AUTODESK UNIVERSITY

BLD502300

Integrating Autodesk Tandem with Business Intelligence Data Flows

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Safe Software

Learning Objectives

- Learn how to connect Autodesk Tandem information to your favorite external applications.
- Learn how to create Autodesk Tandem data flows using FME Workbench.
- Learn about automating workflows using FME Server.
- Learn about the power of the Autodesk Tandem REST API.

Description

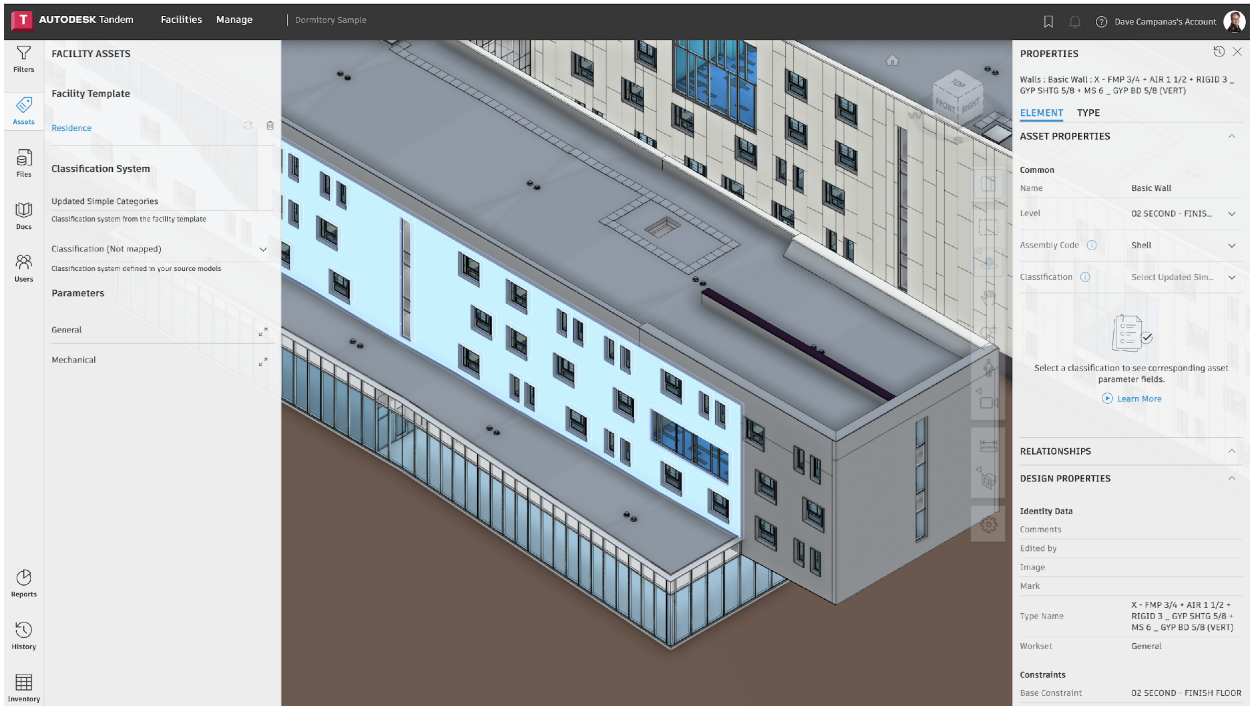
Learn how to automate the exchange and augmentation of information with Autodesk Tandem technology using Safe Software's FME no-code data-integration platform. Together we'll construct automations to extract Autodesk Tandem data to business intelligence tools like Microsoft Power BI and Tableau. And we'll update Autodesk Tandem information with new data, ranging from Microsoft Excel to Internet of Things (IoT) streams.

Speaker(s)

Since 2005, Dave has been an Applications Expert at Safe Software, assisting clients in solving their data flow challenges using FME. Prior to this, Dave was a GIS manager at an aerial mapping firm.

Autodesk Tandem

Tandem is Autodesk's cloud based digital twin technology platform. Twins can be created from Revit or IFC models, then extended through user defined parameters and templates.



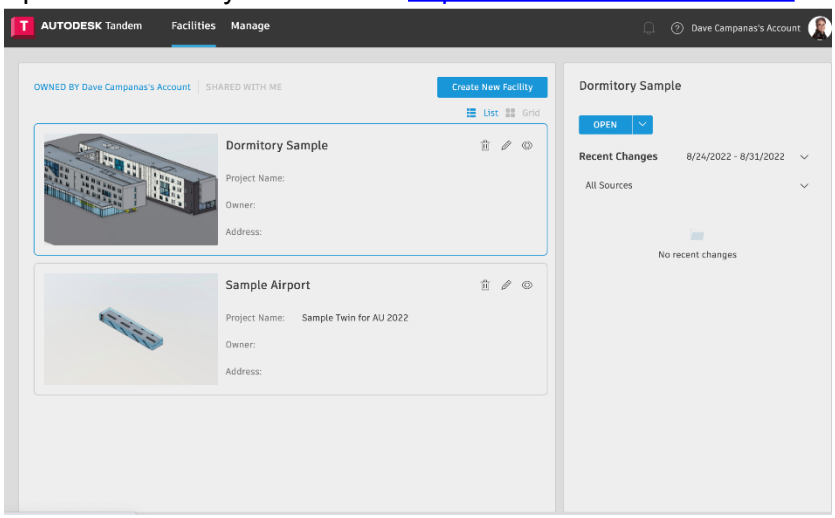
Autodesk Tandem Interface

For a more detailed description of Autodesk Tandem and its capabilities, please see the product web page at https://intandem.autodesk.com/what-is-autodesk-tandem/

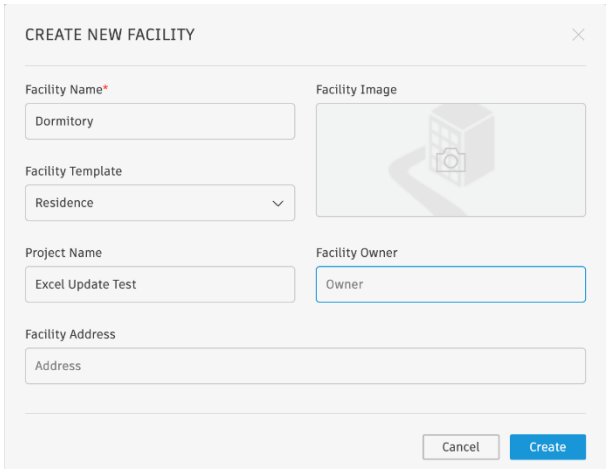
Adding Facilities

The first thing we need to do to use Tandem is to add a Facility.

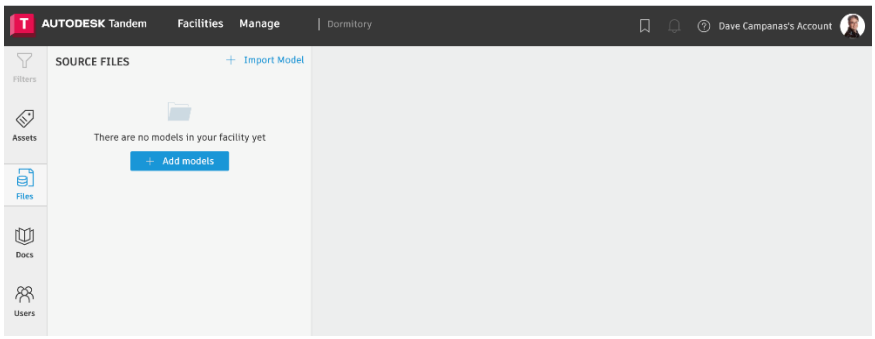
Open Tandem in your browser: https://tandem.autodesk.com/



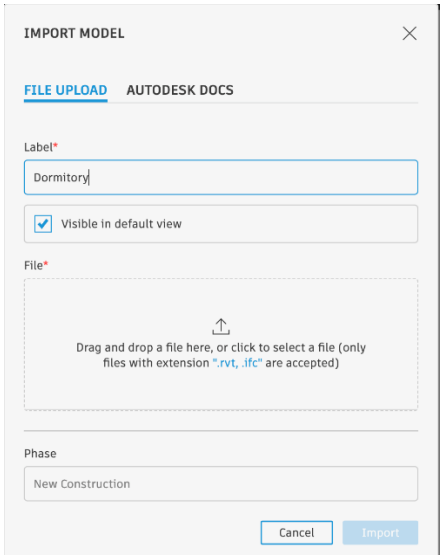
Click the Create New Facility button to bring up the Facility Dialog

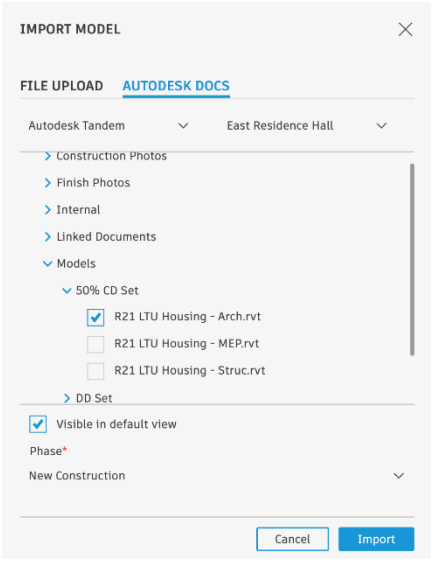


In the Facility Dialog, set the facility name and project name, then click Create to create the new facility. You will then be brought into the new facility and prompted to add models to it.



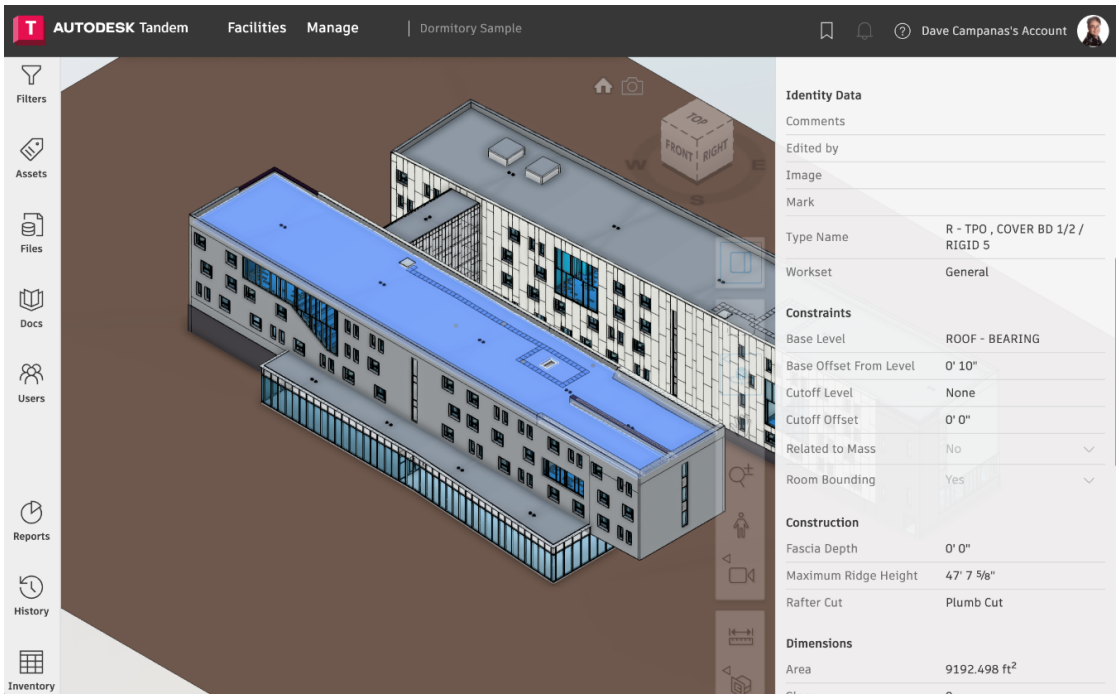
Click the Add Models button to bring up the Add Models dialog.



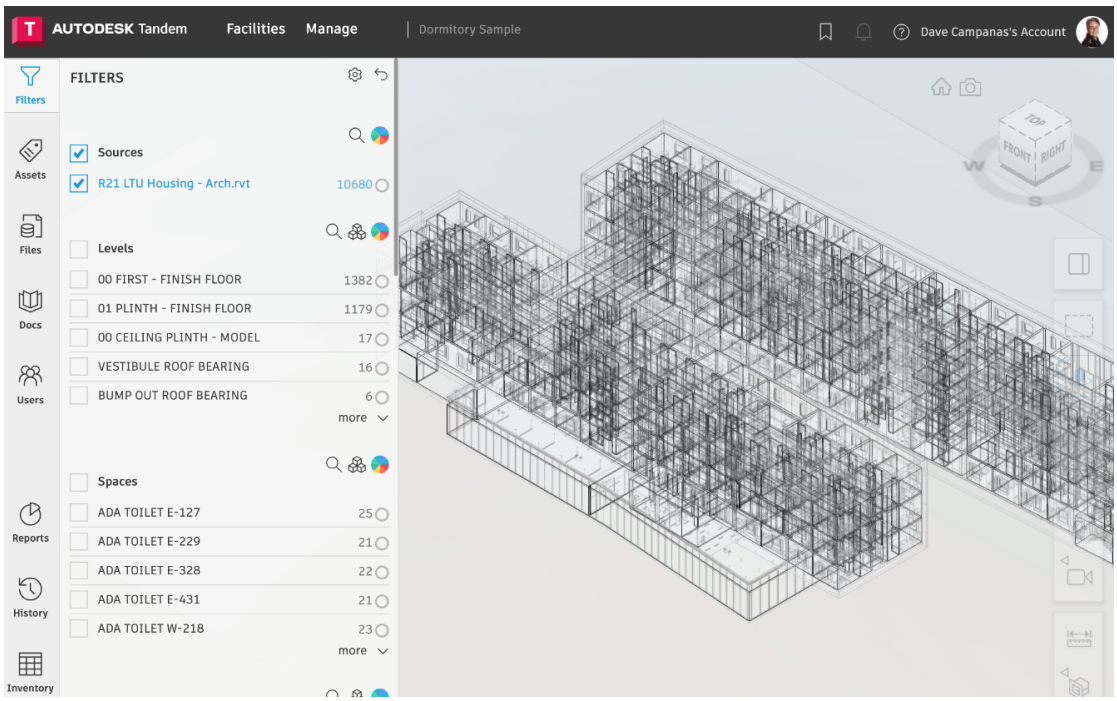


You can import your model from a Revit or IFC file by dragging and dropping it on the File Upload tab, or you can import an existing model from BIM 360 on the Autodesk Docs tab.

Once the model is imported, you will be able to view it within Tandem. Clicking on any feature will show the properties from the Revit or IFC file.



You can set filters on the interface to show only the parts of the model you are interested in.

