. Check if the resource status is updated.

 Note:

- If the status is not updated, please go to Monitor Production Process and check the log. You have to successfully run the process in order to continue the exercise.
- If there are in work SFC on the resource, the resource status change will not be applied immediately, instead you will find it as *Pending Status*

### Create Automatic Triggers for ChangeResourceStatus\_##

1. Log on to DMC and Open the app Manage Automatic Triggers.
2. Enter the following values.

Body Parameter	Assigned Process Variable
Name	Trigger_##
Equipment	EQUIP-SBOOTH-##
Indicator	STATUS-300-##
Trigger Type	On Change
Minimum Retention Time (Seconds)	10
Action Type	Production Process
Available Process	SFD_DMC300_## -> ChangeResourceStatus_## (please select the last deployed and tested version)

3. Enter the values for process input parameters.

Body Parameter	Assigned Process Variable
• inResource	• "SBOOTH-##"
• inStatus	• 'STATUS-300-##'



Note:  
Open the expression editor, select STATUS-300-## on the left and click >

4. Deploy the subscription Trigger-##.



Note:  
With DMC release 2105 the subscription and production process version is 1:1 mapping. This means, if you create a production process with new version, the old subscription will be put to status "Archived" and you need to create a new subscription

### Task 4: Trigger process ChangeResourceStatus\_## automatically by changing tag value

1. (If you have the OPC client opened, please skip this step) Start the OPC UA Client with path D:\Program Files (x86)\Opc.Ua.SampleClients\UaClient##. Enter the URL `opc.tcp://localhost:51210/UA/SampleServer` - [None:None:Binary] and choose Connect.

Field	Value
Protocol	opc.tcp [localhost:51210]
Security Mode	None
Security Policy	None
Message Encoding	Binary

2. Navigate to Data -> Group## -> Static -> Scalar -> StringValue and write the tag value
3. Check auto trigger result from Manage Resource.
4. Check auto trigger result from Monitor Production Process.



Note:

From the start time you will know if the process is triggered by tag value change. If you see the process is triggered but failed, check the error message. If you cannot solve the problem or if the process is not triggered, please contact the instructor.

# Unit 6

## Solution 15

### Trigger Production Process Automatically

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to automate the production. Carson is tasked creating the process to automatically update the resource status when machine sends the signal.

#### Task 1: Create Cloud Production Process ChangeResourceStatus\_##

1. Log on to DMC and open the app *Design Production Processes*
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Manufacturing Automation* → *Design Production Processes*.
2. Add a cloud process to Shop Floor Design SFD\_DMC300\_## and enter the following data

Field	Value
Name	ChangeResourceStatus_##
Description	ChangeResourceStatus_##
Runtime Type	Cloud
Visible to PCo Runtime	<select>

- a) Search for and choose the shop floor design named SFD\_DMC300\_##.
- b) Click *Edit* from top right corner, then click *Save as New Version*.



#### Note:

The status of shop floor design SFD\_DMC300\_## will be changed to “Modified”. If the Shop Floor Design is already in status “Modified”, skip this step

- c) Click “+” (*Add New Tab*) → *Create Production Process*
- d) On the *Create Production Process* screen, enter the data provided in the table

#### 3. Add service category Resource in the Service Library.

- a) Click Editor (the  icon).

- b) Under Services and Processes section, click *Select Services*.
- c) On the *Select Services* screen, navigate to *DMC Cloud* → *DMC*.
- d) Select the category Resource, click *Save*.

4. Find the Controls and business services: Start, Change\_Resource\_Status and End, drag and drop them to the canvas, and connect the services. The process should look like this:



Figure 76: Change Resource Status

- From Controls, drag and drop Start and End to the canvas
- From the Services and Process section, expand DMC\_Cloud -> DMC -> Resource, find the business services Change Resource Status, drag and drop it to the canvas
- Connect all the elements by drawing lines between them, according to the screenshot

### Task 2: Configure Variables for Production Process ChangeResourceStatus\_##

- Create input parameters for the control Start, according to the table:

Input Parameter	Type
inResource	String
inStatus	String

- Click the Start Event , under the Input Parameter section, click *Manage Parameters → Create*
- Enter the Name and Data Type, according to the table

- Click the service Change\_Resource\_Status and assign the input parameters:

Body Parameter	Assigned Process Variable
Plant	"DMC300"
Resource	'inResource'
Status	'inStatus'
User	"P00186"

- Click the service Change\_Resource\_Status, an configuration panel shows up on the right side
  - Assign the value for the input parameters, according to the table
- Click Save All to save the process ChangeResourceStatus\_##

### Task 3: Deploy and test run Production Process ChangeResourceStatus\_##

- Quick Deploy shop floor design SFD\_DMC300\_##

- a) On the overview page of SFD\_DMC300\_##, click Quick Deploy (top right corner)
- b) Click Deploy and Activate. If there is no error, the shop floor design status is changed to "Deployed"

**Note:**

With *Quick Deploy* you do not need to navigate to *Deploy Shop Floor Elements* screen, but you will not see the deployment details. If you get any error, click *Show Report*, then check Activity Log on the app *Deploy Shop Floor Elements*.

