Industry Customer Intelligence Solutions
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Asset Analytics for Manufacturing Equipment in Automotive Solution Guide

Note
Before using this information and the product it supports, read the information in "Notices" on page 45.

Product Information

This document applies to IBM Asset Analytics for Manufacturing Equipment in Automotive Version 1.0 and may also apply to subsequent releases.

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Introduction

The IBM Asset Analytics for Manufacturing Equipment in Automotive solution delivers information and insights into the functioning of robotic equipment in the automotive industry. Dashboards provide maintenance operators with visualizations that indicate the status of equipment and provide predictions about when equipment will fail.

Audience

This guide is intended for administrators and users of the Asset Analytics for Manufacturing Equipment in Automotive solution. It provides information on installation, configuration, and use of the Asset Analytics for Manufacturing Equipment in Automotive solution.

Finding information

To find product documentation on the web, including all translated documentation, access IBM® Knowledge Center (http://www.ibm.com/support/knowledgecenter).

Accessibility features

Accessibility features help users who have a physical disability, such as restricted mobility or limited vision, to use information technology products. Some of the components included in the Asset Analytics for Manufacturing Equipment in Automotive have accessibility features. For more information, see Appendix A, "Accessibility features," on page 35.

Asset Analytics for Manufacturing Equipment in Automotive HTML documentation has accessibility features. PDF documents are supplemental and, as such, include no added accessibility features.

Forward-looking statements

This documentation describes the current functionality of the product. References to items that are not currently available may be included. No implication of any future availability should be inferred. Any such references are not a commitment, promise, or legal obligation to deliver any material, code, or functionality. The development, release, and timing of features or functionality remain at the sole discretion of IBM.

Samples disclaimer

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Chapter 1. Overview

The IBM Asset Analytics for Manufacturing Equipment in Automotive solution works with IBM Predictive Maintenance and Quality. It is designed to help the automotive industry enhance robotic equipment productivity, especially in critical manufacturing functions such as power train, body and weld, paint shop, and final assembly.

Important: Before you install the solution, IBM Predictive Maintenance and Quality 2.5.1 must be installed on your system.

The solution is designed to improve process efficiency, increase asset productivity, manage asset and quality risks, and reduce warranty or scrap cost. It helps companies in the automotive industry to improve operations in the following ways:

- Enhance manufacturing productivity by using predictive analytics to maximize robotic equipment uptime.
- Minimize the cost of maintenance of robotic equipment by adopting predictive maintenance.
- Improve the quality of the manufactured product, which minimizes warranty service and scrap losses.

What need does the solution address?

Automotive manufacturing operations currently involve the use of robotic equipment on the shop floor to provide high precision and high yield work. This equipment is used especially for power train, body and weld, paint shop, and final assembly (transfer cells). Significant costs are associated with production continuity, manufactured product quality, and resource allocation. Although existing tools allow for sensor data collection for robotic equipment, these tools are limited to the tracking of current performance and drilling down on current failure. The unexpected failure of equipment results in significant losses due to lost productivity and scrap.

What does the solution provide?

IBM Asset Analytics for Manufacturing Equipment in Automotive provides prepackaged support for industry use cases that involve robotic assets. It includes predictive models for asset failure analysis, key performance indicators (KPIs) for asset performance, an asset health indicator, a system health indicator, and actionable inferences for reducing risk, losses, and downtime. The solution provides a stack that includes data integration services and business analytics software, providing insights and actionable recommendations in real time.

The solution provides the following features:

- Visualizations to provide insight into manufacturing quality and the risk of failure for robotic equipment
- Specialized predictive analytical models for robotic equipment and its operation
- Dashboards to provide insights to people in a maintenance role
- Easy integration and common deployment with IBM® Predictive Maintenance and Quality

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- Access to IBM® Predictive Maintenance and Quality tools for model, dashboard, report customization, and EAM work order creation and customization

How is the solution used by an organization?

The solution can be used by maintenance or operations organizations in the automotive industry to do the following things:

- Gain situational awareness of robotic equipment
- Establish a risk ranking
- Predict when equipment will either fail or reach a level of poor performance that will lead to unacceptable manufactured product quality
- Abililty to automatically trigger and generate maintenance recommendations

Chapter 2. Installation and configuration

The Asset Analytics for Manufacturing Equipment in Automotive solution is for use with IBM Predictive Maintenance and Quality.

An installation (servers and content) of IBM Predictive Maintenance and Quality 2.5.1 must be complete before the solution is installed.

Planning the installation and configuration of the solution

Prepare a deployment plan to specify which part of the solution is to be deployed and on which computer node. You must ensure that no application is listening on the ports that are used during the installation of the solution.

Note: Ensure that the system ports that will be used by this solution are not used by any other application.

Prerequisites

Before you install the Asset Analytics for Manufacturing Equipment in Automotive solution, there are prerequisites that must be met.