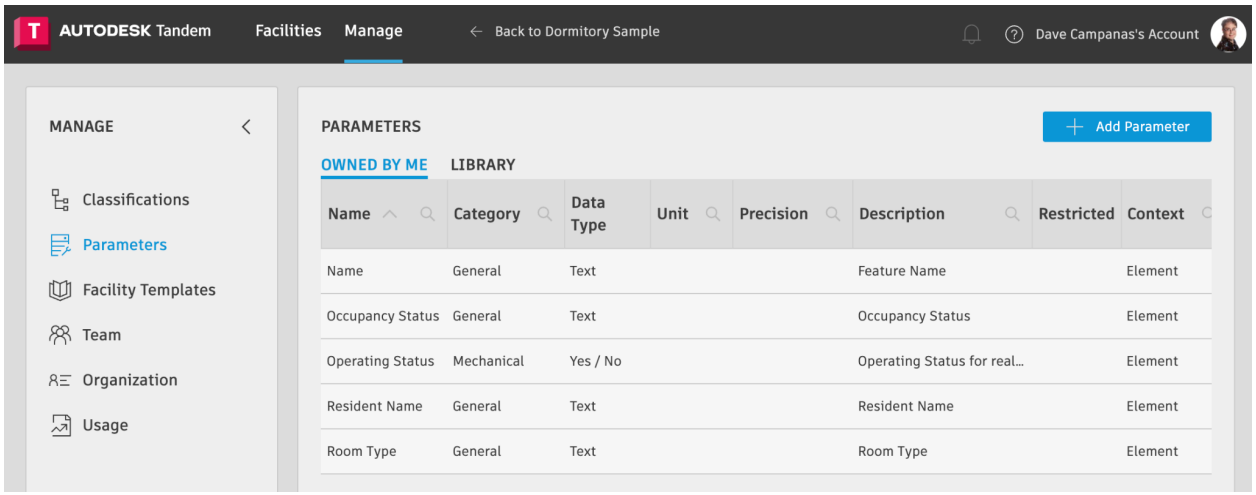


Preparing Tandem for Updating

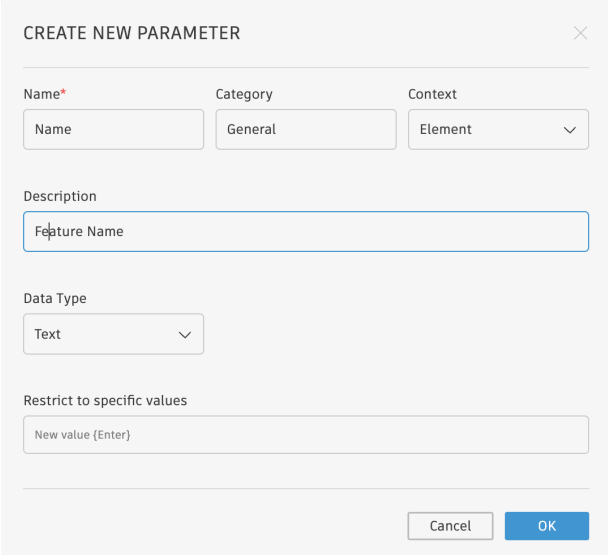
For the next steps, please create Facilities and import the Revit data for both Airports.rvt and R21 LTU Housing - Arch.rvt, which should be included in the class attachment.

In order to add more information to the Tandem model, we must first create the parameters to store it in.

Choose Manage from the top menu, then Parameters from the side menu to bring up the Parameters dialog



Click the Add Parameter button to bring up the Add Parameter dialog:



In this dialog, you can set the parameter name, category and data type.

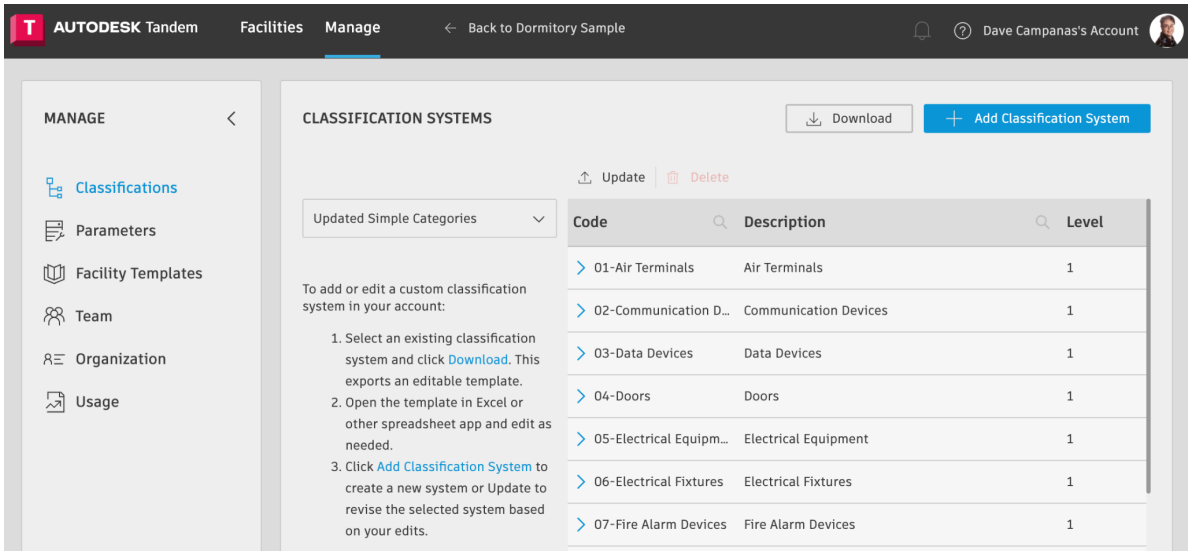
Please add the new parameters listed below:

Name	Category	Data Type	Description	Context
Name	General	Text	Feature Name	Element
Occupancy Status	General	Text	Occupancy Status	Element
Operating Status	Mechanical	Yes/No	Operating Status	Element
Resident Name	General	Text	Resident Name	Element
Room Type	General	Text	Room Type	Element

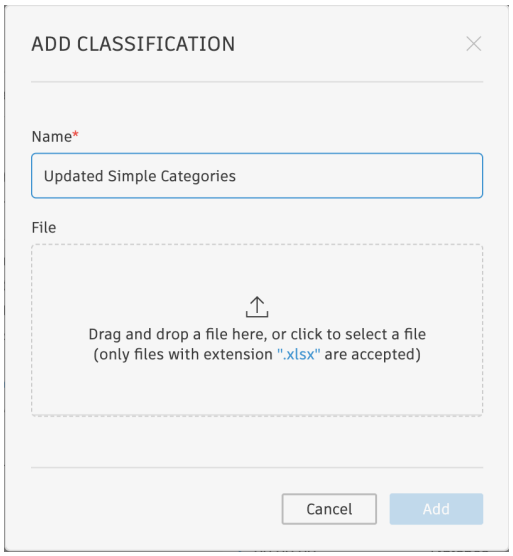
Now that the parameters have been created, we need to add them to the features, by adding them to a Facility Template.

The Facility Templates use Classification systems to set the feature types. I started with Simple Categories for simplicity, but this lacked a category for Rooms, which was the focus of the exercise. So I created a modified Simple Categories classification with Rooms added to it.

To import the updated classification into Tandem, choose Classifications from the side menu:

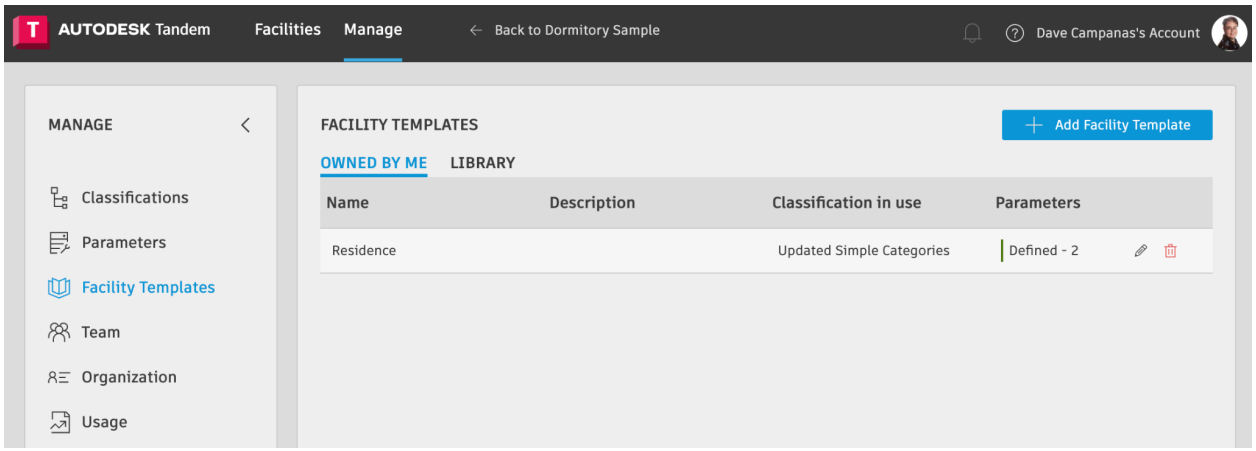


Click the Add Classification System button to bring up the Add Classification dialog:

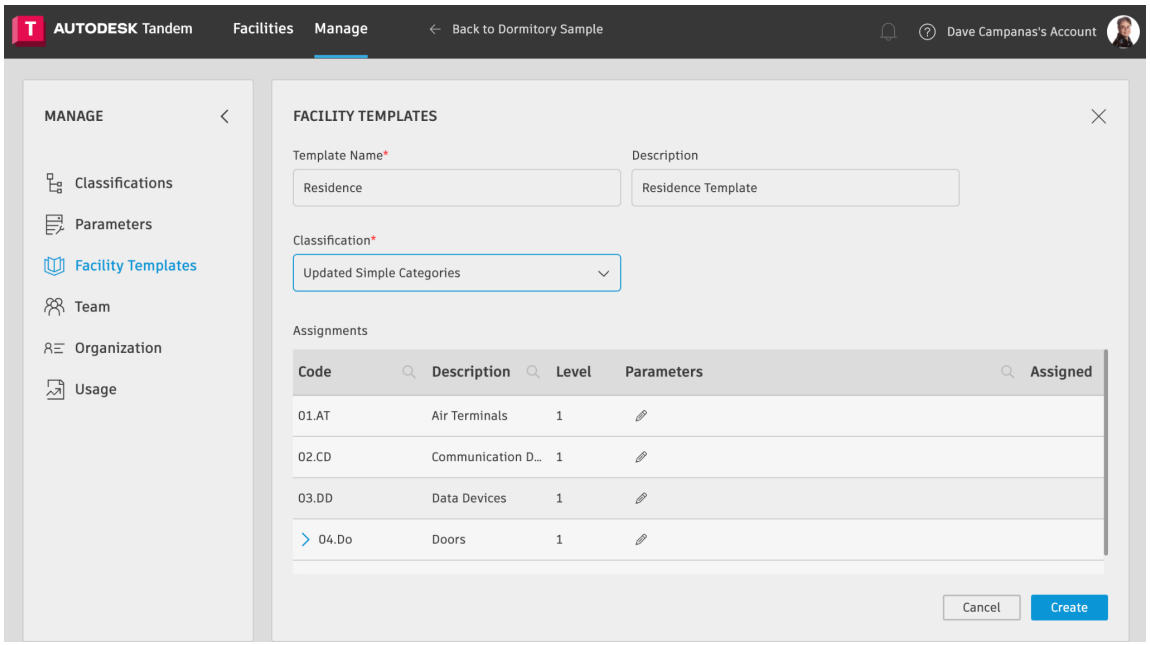


Set the name to Updated Simple Categories, then drag and drop the Updated Simple Categories.xlsx file. Click the Add button to finish up.

Now we need to add the updated Categories to a Facility Template. Choose Facility Templates from the side menu:

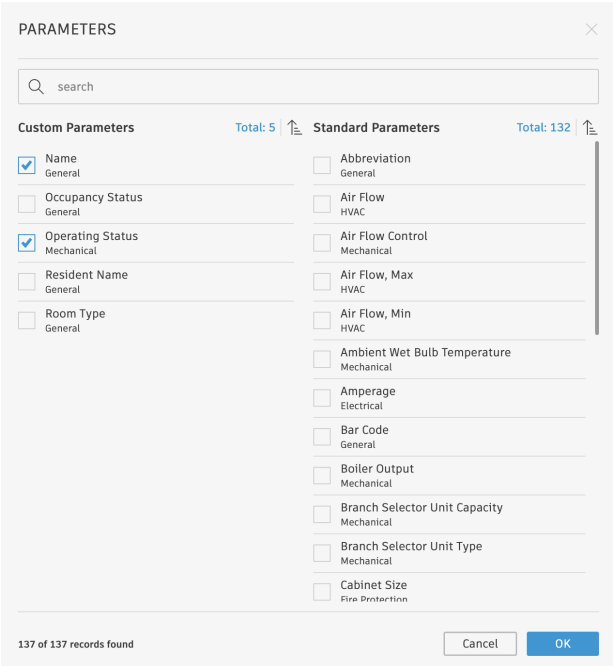


Click the Add Facility Template button to bring up the Facility Templates dialog:

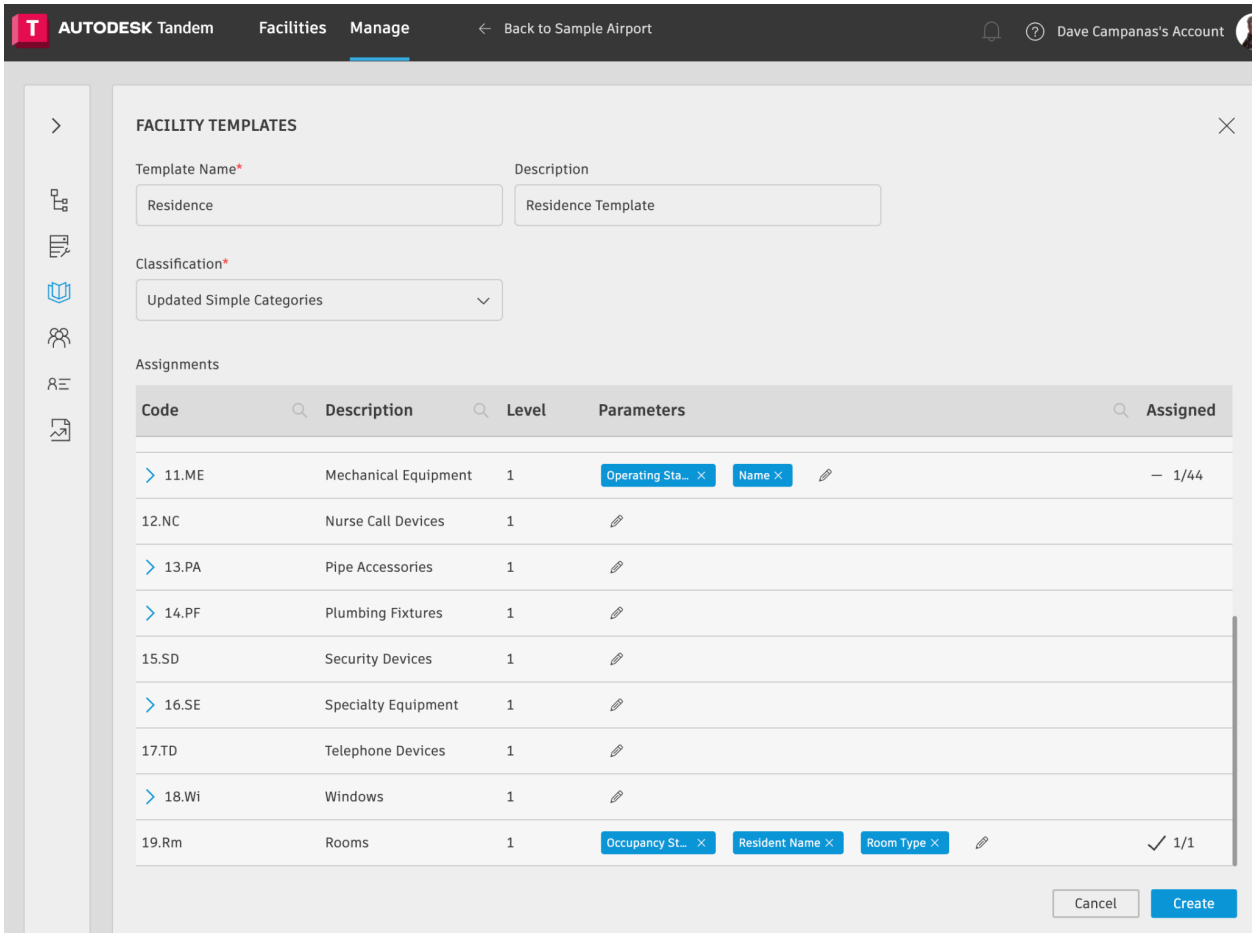


Set Template Name to Residence and Classification to Updated Simple Categories.