2. Open the DMC app Manage Resource (in a new browser tab), check the resource status of SBOOTH-##

  - a) Navigate to DMC app *Manage Resource*
  - b) Select resource SBOOTH-##
  - c) Check the resource status

3. Test the production process and enter the following input parameters:

Body Parameter	Assigned Process Variable
• inResource	• SBOOTH-##
• inStatus	• PRODUCTIVE

**Note:**

The allowed input for "inStatus" are: "PRODUCTIVE", "ENABLED", "SCHEDULED\_DOWN", "UNSCHEDULED\_DOWN", "DISABLED" and "UNKNOWN". You can try any input status which is different from the current resource status, in order to see the result.

- a) On the overview page of SFD\_DMC300\_##, select *ChangeResourceStatus\_##* and click *Run*.
- b) Enter the value for input parameters from the table.
- c) Click *Run*. You should get the message **Run of production process ChangeResourceStatus\_## completed.**
4. Check if the resource status is updated.

  - a) Switch to the app *Manage Resource*.
  - b) Refresh the page and select resource SBOOTH-##.
  - c) Check if the resource status is updated.

**Note:**

- If the status is not updated, please go to Monitor Production Process and check the log. You have to successfully run the process in order to continue the exercise.
- If there are in work SFC on the resource, the resource status change will not be applied immediately, instead you will find it as *Pending Status*

**Create Automatic Triggers for ChangeResourceStatus\_##**

1. Log on to DMC and Open the app Manage Automatic Triggers.
  - a) Login into DMC with the user assigned to you by the course instructor.
  - b) Navigate to *Manufacturing Automation* → *Manage Automatic Triggers*.
  - c) Select the section *Subscription* and click *Create*.

2. Enter the following values.

Body Parameter	Assigned Process Variable
Name	Trigger_##
Equipment	EQUIP-SBOOTH-##
Indicator	STATUS-300-##
Trigger Type	On Change
Minimum Retention Time (Seconds)	10
Action Type	Production Process
Available Process	SFD_DMC300_## -> ChangeResourceStatus_## (please select the last deployed and tested version)

3. Enter the values for process input parameters.

Body Parameter	Assigned Process Variable
• inResource	• "SBOOTH-##"
• inStatus	• 'STATUS-300-##'

Note:  
Open the expression editor, select STATUS-300-## on the left and click >

- a) Enter the value for input parameters according to the table.

b) Click *Create*.

**4. Deploy the subscription Trigger-##.**



**Note:**

With DMC release 2105 the subscription and production process version is 1:1 mapping. This means, if you create a production process with new version, the old subscription will be put to status “Archived” and you need to create a new subscription

a) Click *Quick Deploy*.

b) If you get validation error, click *Show Report*. On the next screen, click *Add Dependency*. Then from top right corner, click *Deploy and Activate* from the drop down.

**Task 4: Trigger process `ChangeResourceStatus_##` automatically by changing tag value**

1. (If you have the OPC client opened, please skip this step) Start the OPC UA Client with path `D:\Program Files (x86)\Opc.Ua.SampleClients\UaClient##`. Enter the URL `opc.tcp://localhost:51210/UA/SampleServer - [None:None:Binary]` and choose *Connect*.

Field	Value
Protocol	opc.tcp [localhost:51210]
Security Mode	None
Security Policy	None
Message Encoding	Binary

a) Navigate to the file path `D:\Program Files (x86)\Opc.Ua.SampleClients\UaClient##`, start `Opc.Ua.SampleClient.exe`

b) Enter the link `opc.tcp://localhost:51210/UA/SampleServer - [None:None:Binary]`

c) Click *Connect*.

d) Click *OK*.

e) On the *Open Session* pop-up, leave the information as it is.

f) Click *OK*.

2. Navigate to Data -> Group## -> Static -> Scalar -> StringValue and write the tag value

a) On the OPC Client, browse for Data -> Group## -> Static -> Scalar -> StringValue.

b) Right click and select *Write*.

c) Double click on the tag StringValue, on the pop-up, enter any (new) value from “PRODUCTIVE”, “ENABLED”, “SCHEDULED\_DOWN”, “UNSCHEDULED\_DOWN”, “DISABLED” and “UNKNOWN” (write without quotation marks). The value should be different than the resource current status.