The following conditions must be met before the solution can be installed:

- You understand your existing environment so that you can determine where you want the various components of the application to reside.
- You have a Red Hat Enterprise Linux operating system that you can install to. The Solution Installer works only on that version of Linux.
- You have administration rights and the ability to copy files between computers.
- IBM Predictive Maintenance and Quality 2.5.1 is installed and configured.

Downloading the solution

You must download the Asset Analytics for Manufacturing Equipment in Automotive solution from IBM Passport Advantage.

Before you begin

You must have a Passport Advantage account and be entitled to the package.

About this task

Passport Advantage contains package repositories. Instead of downloading the package from Passport Advantage and creating a repository locally, you access the repository on Passport Advantage.

Procedure

1. Set the Passport Advantage preference to connect to Passport Advantage.
2. Download the tar.gz file.
3. Move the tar file to the Linux node from which you want to run the installation.
4. Uncompress the tar file.

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Contents of the download package

The Asset Analytics for Manufacturing Equipment in Automotive solution package, which you download from Passport Advantage, contains several parts.

The following parts are included in the package:

- Analytics node artifacts: The IBM SPSS content is provided in a .pes file that you import into the IBM SPSS Collaboration and Deployment Services Content Repository. It consists of a training model and job, and a scoring model and job, and the decision management rules stream.
- Data node artifacts: SQL files for creating the production data table in the IBMPMQ database and for importing data for those tables.
- Business Intelligence (BI) node artifacts: IBM COGNOS BI dashboards, images that are used in the dashboards, a map specification, and the Framework Manager model.
- ESB node artifacts: IBM Integration Bus solution bar files for custom flows to onboard data and trigger the analytics training and scoring jobs. Also included are WebSphere MQ scripts, properties, and XML files that are required by the custom flows and for IBM Predictive Maintenance and Quality core components.

Modifying the sudoers file for the user who runs the installation

To run the Asset Analytics for Manufacturing Equipment in Automotive installation, you must be either **root** user or have **sudo** permission on each node computer, and you must disable `requiretty` during the installation.

To install with **sudo** user permissions, you must also add the user to the `sudoers` file.

Procedure

1. Log in as **root** user.
2. Enter the following command to open the `sudoers` file for editing:
   ```
   visudo -f /etc/sudoers
   ```
3. Locate the following line:
   ```
   Defaults requiretty
   ```
4. Press the I key to insert text.
5. Type a number sign (#) in front of `Defaults requiretty` to comment out the line. For example, the line will appears as `#Defaults requiretty`
6. If you run the installer as a user with **sudo** user permissions, go to the end of the file, and add the following line for your user:
   ```
   username ALL=(ALL) NOPASSWD: ALL
   ```
7. Press the Esc key, and enter `:wq` to save and close the file.
8. Repeat these steps on each computer on which you install a Asset Analytics for Manufacturing Equipment in Automotive node.

Computer firewall settings required for the installation

The solution installer requires bidirectional communication with each node when you install a server component or server artifact component, and your firewall can interfere with this communication.

To ensure bidirectional communication, you must configure your firewall settings for the installation. Alternatively, you can temporarily disable your firewall during the installation.

A script is provided to open all necessary ports on the installation node. You can either use the `firewall.sh` script, open the ports manually, or disable the firewall settings.

In addition to opening ports on the installation node computer, you must open some ports on each computer to which content from the solution will be copied.

Configuring your firewall settings on the installation node computer by using the Firewall script

You can run the firewall.sh script to open the ports on the installation node.

About this task

The firewall.sh script opens the following ports on the solution installer node:

- 8080 incoming
- 443 incoming
- 9683 incoming
- 22 outgoing

Procedure

1. As the root user or as a user with sudo permissions, log on to the computer that contains the solution installer node.
2. Back up your existing firewall settings by typing the following command: `/etc/init.d/iptables save`.
3. Run the firewall.sh script.

Manually configuring firewall settings on the installation node

If you prefer not to disable your firewall settings or use the firewall.sh script, you can manually configure your firewall settings on the installation node.

Procedure

1. As the root user or as a user with sudo permissions, log on to the computer that contains the solution installer node .
2. Back up your existing firewall settings by typing the following command: . `/etc/init.d/iptables save`
3. On the computer that contains the solution installer node, add rules for the ports that are required by the installer by typing the following commands:

```
iptables -I INPUT -p tcp --dport 8080 -j ACCEPT
iptables -I OUTPUT -p tcp --sport 8080 -m state --state
RELATED,ESTABLISHED -j ACCEPT

iptables -I INPUT -p tcp --dport 443 -j ACCEPT
iptables -I OUTPUT -p tcp --sport 443 -m state --state
RELATED,ESTABLISHED -j ACCEPT

iptables -I INPUT -p tcp --dport 9683 -j ACCEPT
iptables -I OUTPUT -p tcp --sport 9683 -m state --state
RELATED,ESTABLISHED -j ACCEPT

iptables -I OUTPUT -p tcp --dport 22 -j ACCEPT
iptables -I INPUT -p tcp --sport 22 -m state --state
RELATED,ESTABLISHED -j ACCEPT
```

Configuring firewall settings on other computers that will contain content from the solution

On all node computers to which content from the solution will be copied, the ports 443, 9683, and 8080 must be opened for the installation process.