Using this same screen, we can assign the new Parameters to the Mechanical Equipment and Rooms. Scroll down until you see Mechanical Equipment in the Description, then click the pencil icon beside it to edit the Parameters:

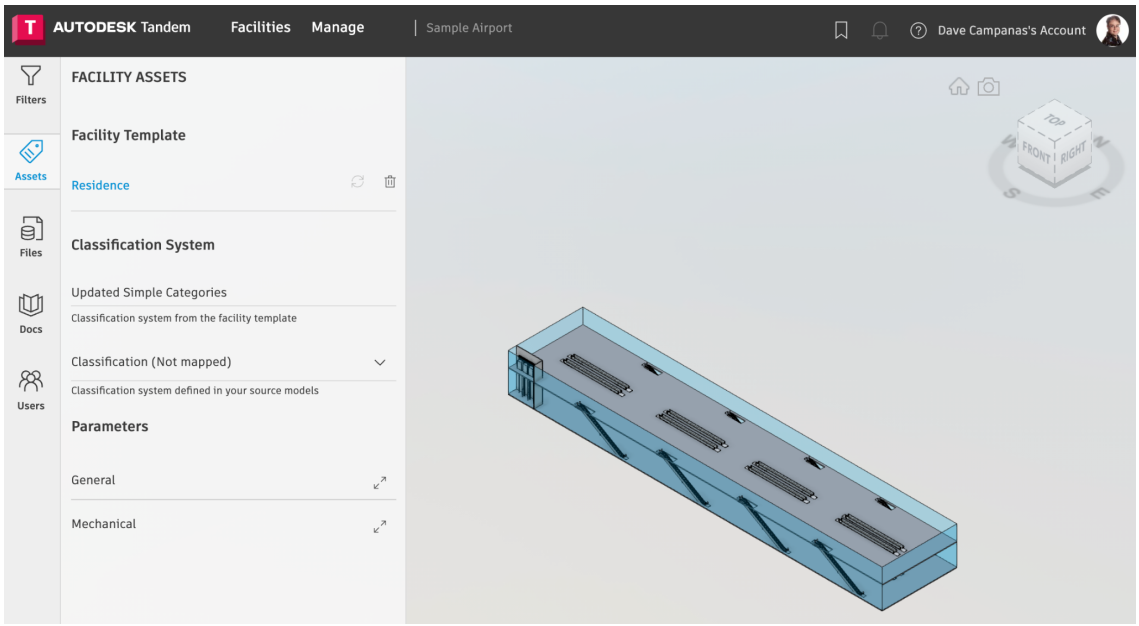


Check the Name and Operating Status Custom Parameters, then click OK. Edit Rooms as well, to add the Parameters Occupancy Status, Resident Name and Room Type. The added Parameters should show up in the rows:

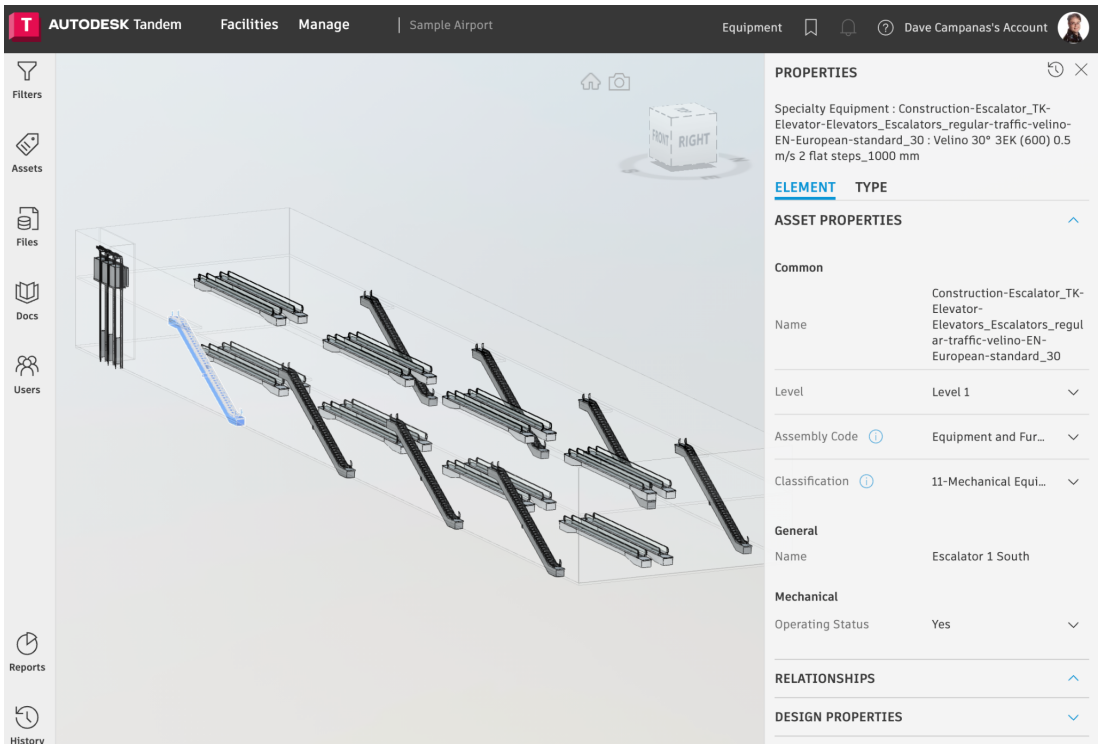


Once the new Parameters are assigned to the Codes, we can click Create to add the new Facility Template.

The next step is to set the new template on the models. Open each model, then choose Assets from the side menu, and set Facility Template to Residence.



Once the templates are set, exit and re-enter the Airport model. Clicking on the equipment features should show the new Parameters:



Both General - Name and Mechanical - Operating Status will be blank. The new parameters added to the Dormitory model will also be blank. The first exercises will fill in the Dormitory parameters, but we will need to add names to the equipment in the Airport. You can do this by clicking on the equipment, then clicking on the General - Name parameter and filling in the name. At the same time I would recommend setting the Operating Status to Yes.

For the presentation, I used the following equipment names:

Elevator 1
Elevator 2
Elevator 3
Escalator 1 South
Escalator 2 South
Escalator 3 South
Escalator 4 South
Escalator 1 North
Escalator 2 North
Escalator 3 North
Escalator 4 North
Moving Walkway 1 Outbound Level 1
Moving Walkway 1 Inbound Level 1
Moving Walkway 2 Outbound Level 1
Moving Walkway 2 Inbound Level 1
Moving Walkway 3 Outbound Level 1
Moving Walkway 3 Inbound Level 1
Moving Walkway 4 Outbound Level 1
Moving Walkway 4 Inbound Level 1
Moving Walkway 1 Outbound Level 2
Moving Walkway 1 Inbound Level 2
Moving Walkway 2 Outbound Level 2
Moving Walkway 2 Inbound Level 2
Moving Walkway 3 Outbound Level 2
Moving Walkway 3 Inbound Level 2
Moving Walkway 4 Outbound Level 2
Moving Walkway 4 Inbound Level 2

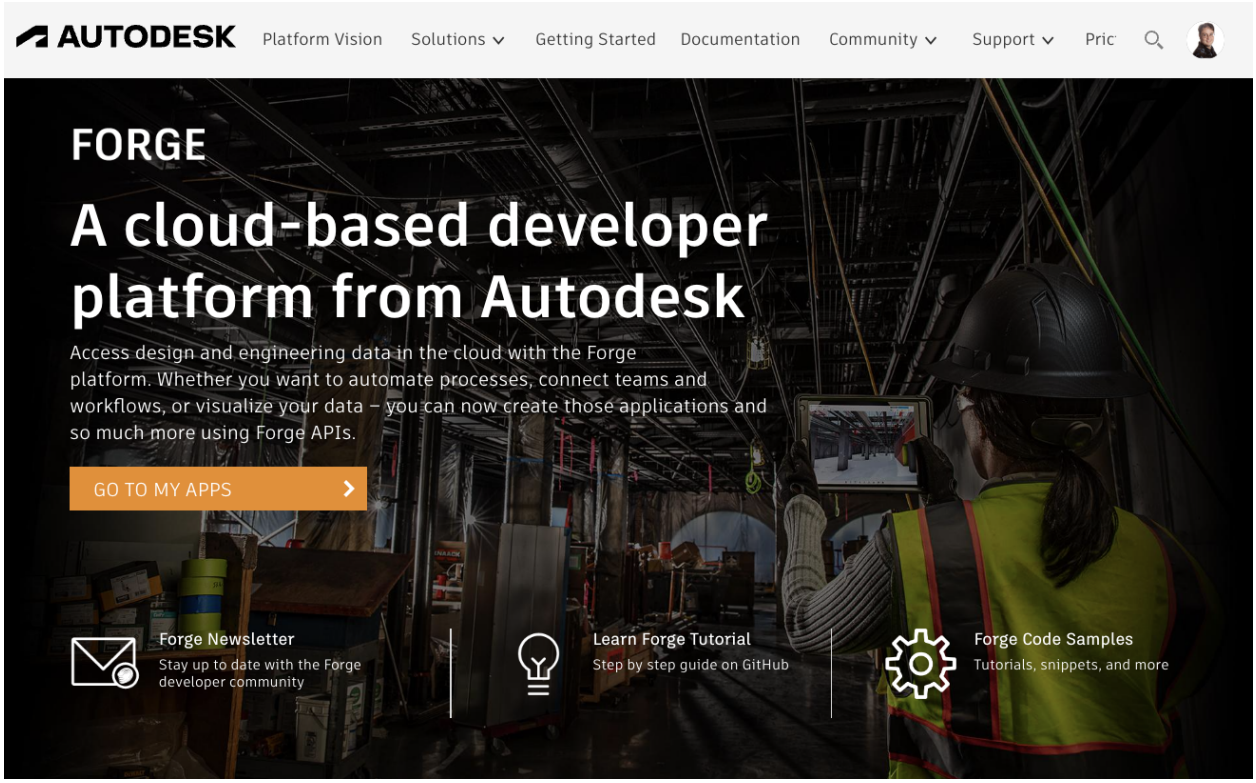
Tandem REST API

Tandem has a REST API that can be used to communicate with it in order to extract and update the feature properties. FME uses this REST API for its Tandem interactions. You can find more information on this API at https://autodesk-tandem.github.io/

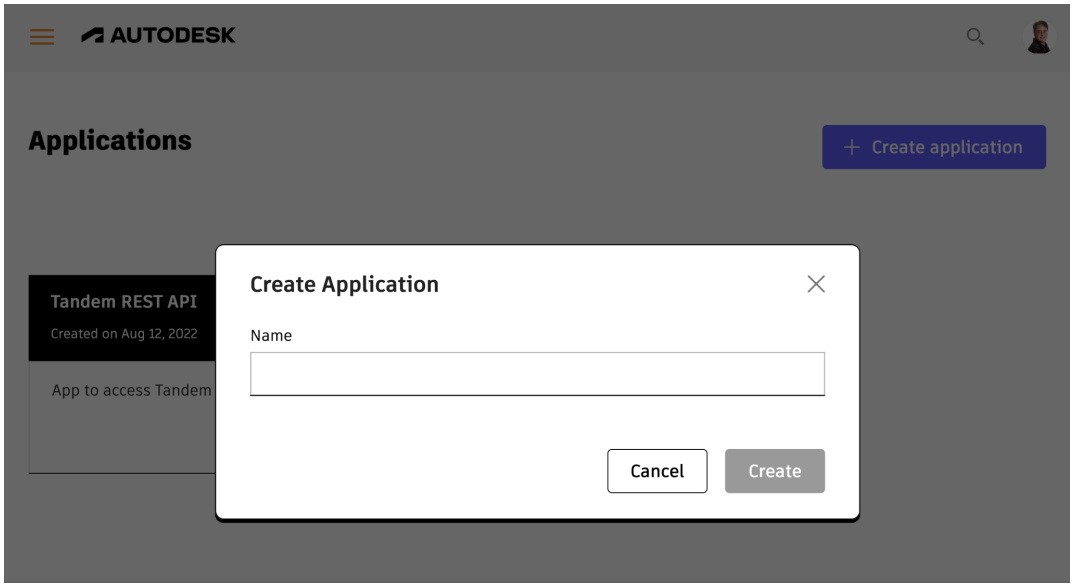
Creating a Forge App

In order to use the REST API or FME to communicate with Tandem, we must first register a Forge App to handle the authentication and permissions. You will need a Forge login, but this can be obtained by signing up for free.

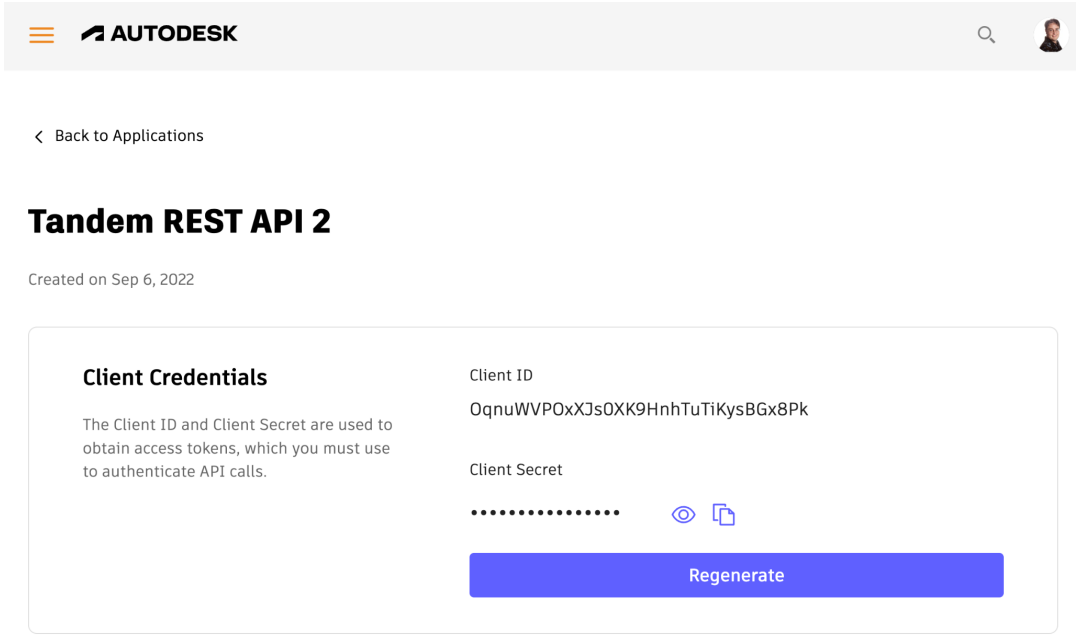
Navigate and login to https://forge.autodesk.com/ to see the following page:



Click on Go to My Apps to go to the Applications screen. If you have any existing Apps, they will show up here. Click the Create App button to create a new App.

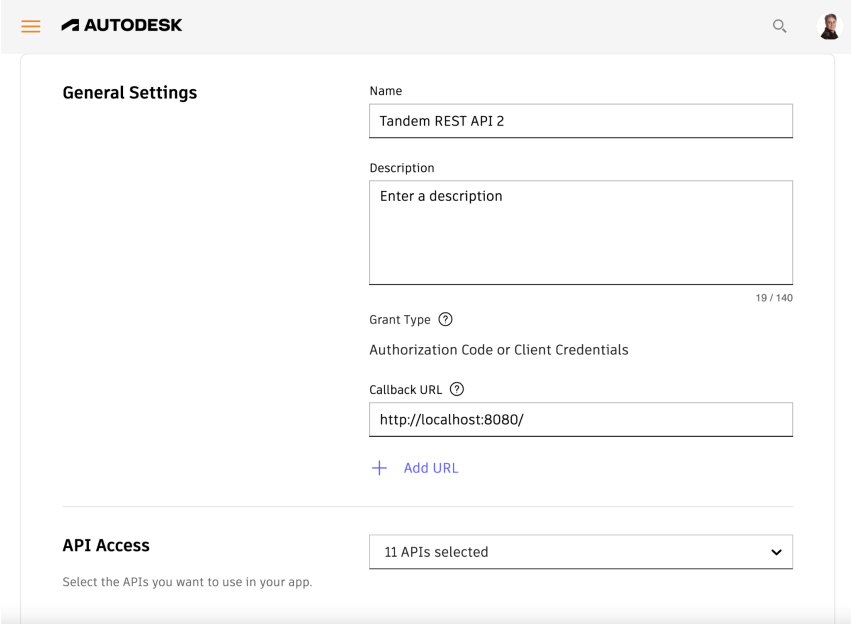


Enter the name you want to use for the Application, ie. Tandem REST API, then click Create.