Name	NodeID	Value	Status	Timestamp
StringValue	ns=2;i=13005	ENABLED	Good	1/1/0001 12:00:00 AM

- d) Click OK.
  - e) Click Next.
  - f) Click Write.
3. Check auto trigger result from Manage Resource.
- a) Navigate to DMC app *Manage Resource*.
  - b) Select resource SBOOTH-## and check if the status changed to the value you wrote on the OPC client.
4. Check auto trigger result from Monitor Production Process.
- a) Navigate to DMC app *Monitor Production Process*.
  - b) Filter on process SFD\_DMC300\_##.
  - c) Check if you can find the process instance.

**Note:**

From the start time you will know if the process is triggered by tag value change. If you see the process is triggered but failed, check the error message. If you cannot solve the problem or if the process is not triggered, please contact the instructor.



## LESSON SUMMARY

You should now be able to:

- Describe the two types of production process
- Describe the available business services
- Describe the configuration of the production process
- Describe the relationship among production process, service provider, equipment model, Plant Connectivity and OPC UA Server

Duplication is prohibited.

Duplication is prohibited.

## Learning Assessment

1. What are the properties of a shop floor design?

*Choose the correct answers.*

- A The shop floor design can be edited in status “draft” and status “deployed” (by creating new version).
- B A user must be assigned to a production shop floor design to edit, deploy, or delete it.
- C You can edit the shop floor design at any time.
- D You can test run the shop floor design at any time.

2. The available services for cloud process and automation process are the same.

*Determine whether this statement is true or false.*

- True
- False

3. You can use services from service providers associated with different PCo System, in the same automation process.

*Determine whether this statement is true or false.*

- True
- False

## Learning Assessment - Answers

1. What are the properties of a shop floor design?

*Choose the correct answers.*

- A The shop floor design can be edited in status "draft" and status "deployed" (by creating new version).
- B A user must be assigned to a production shop floor design to edit, deploy, or delete it.
- C You can edit the shop floor design at any time.
- D You can test run the shop floor design at any time.

Correct. You can directly edit the shop floor design in status "draft", if the shop floor design is in status "deployed", you need to create a new version and edit. Only the user assigned to the shop floor design in type production has the authorization to edit, deploy and delete.

2. The available services for cloud process and automation process are the same.

*Determine whether this statement is true or false.*

- True
- False

Correct. The available services for cloud process and automation process are different.

3. You can use services from service providers associated with different PCo System, in the same automation process.

*Determine whether this statement is true or false.*

- True
- False

Correct. You can only chose 1 PCo as run time environment for an automation sequence.

## Lesson 1

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## UNIT OBJECTIVES

- Describe the basic functionalities of Digital Manufacturing Cloud Dashboard Designer
- Visualize Sensor Data with Dashboard Designer

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# Unit 7

## Lesson 1

# Visualizing Sensor Data with Dashboard Designer

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## LESSON OBJECTIVES

After completing this lesson, you will be able to:

- Describe the basic functionalities of Digital Manufacturing Cloud Dashboard Designer
- Visualize Sensor Data with Dashboard Designer

## Dashboard Designer



In SAP Digital Manufacturing Cloud, you can create and manage the custom dashboards in Dashboard Designer app.

To access the Dashboard Designer App, use the following path:

*Personalized Dashboards, Reports and KPIs → Dashboard Designer*

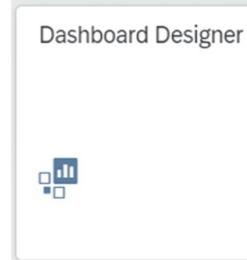


Figure 77: Manage Service Provider in DMC



The **Dashboard Designer** app helps you create interactive manufacturing dashboards using drag and drop on a wide variety of business and operational data.

Dashboards can be created with:

- Standard KPI data
- Custom KPIs configured using the analytical model
- Real Time Indicators: These are equipment indicators configured in the machine/equipment model and assigned to enterprise hierarchy nodes.
- Transactional Data: This is transactional data at the operation, order, and work center level. Also available is transactional data related to production rate and planned versus actual production data.
- Some reports from Digital Manufacturing Cloud for execution.



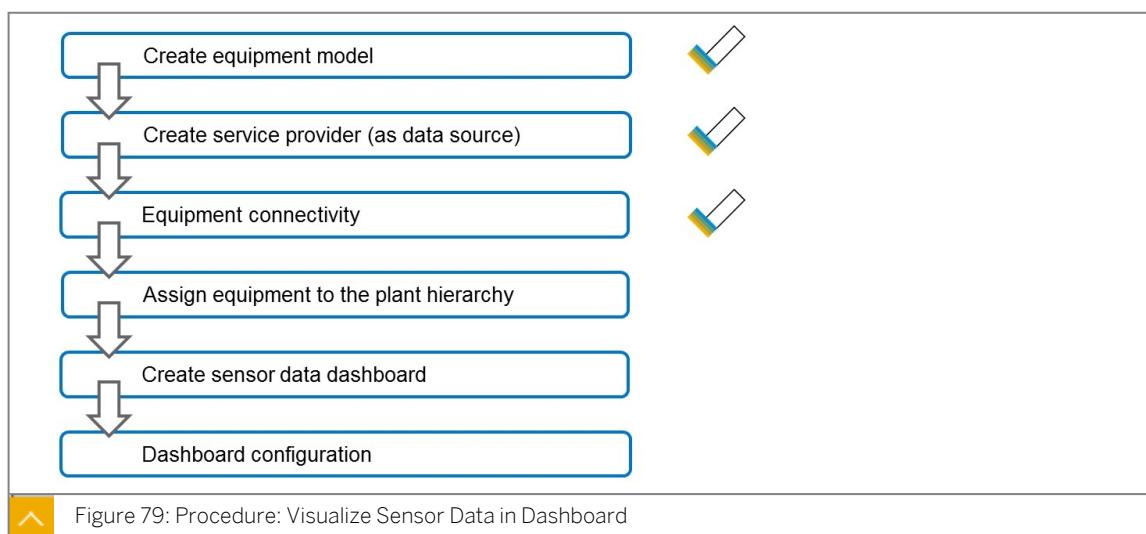
Figure 78: Dashboard Designer

The functionalities of Dashboard Designer include:

- Compose a dashboard with different KPIs
- Define a layout of your choice and integrate KPI visualizations grouped by any of the dimensions

- Multiple visualizations i.e. charts (line, bar, pie, donut, horizontal bar, stacked bar, heatmap) and tiles
- Choose decimal format, colors, target lines etc.
- User-friendly dashboarding features for faster dashboard creation, i.e. move content to clipboard, undo/redo, move content to different cell
- Interactive dashboards with filtering capabilities
- Value help for all the dimensions available for filtering in the filter bar
- Support for smart chart and smart table allowing configuration changes by end user e.g. chart type, dimension, measures etc.
- Personalized filter option for quick access of data in dashboard
- Store multiple filter variants and choose to have one as default
- Analytical view allowing grouping and filtering of data
- Root cause analysis with drill down within chart
- Chart visualization with auto scaling and title definition
- Data download in an excel for detail analysis

## Visualizing Sensor Data



To visualize the sensor data in the dashboard, follow the steps:

- Create equipment model: The equipment model is the virtual representation of the machine in the system.
- Create service provider (as data source): The service provider establishes the connection from cloud to the OPC server as the sensor data source.
- Equipment connectivity: Assign the service provider to the equipment model, and connect the equipment indicators to the tags on OPC server.
- Assign equipment the plant and plant hierarchy.

- Create sensor data dashboard: Define layout and add machine indicator.
- Dashboard configuration: Define the dashboard properties such as chart type and filter conditions.

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## Unit 7

### Exercise 16

# Visualize Sensor Data with Dashboard Designer

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to display the real-time sensor data from the spray booth. Carson is tasked with creating a dashboard to visualize the sensor data.

#### Task 1: Assign Equipment to the Plant Hierarchy

1. Go to DMC homepage and open the app *Manage Hierarchies*
2. Find the plant hierarchy *DMC300\_Plant*
3. Assign equipment *EQUIP-SBOOTH-##* to plant node *DMC300* and enter the following data:

Table 16:

Field	Value
Node Type	Equipment
Equipment	<i>EQUIP-SBOOTH-##</i>
Valid From	<one day before current date>
Valid to	<3 days after the current date>

4. Publish the plant hierarchy *DMC300\_Plant*

#### Task 2: Create Sensor Data Dashboard

1. Open the app *Dashboard Designer*
2. Create a new dashboard and split the dashboard vertically into 2 parts
3. Drag and drop the indicators *PRESSURE* and *CYCLETIME* to each cell to display the indicator value on the dashboard. As a result, the two indicators are displayed, and sensor data is read from the machine through the PCo connectivity.