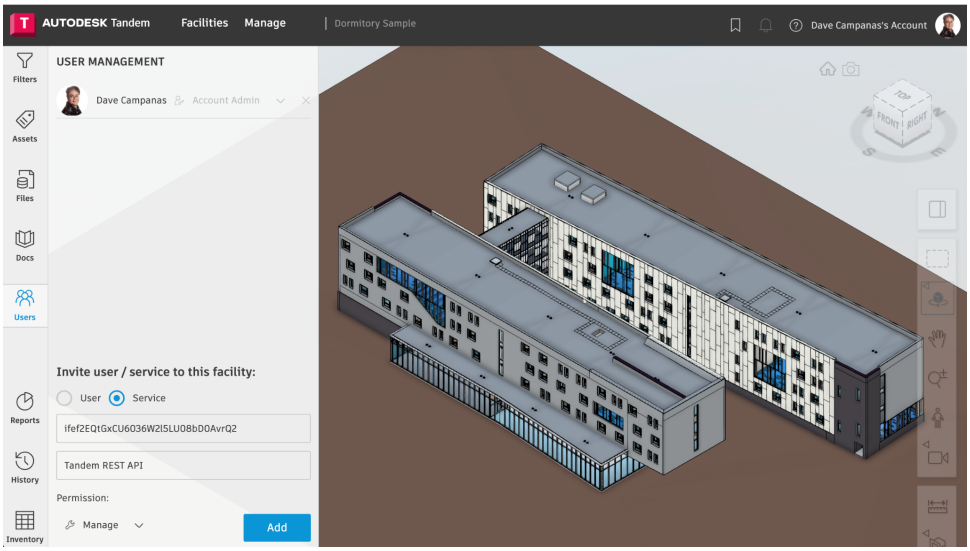
A new page will come up, showing you the App credentials. Copy and paste the App Name, Client ID and Client Secret key into a secure location - we will need these later.

Further down the page, you can adjust the Settings and API Access for the App, if you like. I would recommend not changing the APIs selected.



Adding the Forge App to Tandem

In order to give the Forge App access to your Tandem models, you must add it as a User.



Enter the Facility, then click Users on the side menu. Choose the Service option, then add the App Client ID and Name. Set Permission to Manage, then click the Add button to add the Service.

Do the same for the Airport model.

Tandem is now ready for reading and updating.

Installing FME

The two exercises require the use of FME Desktop and FME Server. Trial versions of these applications can be obtained from https://www.safe.com/fme/trial/#platform. Run the Express install for both applications. You can use the default admin or superuser account in FME Server for the exercises.

Exercise 1 - Updating the Dormitory Facility from Excel

In this exercise, we are going to read the Dormitory features from Tandem, extract the Rooms, then fill in the new Room parameters from the Excel file, using FME Desktop.

The Excel file contains a sheet with the details of each room:

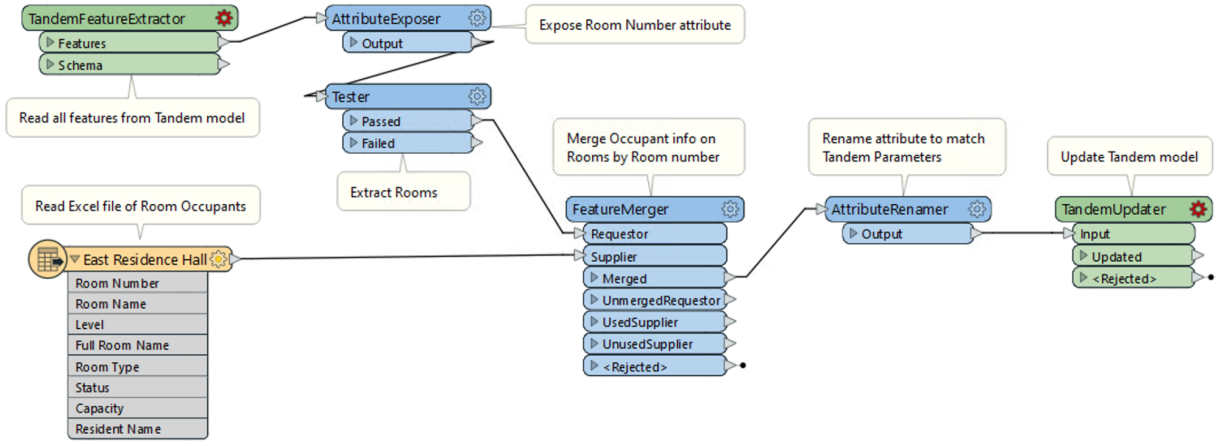
D9 | DORMITORY CORRIDOR

	A	B	C	D	E	F	G	H
1	Room Number	Room Name	Level	Full Room Name	Room Type	Status	Capacity	Resident Name
35	W-312	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Angelita Kihn, Brandyn Abbott
36	W-345	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Unoccupied	2	
37	W-341	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Dixie Schiller, Manley Zemlak
38	W-339	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Clark Gorczany, Price Durgan
39	W-335	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Miles Cassin, Garfield Hirthe
40	W-325	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Halie Douglas, Friedrich Jast
41	W-320	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Emely Quitzon, Kiana Prosacco
42	W-309	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Immanuel Grant, Mariela Harber
43	W-306	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Tanya Collins II, Cody Carter
44	W-301	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Saige Predovic, Leola Lesch
45	W-342	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Unoccupied	2	
46	W-310	UNIT	THIRD FLOOR	DORMITORY UNIT	Residence	Occupied	2	Shanel Miller, Murl Gottlieb

East Residence Hall

The common key between the Excel data and the Dormitory Rooms is the Room Number.

Open Update_Room.fmw in FME Workbench:

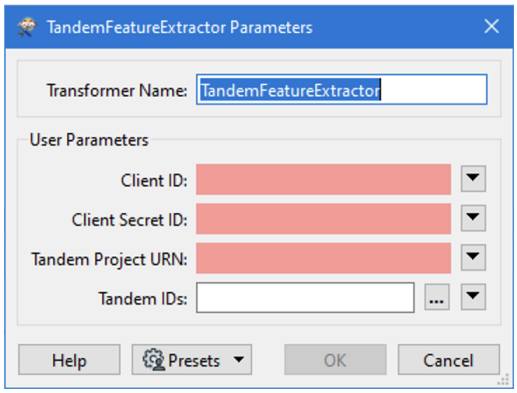


This workspace carries out the following steps:

- Reads the Excel data
- Reads all the feature parameters from Tandem (in the TandemFeatureExtractor)
- Filters the Tandem Rooms from the other Tandem features
- Joins the Excel info to the Tandem Rooms by Room Number
- Renames the Excel attributes to the Tandem parameter names
- Updates the Tandem model with the new Room parameters (in the Tandem Updater)

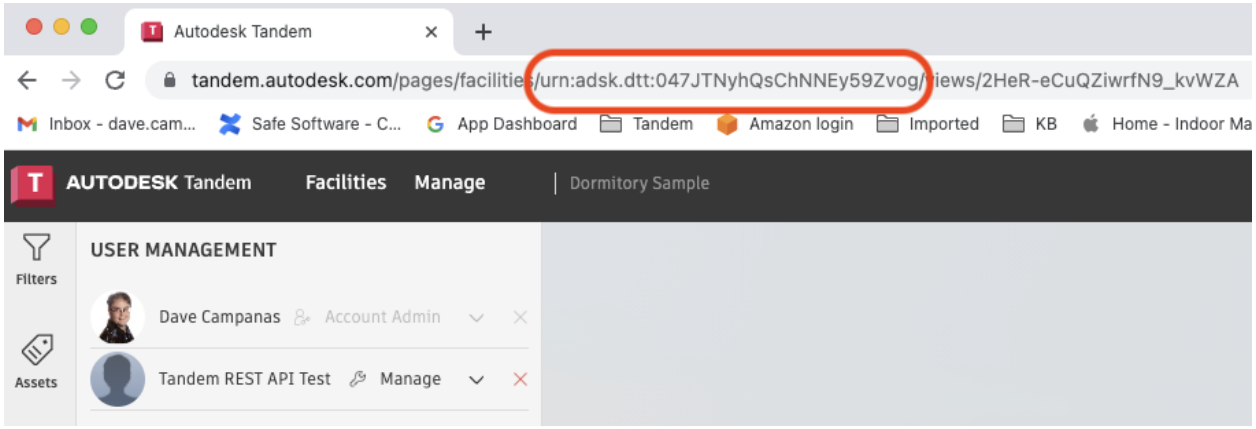
Before we can run the workspace, we need to provide some information to the Tandem transformers.

Click the red sprocket symbol on the TandemFeatureExtractor to bring up its properties:



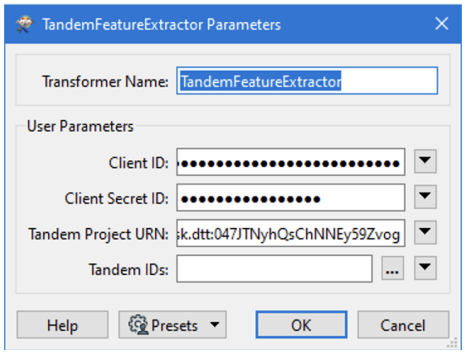
In the first two boxes, add the Client ID and Secret ID from the Forge App you created. This authorizes the transformer to modify your Tandem data

The Tandem Project URN is the location of the Facility Model you want to access. You can find this by opening the model in Tandem and looking at the URL in the Browser:

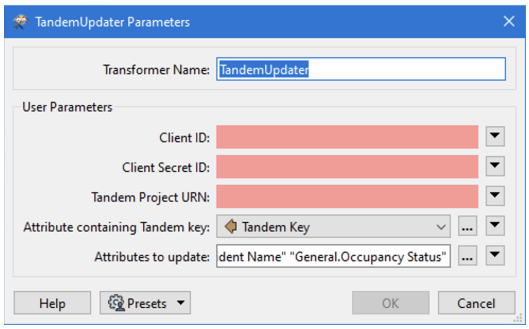


The circled part of the URL is the model URN. Copy and paste it into the Tandem Project URN text box.

The Tandem IDs box is optional. If you know the Tandem IDs of the feature you want to read, you can set them here, and only those features will be read. In this case, we do not know the IDs of the Rooms, so we will leave this box blank, which will cause the transformer to read all the Tandem features.



Click the red sprocket on the TandemUpdater and fill in the same fields:



The TandemUpdater has two new settings:

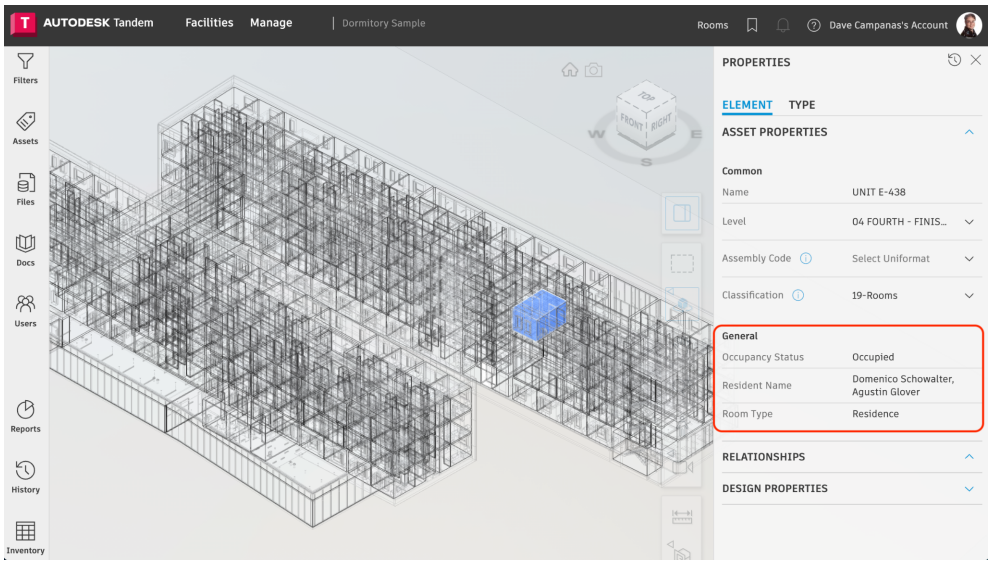
- Attribute containing Tandem key - this tells Tandem which feature to update. The TandemFeatureExtractor has provided this for us, in the attribute Tandem Key.
- Attributes to Update - which Tandem parameters to update, in the form <Category>.<Parameter Name>. These are chosen from a list of attributes available on the incoming features.

These new settings are already populated for you.

Click the Save icon on the menu bar to save your changes.

Now that the Tandem transformers have had their parameters set, we can run the workspace to update the Tandem model. Please ensure the East Residence Hall - Occupancy Info.xlsx is in the same folder as the workspace. Click the green Run icon in the top menu bar to start the workspace.

When the workspace finishes without error, re-open the Dormitory facility in Tandem, then filter the view to see only the Rooms. If you click on a Room, you should see the parameters filled in:

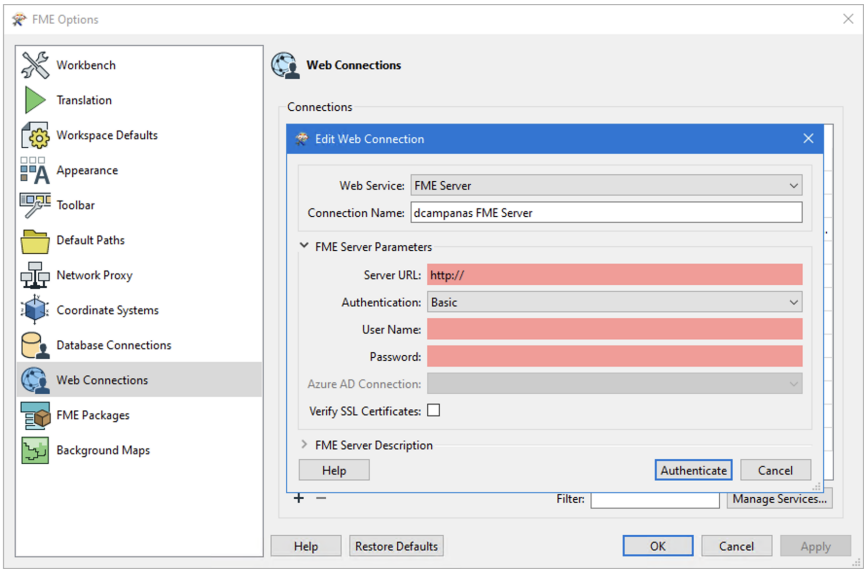


Congratulations, you have updated your Tandem model.

Publishing to FME Server

FME Desktop is great for designing your workflows, and running the occasional process, but to share your workflows with the rest of your organization, it is best to publish them to FME Server. This allows anyone in your organization to run your workflow through a simple web interface.

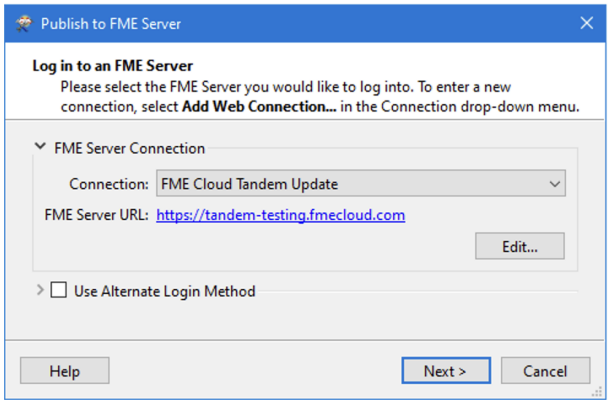
The first step is to publish your workspace to FME Server. To do this we need to create a connection to your FME Server. Open Update_Rooms in FME Workbench if it is not already open, then pick Tools - FME Options from the top menu. Pick the Web Connections icon, then click the '+' button at the bottom of the Web Connections to add a new connection:



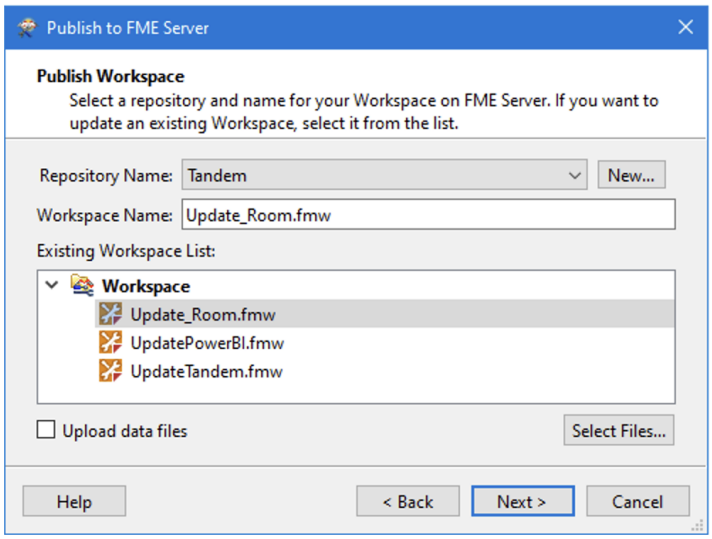
Set the Connection Name to best describe the FME Server connection.

Fill in the URL to FME Server, along with your user name and password. Click Authenticate to check settings and save the connection.

From the top menu, choose File - Publish to FME Server. In the dialog, select the new FME Server connection you created:

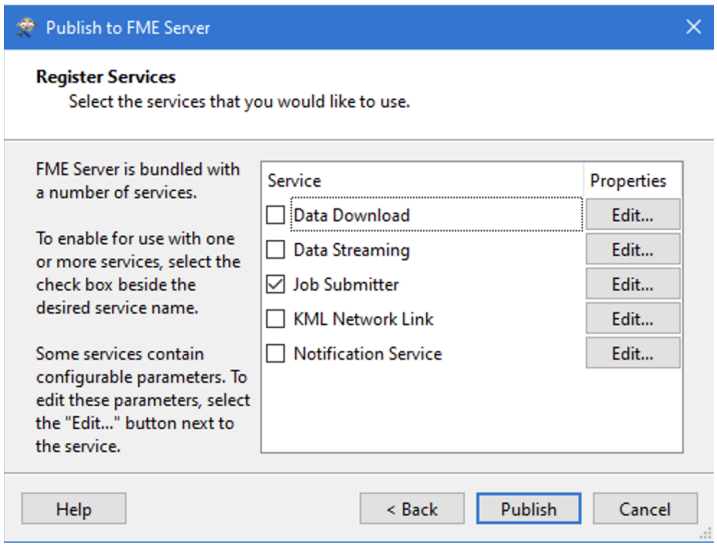


Click Next to continue:



The next dialog allows you to choose which repository to store the published workspace in. Repositories are like folders, and let you organize your workspaces for clarity. Create a new repository named Tandem to store the workspace in.

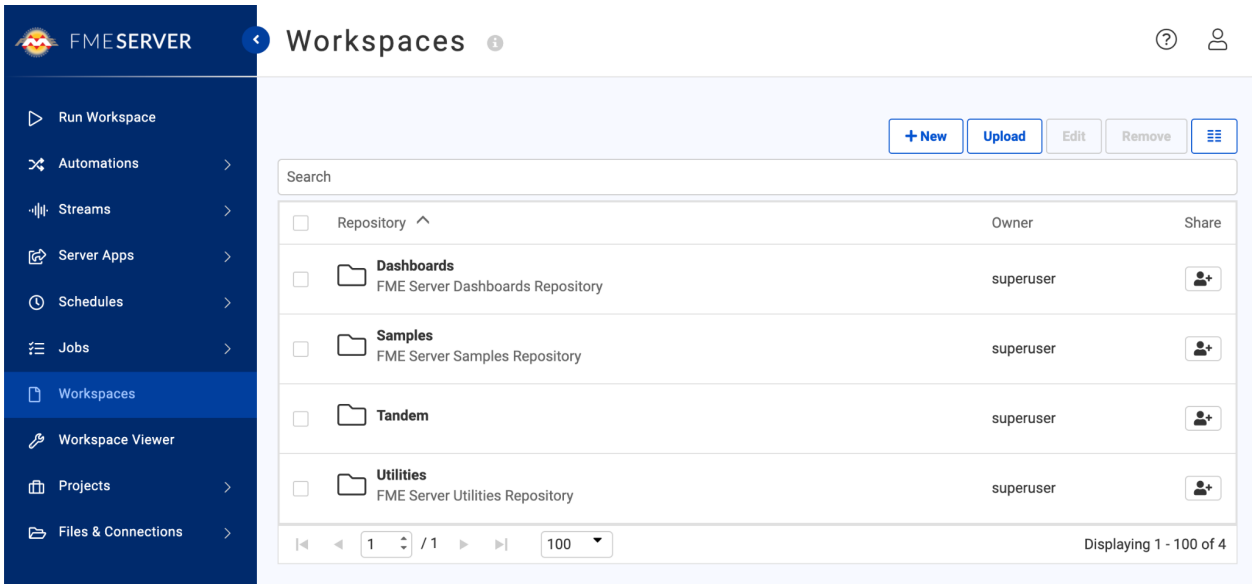
Click Next to continue to the services dialog:



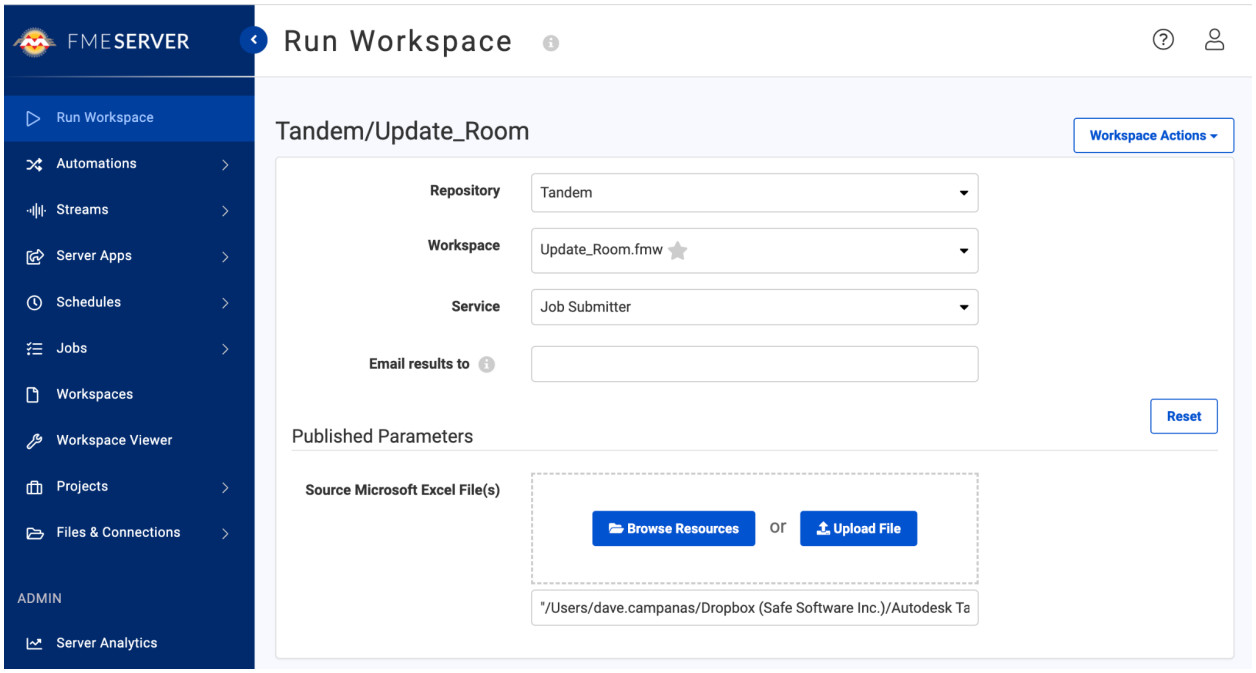
This dialog allows you to associate your workspace with FME Server services. If your workspace outputs a data file, you would likely associate it with the Data Download service, which will zip up the output data and provide the user a link to download it. If your workspace outputs an HTML document or image file, you can associate it with the Data Streaming service, which will stream the file back to the user's browser.

In this case, we are not returning any data to the user, so we will use the default Job Submitter service. Click Publish to finish the publishing process.

Now the workspace is published, we will switch to the FME Server interface and pick Workspaces from the menu:

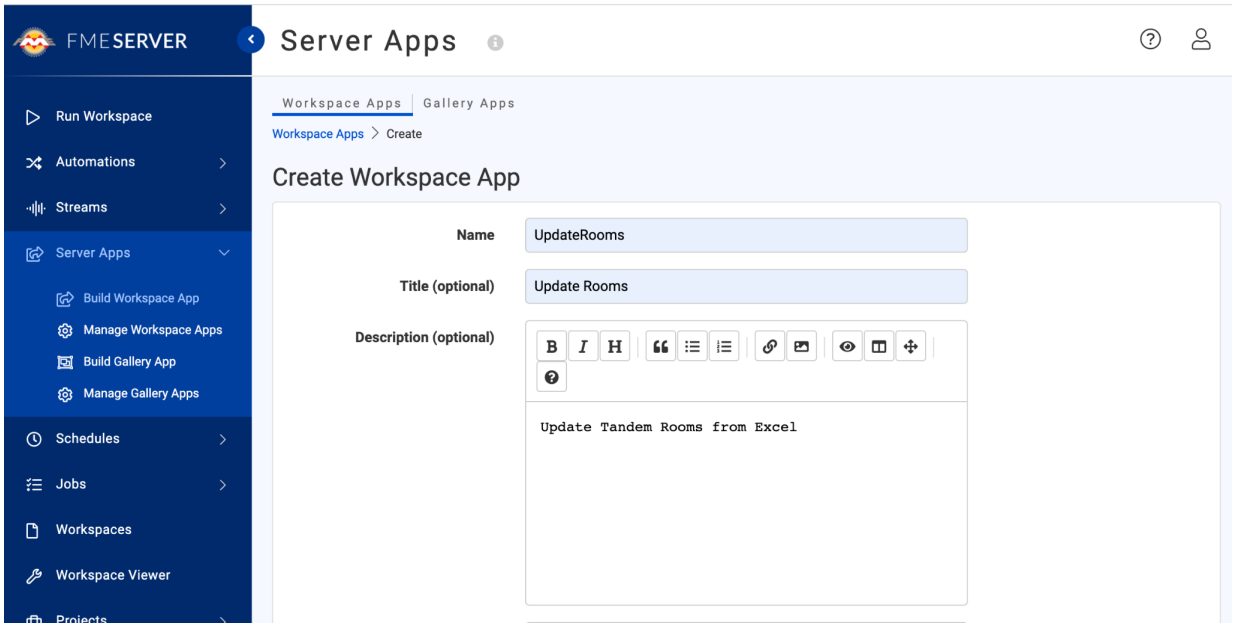


Pick the Tandem repository and navigate to the Update_Rooms workspace:

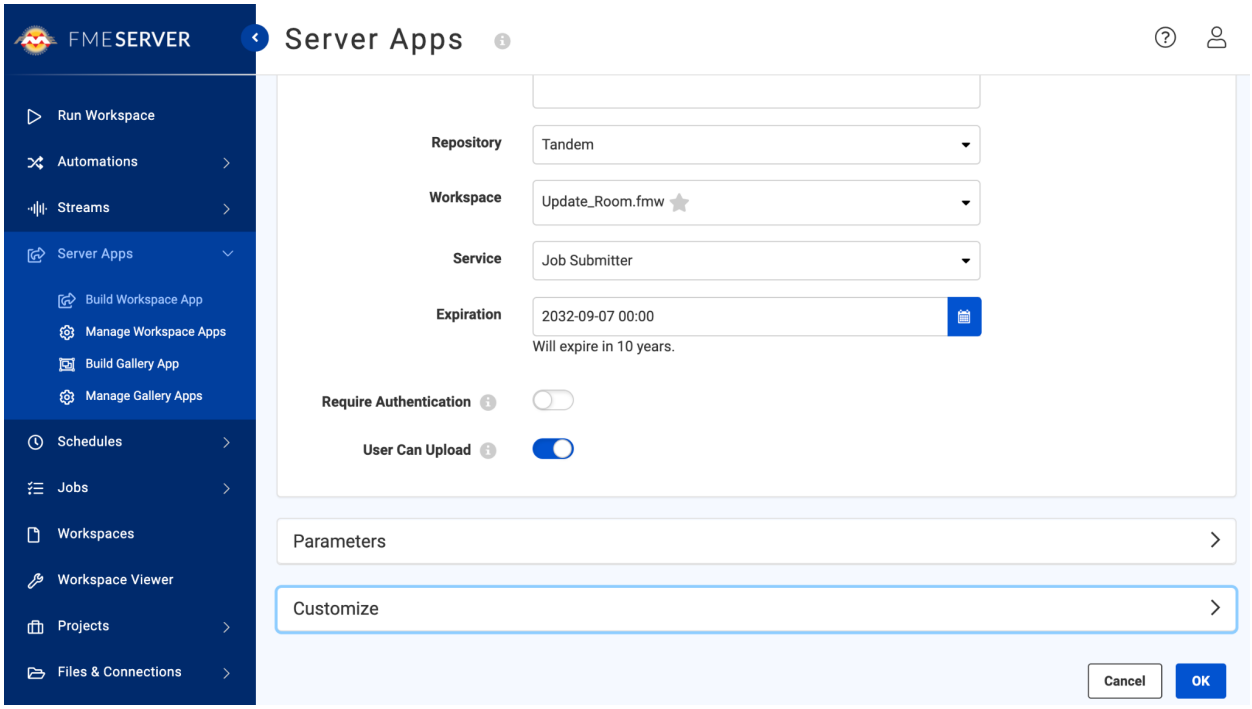


Click the Workspace Actions button, then select Create Workspace App.

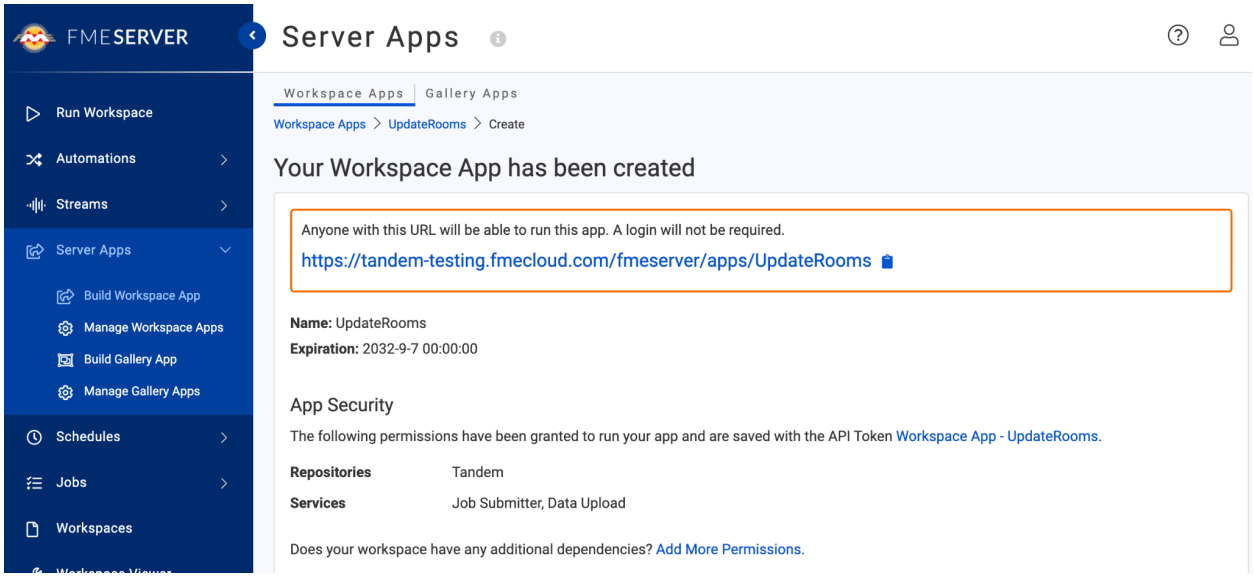
Fill in the Name, Title and Description fields:



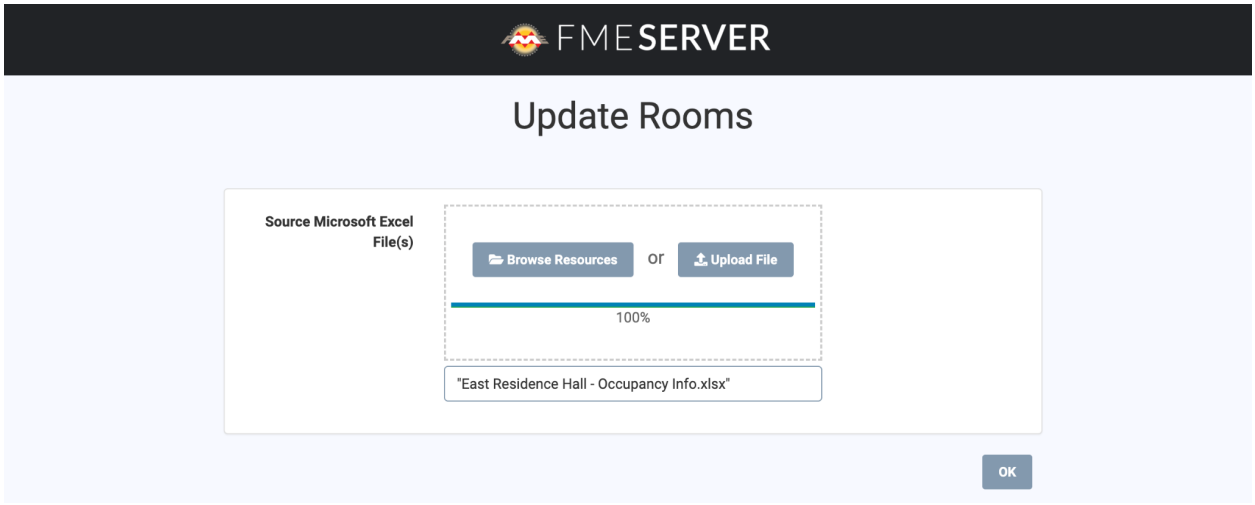
Scroll down and ensure that Require Authentication is disabled and User can Upload is enabled. This will make the Server App available to everyone in your organization.