Figure 80: Dashboard

4. Save the dashboard with the name SensorData-## under the folder WEB
5. Click Preview to preview the dashboard

### Task 3: (Optional) Dashboard Configuration

1. Find the dashboard SensorData-##
2. Adjust the display parameters so that the gauge chart ranges from 0 to 20. The color for value 0 to 10 is green, 10 to 15 is yellow and 15 to 20 is red or adjust the chart range and color indicator according to the current value you see.



Figure 81: Dashboard

# Unit 7

## Solution 16

# Visualize Sensor Data with Dashboard Designer

Carson is a consultant with the high-tech ABC Company. The company is considering connecting Digital Manufacturing Cloud to shop floor in order to display the real-time sensor data from the spray booth. Carson is tasked with creating a dashboard to visualize the sensor data.

### Task 1: Assign Equipment to the Plant Hierarchy

1. Go to DMC homepage and open the app *Manage Hierarchies*
2. Find the plant hierarchy *DMC300\_Plant*
3. Assign equipment *EQUIP-SBOOTH-##* to plant node *DMC300* and enter the following data:

Table 16:

Field	Value
Node Type	Equipment
Equipment	<i>EQUIP-SBOOTH-##</i>
Valid From	<one day before current date>
Valid to	<3 days after the current date>

- a) Choose the plant node *DMC300*
- b) Click + (Add).
- c) On the Add Node screen enter the data provided in the table
4. Publish the plant hierarchy *DMC300\_Plant*
  - a) On the top-right of the screen, click *Publish Nodes*

### Task 2: Create Sensor Data Dashboard

1. Open the app Dashboard Designer
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to *Personalized Dashboards, Reports, and KPIs* → *Dashboard Designer*
2. Create a new dashboard and split the dashboard vertically into 2 parts
  - a) On the Dashboard Designer screen click *New*

- b) Select Dashboard
  - c) Click anywhere on the panel, and choose the icon Split Cell which appears on the top right side
  - d) On the Split Cell screen choose Vertically and enter 2 in Number of Cells field
  - e) Choose OK
3. Drag and drop the indicators PRESSURE and CYCLETIME to each cell to display the indicator value on the dashboard. As a result, the two indicators are displayed, and sensor data is read from the machine through the PCo connectivity.



- Figure 80: Dashboard
- a) Choose Real Time Indicator in the panel on the right
  - b) Expand the Enterprise Hierarchy node ... → Germany → DMC300 → EQUIP-SBOOTH-## → IG-300-##.
  - c) Drag and drop the indicators PRESSURE and CYCLETIME to each cell of the dashboard
  - d) Two gauge charts appear on the dashboard
4. Save the dashboard with the name SensorData-## under the folder WEB
- a) Click the Save icon
  - b) On the Dashboard screen, expand the project DMC300//WEB
  - c) Enter the file name **SensorData-##**
  - d) Click Save
5. Click Preview to preview the dashboard

### Task 3: (Optional) Dashboard Configuration

1. Find the dashboard SensorData-##
  - a) Login into DMC with the user assigned to you by the course instructor
  - b) Navigate to Personalized Dashboards, Reports, and KPIs → Dashboard Designer -
  - c) Click Open

Duplication is prohibited.

Duplication is prohibited.

d) Expand the project path //WEB -> SensorData-##

e) Click Open

2. Adjust the display parameters so that the gauge chart ranges from 0 to 20. The color for value 0 to 10 is green, 10 to 15 is yellow and 15 to 20 is red or adjust the chart range and color indicator according to the current value you see.



Figure 81: Dashboard

a) Click on the cell CYCLETIME, few icons appear on the right side

b) Click *Configure Display Parameters*

c) On the Configure Display Parameters screen select the *Display* tab and change the *X-Axis End* to **20**

d) In the Color Indicator Section, enter the following data:

Table 17:

From	To	Color
0	10	Green
10	15	Yellow
15	20	Red



Note:

The data is randomly generated via a PCo agent and the value might be very large, try to adjust the chart range and color indicator to the real-time value

e) Click *Apply*

f) Click *Preview*, you should see the figure is updated



## LESSON SUMMARY

You should now be able to:

- Describe the basic functionalities of Digital Manufacturing Cloud Dashboard Designer
- Visualize Sensor Data with Dashboard Designer

## Learning Assessment

1. In Digital Manufacturing Cloud Dashboard Designer, you can create custom dashboard using:

*Choose the correct answers.*

- A Standard KPIs
- B Custom KPIs
- C Real time indicators
- D Transactional data

## Learning Assessment - Answers

1. In Digital Manufacturing Cloud Dashboard Designer, you can create custom dashboard using:

*Choose the correct answers.*

- A Standard KPIs
- B Custom KPIs
- C Real time indicators
- D Transactional data

Correct. You are able to visualize all of them with DMC dashboard designer.