Click the OK button to publish the App. A new screen will come up with the link to the new Server App.

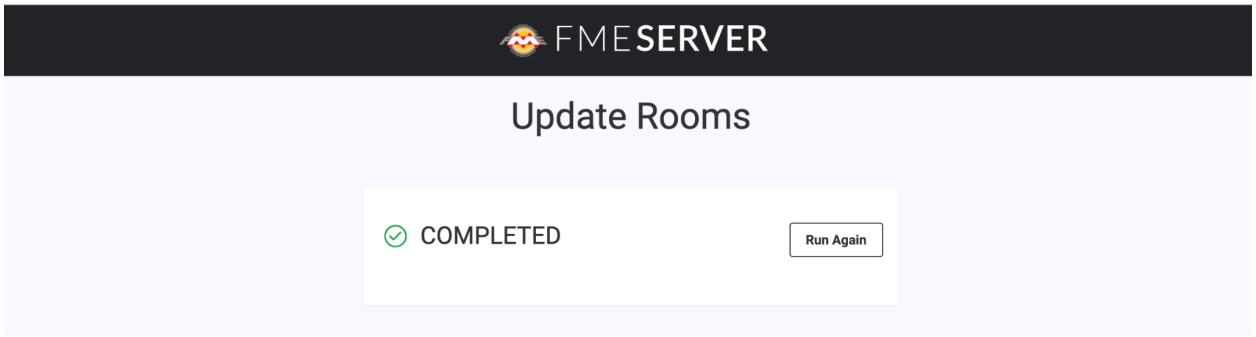


Click on the link to run the App. Drag and drop the ‘East Residence Hall - Occupancy Info.xlsx’ file onto the file upload box.



Press the OK button to run the App.

When it is finished, you will see the Completed page:



Exercise 1 Conclusion

In this exercise, we have seen how we can:

- Use an FME workspace to update the Tandem Facility from an Excel file
- Publish the workspace to FME server to allow others in your organization to update Tandem through a web interface.

Exercise 2 - Using Tandem as Part of a Live Equipment Status Dashboard

In this exercise we are going to update Equipment Status in Tandem in response to IoT notifications, then update a Power BI live dashboard from the status in Tandem, all in real-time.

This process will be implemented using the following tools

- An FME Server Automation will listen for message posted by the IoT hub
- When a message is received, the Automation will run the UpdateTandem workspace to interpret the JSON message from the IoT hub and update the appropriate Equipment in Tandem.
- Once Tandem is updated, the Automation will run the UpdatePowerBI workspace to read the status of all the Equipment in Tandem and update a PowerBI real-time streaming dataset and its dashboard.

Preparation

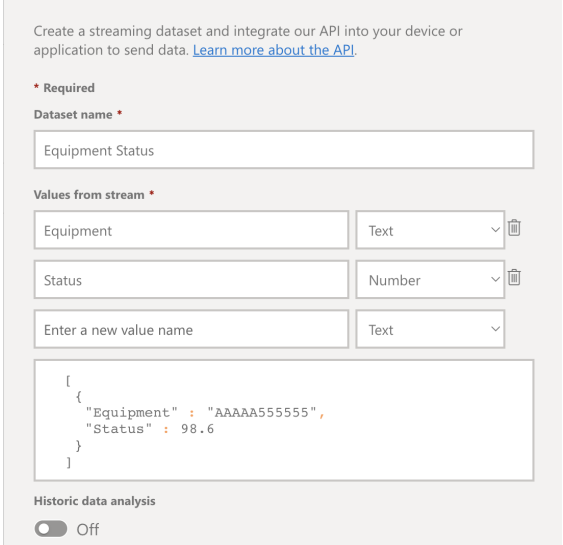
We have already prepared the Airport facility for this exercise, by setting the name and status on the Equipment.

The Airport facility is fictional, and so the sensors do not exist. Normally, the sensors would be connected to an IoT hub like IBM Watson or AWS IoT Core, which can then provide the updates by posting a JSON packet to a URL. We will be simulating this traffic using the SensorSimulator workspace run in FME Desktop.

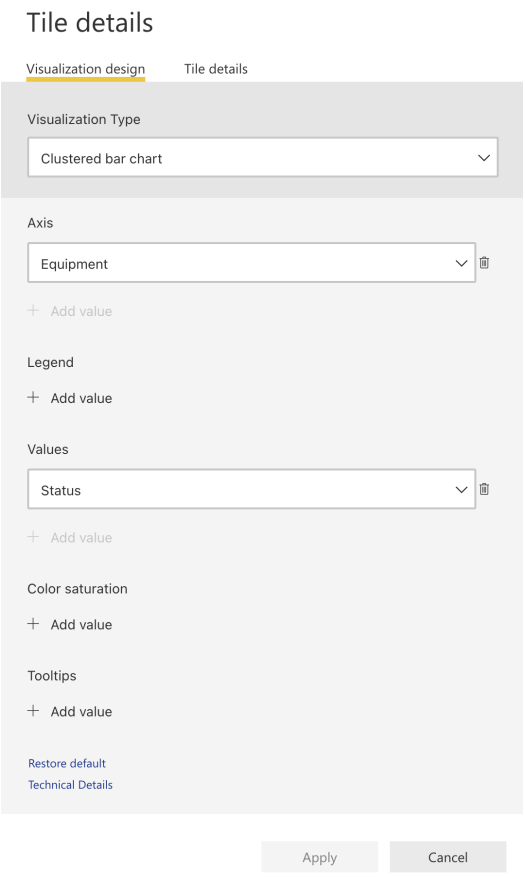
To create the Power BI dashboard, please follow the steps provided at the following link:

https://docs.microsoft.com/en-us/power-bi/connect-data/service-real-time-streaming#set-up-your-real-time-streaming-dataset-in-power-bi

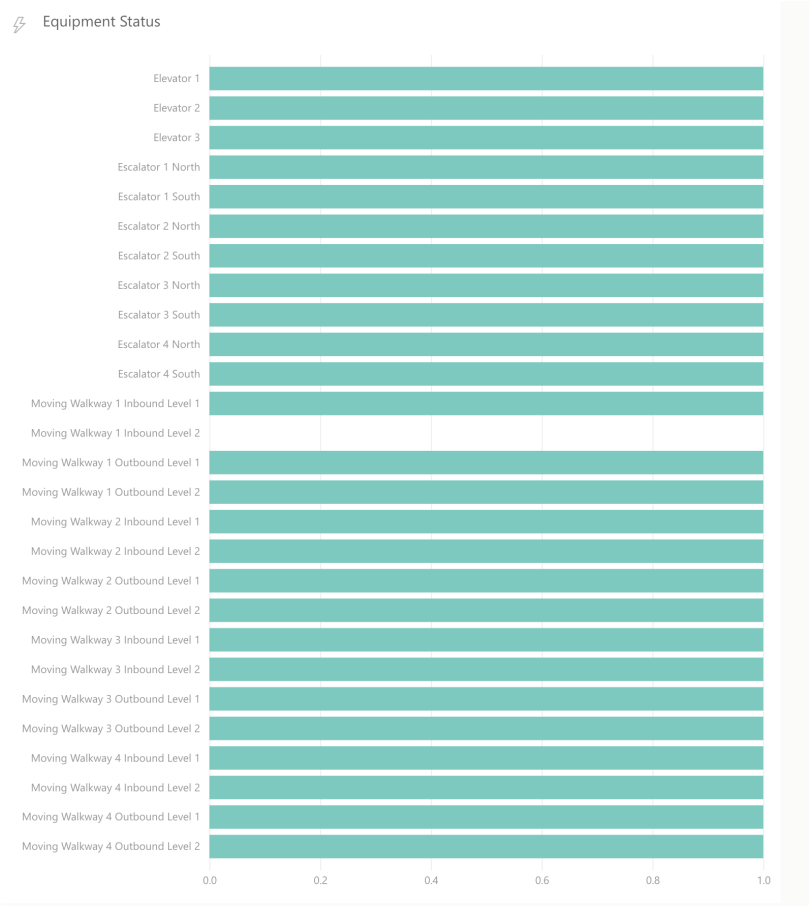
Use the following settings for the streaming dataset:



Use the following settings for the dashboard tile:



The Status will be provided as 0 or 1, giving you a simple On/Off display for the equipment:



After setting up the streaming dataset, you will be provided with a URL to post the data to. Copy and save this URL for future use.

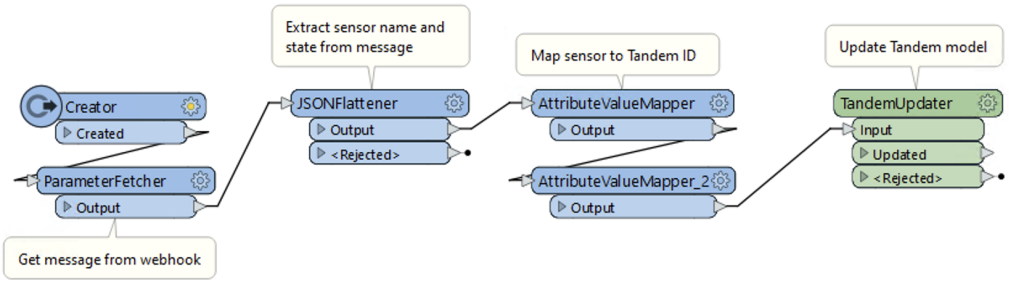
Set up FME Workspaces

The UpdateTandem and UpdatePowerBI workspaces need to be configured for your system before they can be used. To assist with this configuration, we have included the helper workspace GetEquipmentIDs.

Open GetEquipmentIDs in FME Workbench. Open the TandemFeatureExtractor properties and set Forge App information and Airport model URN. Run the workspace to create the Excel file EquipmentLookup.xlsx. This file contains a table of the Equipment Name, Sensor Name and Tandem Key. On the second sheet, it also contains a comma delimited list of all the Equipment Tandem IDs.

If the output is not complete, please check that you have named the Airport Equipment as specified on page 13.

Open UpdateTandem in FME Workbench:

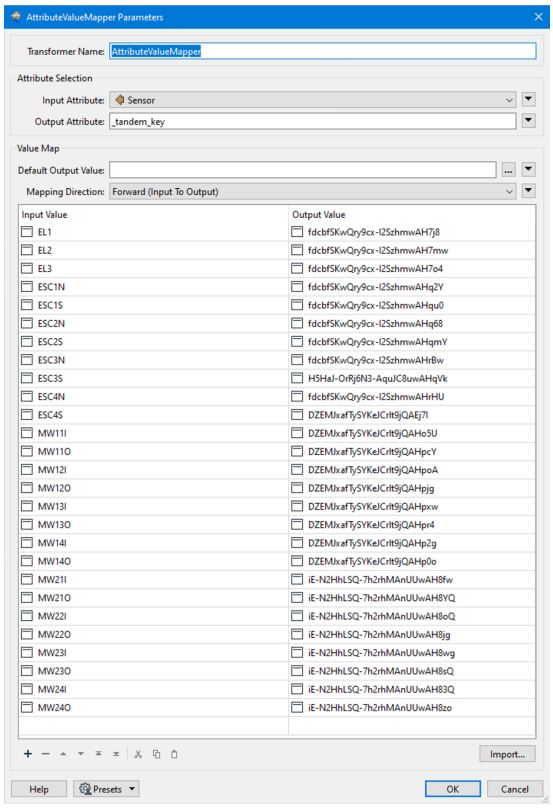


This workspace:

- uses a JSONFlattener extract the Sensor Name and Status (On/Off) from the IoT hub JSON message
- maps the sensor name to the Tandem ID of the matching Equipment in AttributeValueMapper
- maps the status to true/false in AttributeValueMapper_2
- updates the Tandem Equipment with it status in the TandemUpdater

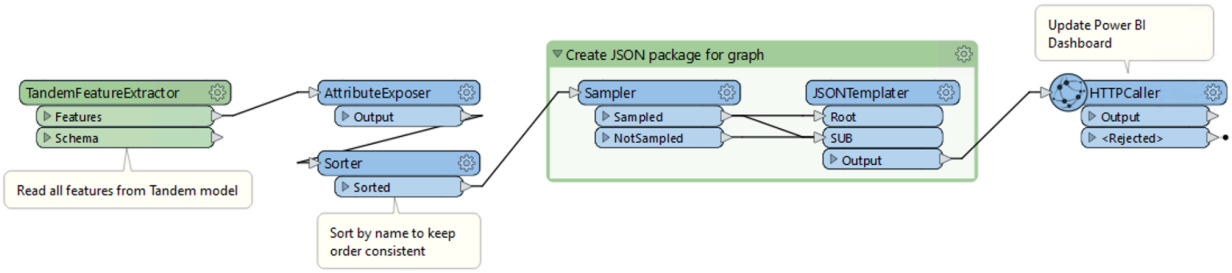
Before using this workspace, we must first set the Forge App keys and Airport model URN on the TandemUpdater.

We also need to populate the Tandem keys in the AttributeValueMapper, using the information from EquipmentLookup.xlsx:



Once you configured these transformers, save the workspace and publish it to your FME Server, in the repository Tandem, using the Job Submitter service.

Open UpdatePowerBI in FME Workbench:

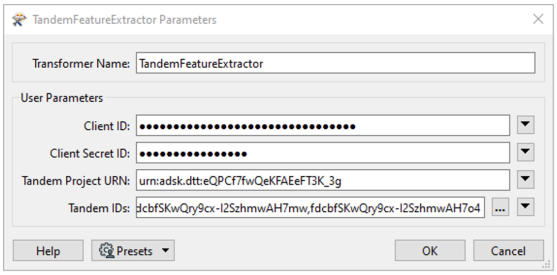


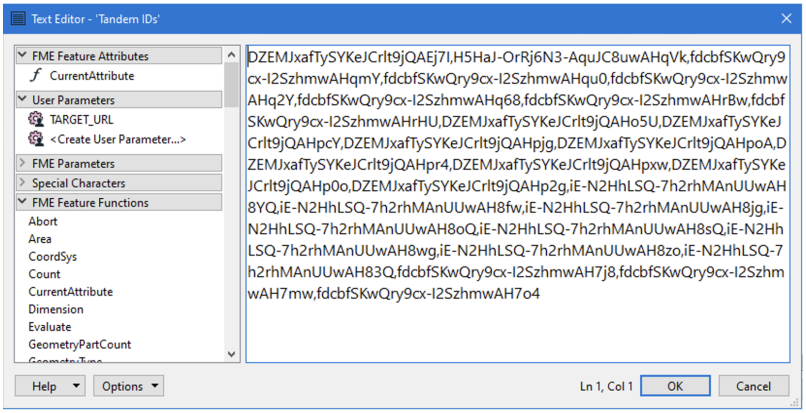
This workspace:

- Reads the properties of all the Equipment features in the Tandem model
- Sorts the features by name
- Creates a JSON package with the Equipment names and status using the JSONTemplater
- POSTs the JSON package to the PowerBI streaming dataset URL using the HTTPCaller

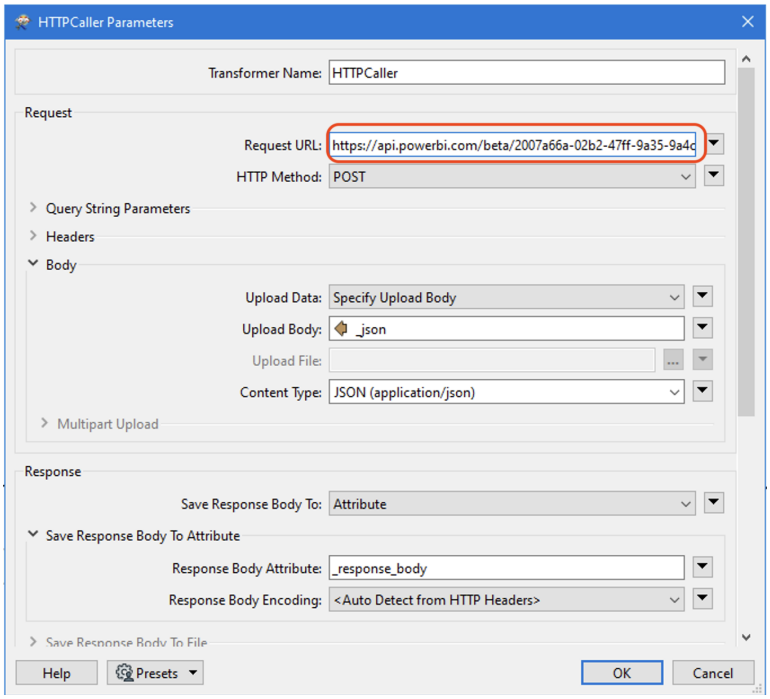
The workspace posts all the Equipment instead of just the changed one in order to keep the PowerBI ordering constant. This makes it easier to see the changing status on the dashboard.

Open the properties of the TandemFeatureExtractor, then add the Forge App keys and Airport facility URN. We also want to set the Tandem IDs, which will give us better performance by only reading a subset of the Tandem data. Sheet 2 in EquipmentLookup.xlsx contains a comma delimited list of the Equipment IDs. Copy and paste this list into the Tandem IDs box.





Open the properties of the HTTPCaller, then set the Request URL to the URL provided by the PowerBI streaming data setup:



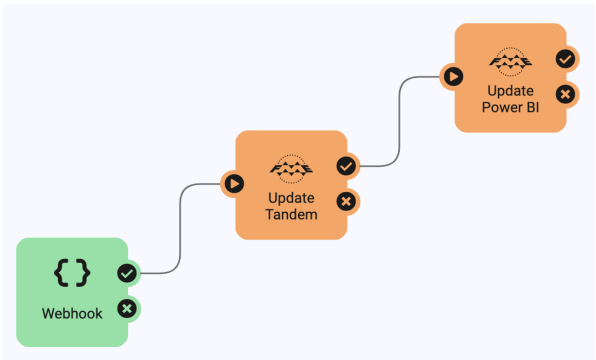
Once you configured these transformers, save the workspace and publish it to your FME Server, in the repository Tandem, using the Job Submitter service.

Create the FME Server Automation

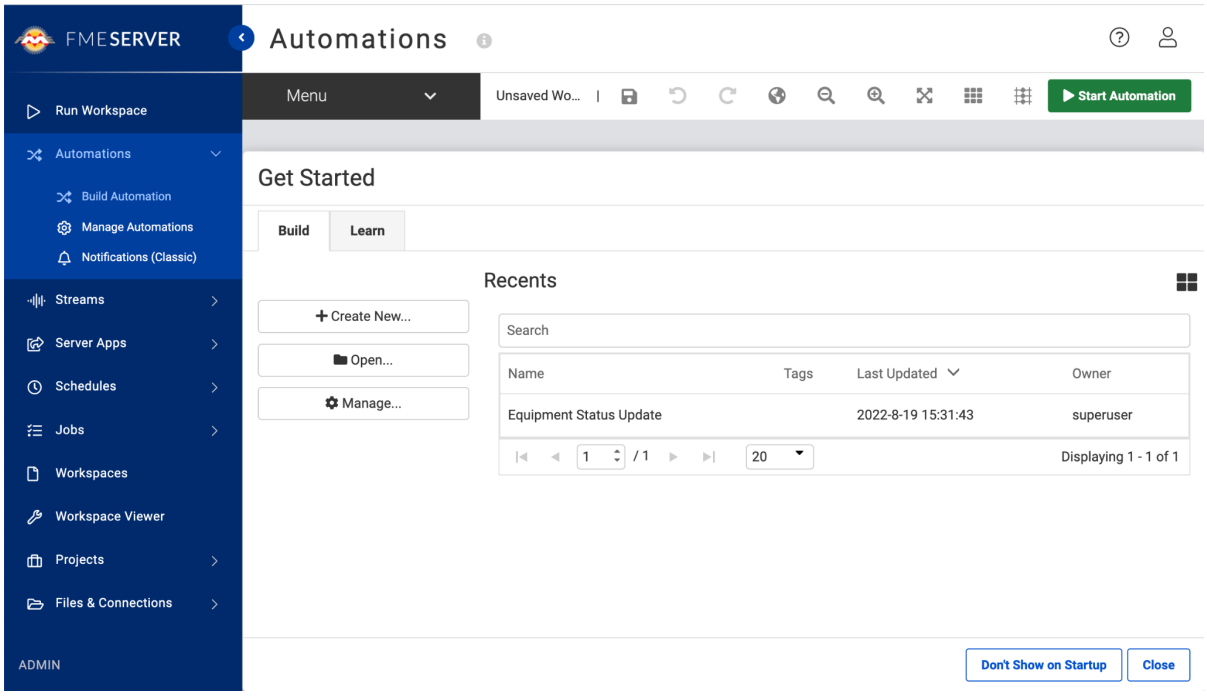
FME Server Automations allow you to create workflows that occur on a schedule, or in response to outside events. For a more in-depth explanation, please see the following page:

https://community.safe.com/s/article/getting-started-with-automations

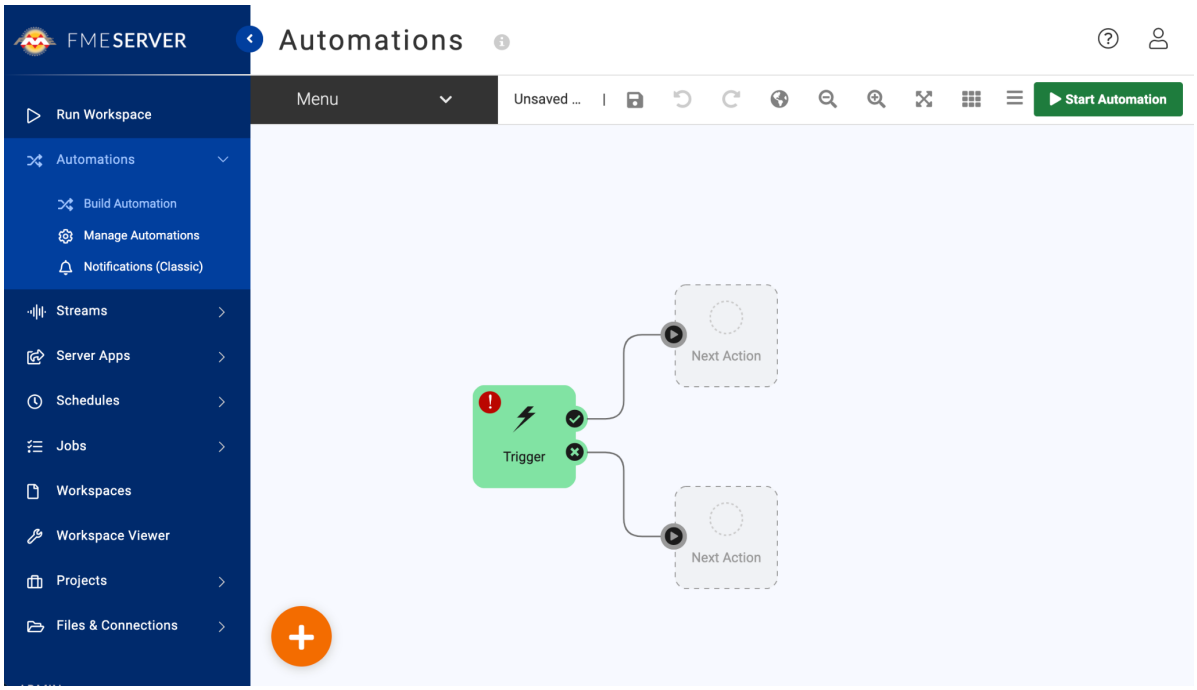
We are going to create an Automation that will respond to a POST from the IoT hub by running the UpdateTandem and UpdatePowerBI workspace in sequence.



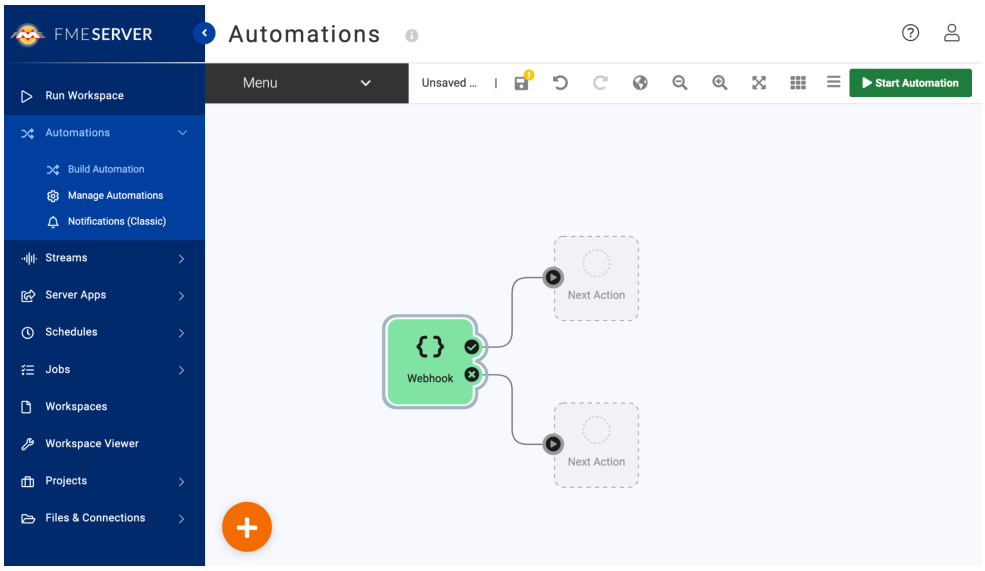
In FME Server, choose Automations - Build Automation from the side menu.



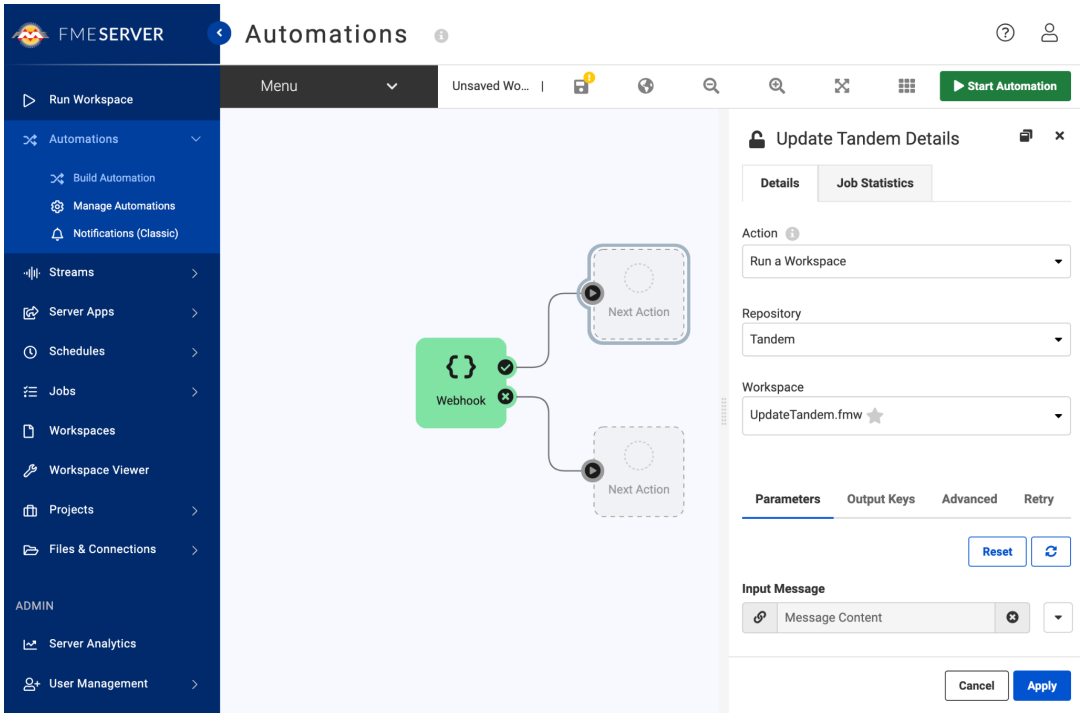
Click the Create New button to begin creating the Automation. You will find yourself in the Automation editing screen with a Trigger already placed.



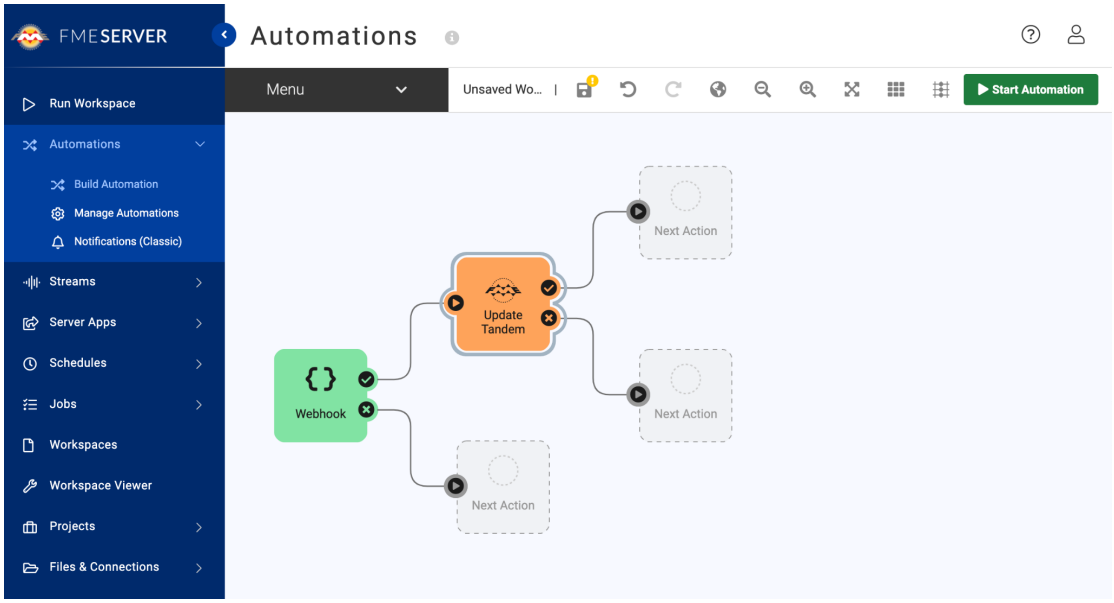
Click on the Trigger to configure it. Set the Trigger type to Webhook, then click the Apply button.



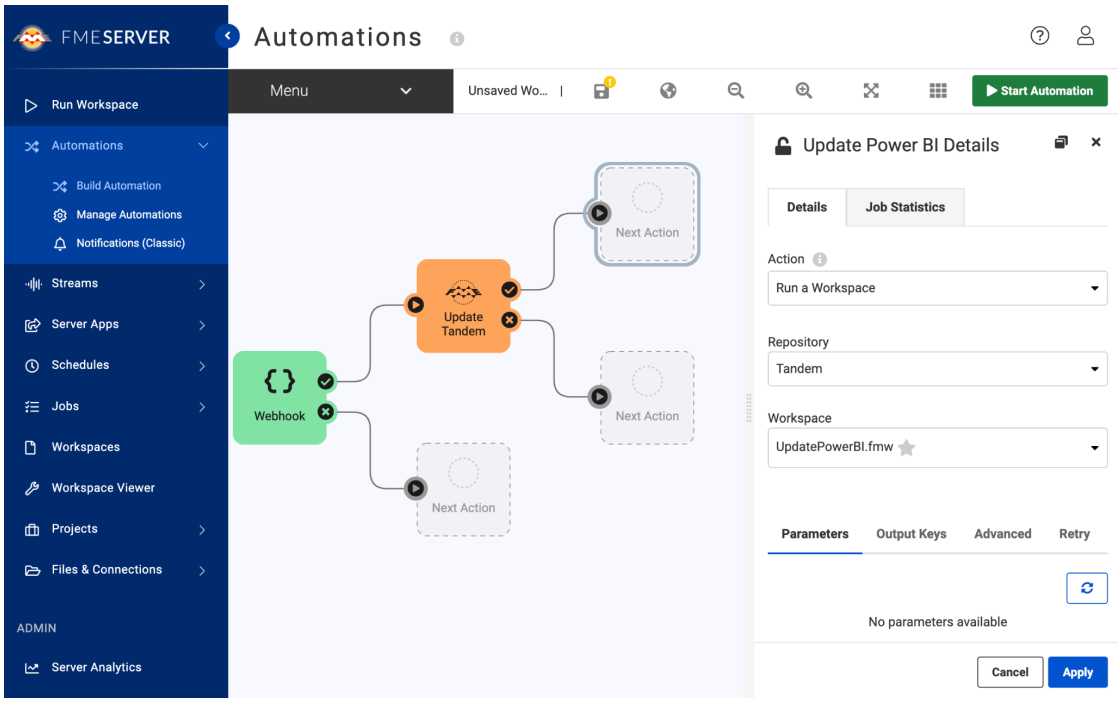
You will see that the Trigger has two outputs: a check mark for success and an X for failure. Click on the grey Next Action box on the top to set the steps to take when the Webhook is triggered. In the Select an Action dropdown, choose Run a Workspace, then pick the Tandem Repository and UpdateTandem workspace.



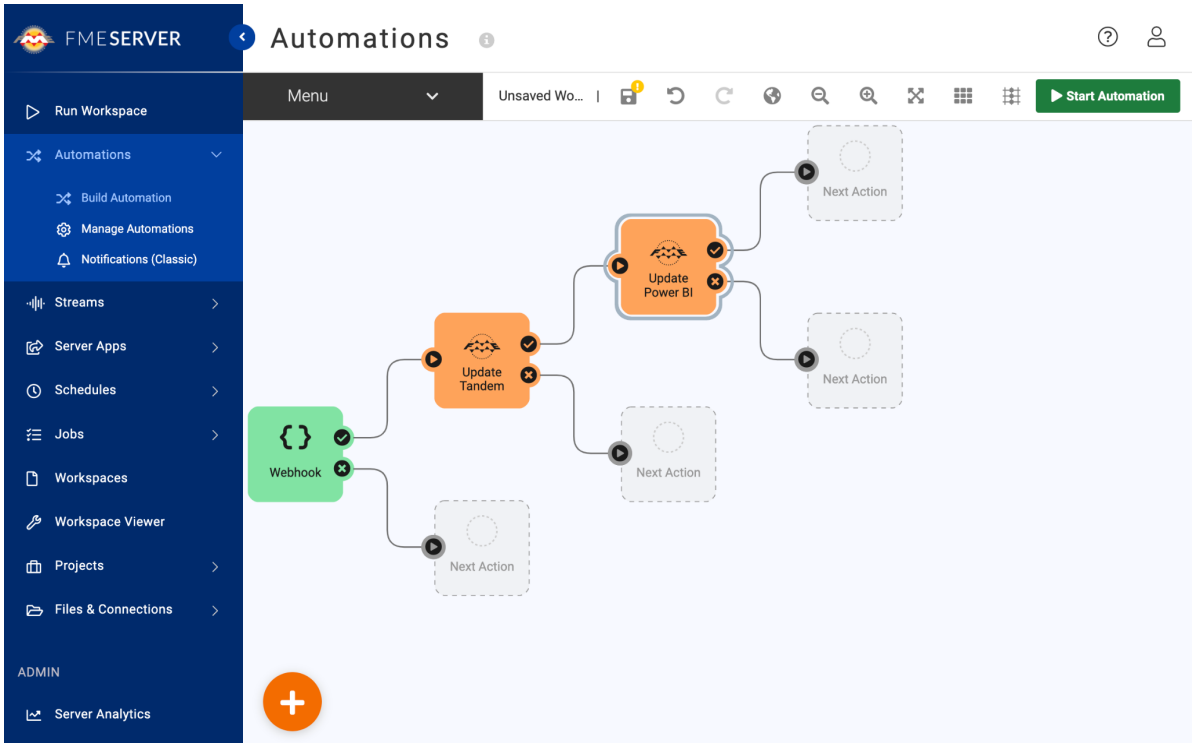
At the bottom, click the triangle button beside Input Message, then choose Webhook - Message Content. This will feed the JSON contents of the IoT POST to the workspace for interpretation. Finally, click the Apply button to apply the settings.



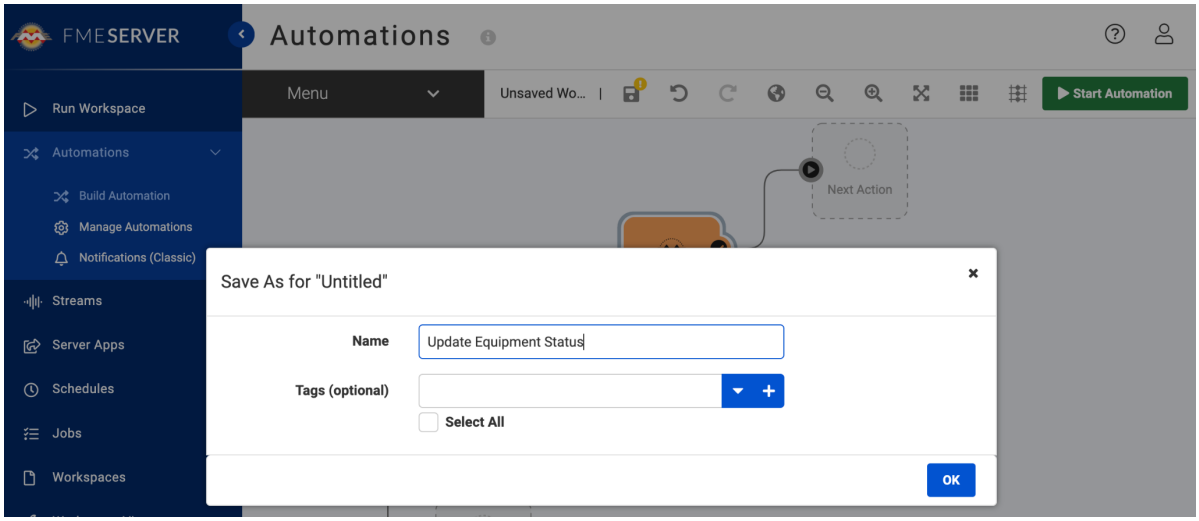
Click on the Next Action connected to Update Tandem check mark output to set up the next step. In the Select an Action dropdown, choose Run a Workspace, then pick the Tandem Repository and UpdatePowerBI workspace. Click the Apply button to save the settings.



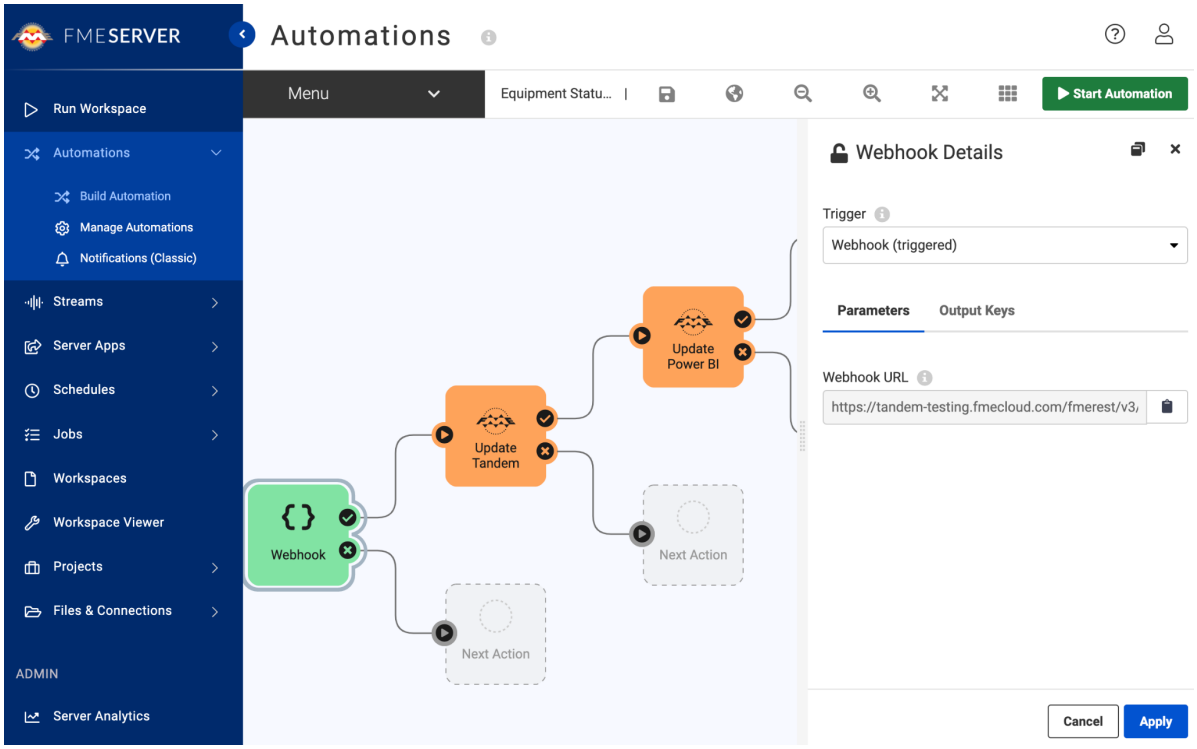
The Automation is now finished.



Click the Save icon to save and name the Automation.



After saving, open the Automation again and click on the Webhook Trigger.



The Webhook URL is generated when the Automation is saved, so now you can copy it to use in configuring the IoT hub messaging. In this case, we are simulating the IoT messages, so we will use it in the simulation workspace.

Click the Start Automation button. Active Automations should be constantly running, in order to respond to messages.

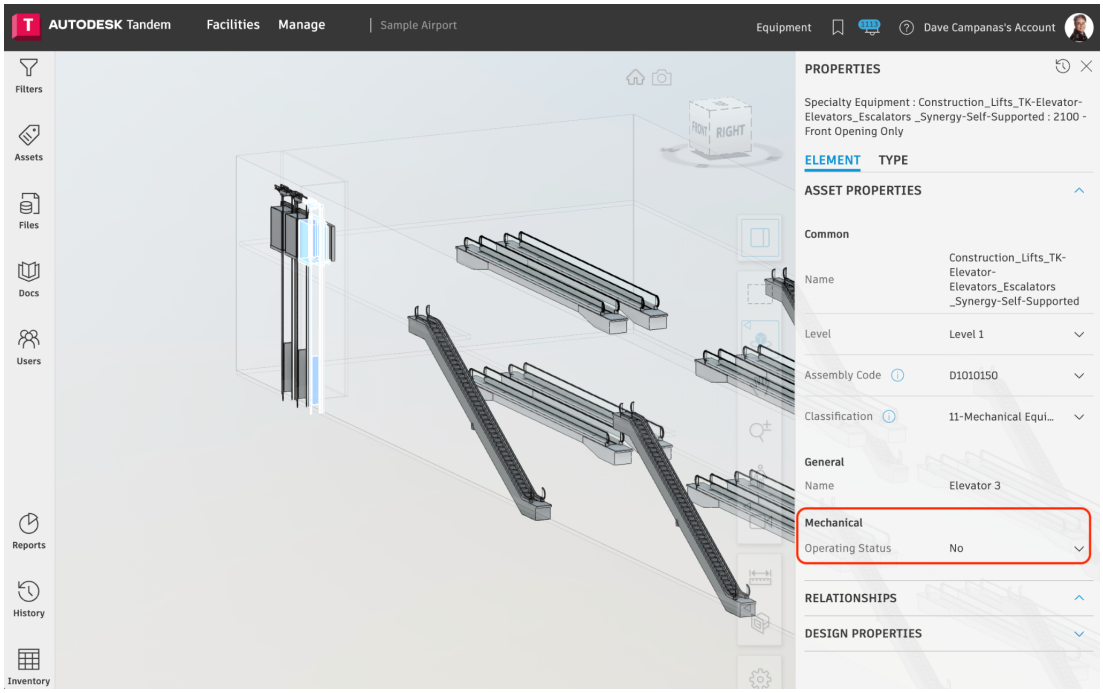
Run the Simulation

Open the workspace SensorSimulator, then edit the properties of both HTTPCallers to set the Request URL to the Webhook URL from the Automation. Save the workspace, then run it.

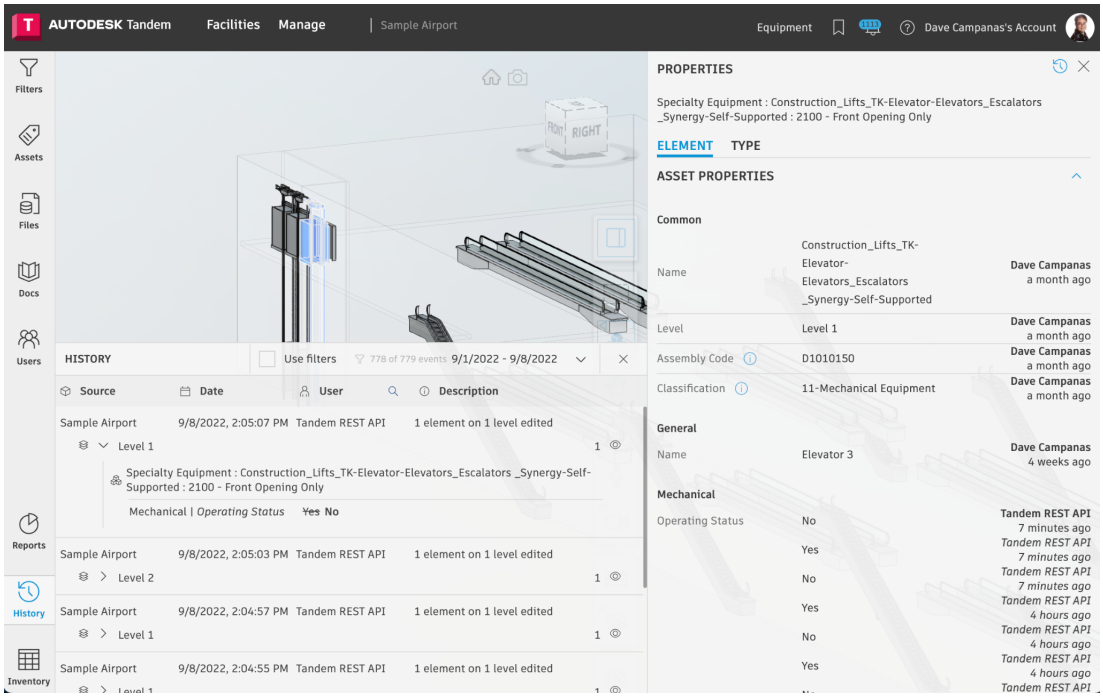
The simulator workspace will randomly pick a Sensor name every five seconds, then POST a message to the webhook setting its status to Off. A few seconds later, it will POST another message setting the same Sensor to On.

Once the workspace is running successfully, switch to Power BI and open the dashboard you created. You should see the Equipment bars disappearing and reappearing as the simulator turns them on and off again.

If you stop the simulation while a piece of Equipment is turned Off, then examine it in Tandem, you will see that it reflects the status in the dashboard.



Tandem retains a history of all changes to a model.



You can view the history of the entire model, or of just the selected feature. This history can be quite useful for analyzing the uptime of the equipment being monitored.

Exercise 2 Conclusion

In this exercise, we have seen how we can:

- Use an FME workspace to update the Tandem Facility from an IoT hub message
- Use an FME workspace to update a Power BI live stream from Tandem
- Use an FME Server Automation to monitor IoT messages and run the workspaces to update both Tandem and Power BI
- View the update history in Tandem

Final Words

I hope these exercises have given you a good idea of what can be done using Tandem and its REST API through FME Desktop and FME Server.

For any questions about this presentation, please contact me

- dave.campanas@safe.com

For more information on FME, or a free trial of FME Desktop or Server

- www.safe.com

For assistance using FME

- community.safe.com

For more information on Tandem

- help.autodesk.com/view/TANDEM/ENU/

Tandem REST API documentation

- https://autodesk-tandem.github.io/