Procedure

1. On each of the computers to which content for the solution will be copied, add rules for the ports that are required by the installer by typing the following commands:

```
iptables -I OUTPUT -p tcp --dport 443 -j ACCEPT
iptables -I INPUT -p tcp --sport 443 -m state --state RELATED,ESTABLISHED -j ACCEPT

iptables -I OUTPUT -p tcp --dport 9683 -j ACCEPT
iptables -I INPUT -p tcp --sport 9683 -m state --state RELATED,ESTABLISHED -j ACCEPT

iptables -I OUTPUT -p tcp --dport 8080 -j ACCEPT
iptables -I INPUT -p tcp --sport 8080 -m state --state RELATED,ESTABLISHED -j ACCEPT
```

2. Type the following command to save your firewall settings:

```
/etc/init.d/iptables save
```

3. Type the following command to restart your firewall:

```
/etc/init.d/iptables restart
```

4. Verify that your changes are applied by using the following command:

```
iptables -L
```

   The added port appears in the list.

5. Repeat these steps on each computer on which you will install an IBM Asset Analytics for Manufacturing Equipment in Automotive node.

Disabling firewall settings during installation (optional)

If you choose to temporarily disable your computer's firewall during the installation of the IBM Asset Analytics for Manufacturing Equipment in Automotive solution, ensure that you enable the firewall on each node after the installation is complete.

About this task

Important: If you disable your computer's firewall during the installation, you must still ensure that the required ports are opened on each node computer when you restart your firewall.

Procedure

1. Log on to the computer as the root user or as a user with sudo permissions.
2. Type the following command:

```
/etc/init.d/iptables stop

/etc/init.d/iptables save
```

3. Repeat these steps on each computer on which you install a node and on the server from which you are running the installation.

What to do next

After the installation is complete, on each node, type `/etc/init.d/iptables start` to restart your firewall.

Deploying the installation files on the nodes

You use the Solution Installer to deploy the installation files to the appropriate nodes.

Before you begin

Ensure that you know the following information for each of the nodes in your solution:

- Host name or IP address
- Password of the **root** user ID or a user ID and password that has **sudo** permissions

About this task

In this task, you create an installation configuration of your solution by dragging nodes onto a canvas, adding components to the nodes, and defining properties for the components.

Procedure

1. Log on to the computer where you downloaded the solution package.
2. Decompress the solution package.
3. Go to the solution installer directory. For example:
   `/<...>/CN82XEN/SolutionInstaller/`
4. Enter the following command:
   `./firewall.sh`

   The ports that are used to transfer files to the nodes are opened on the server.
5. Enter the following command:
   `./setup.sh` *`username first name last name email`*

   The web server is started and the URL for the Solution Installer is displayed in the command line.
6. Start the Solution Installer by pasting the URL into a web browser.
   https://<Hostname>:8080/UI/index.html
7. Read the license agreement and click **Accept**.
8. Click **New Configuration** and then click **OK**.
9. Define the Business Intelligence node:
   a. Under **Mandatory Content List**, drag a **Node** onto the canvas.
   b. Under **Property Editor**, enter values for the Business Intelligence node.
   c. Drag **Cognos BI Content** onto the node. Do not change the values under **Property Editor**.
   d. Drag **Cognos BI Report Images** onto **Cognos BI Content**. Do not change the values under **Property Editor**.
   e. Define the **DBNode** and drag **Database Content** onto **DBNode**. Do not change the values under **Property Editor**.
10. Define the IBM Integration Bus node:
    a. Under **Mandatory Content List**, drag a **Node** onto the canvas.
    b. Under **Property Editor**, enter values for the IBM Integration Bus node.

c. Drag **IBM Integration Bus Content** onto the node. Do not change the values under **Property Editor**.

Installing the database node artifact

The `IBMPMQ_additional.sql` file is an additional DDL to be run on top of the PMQ Data Model DDL. It is to be executed on the **Database** node IBMPMQ.

Installing the ESB node artifact

You must move the properties, orchestration, and solution definition files to the appropriate directories on your IBM Integration Bus node computer.

Procedure

1. Log in to the Integration Bus node computer as the `mqm` user.

   The user must be the mqm user or a member of the mqm group. If you copy the files as another user, they might not be processed by the Integration Bus node components.
2. Go to the directory where you installed the solution content files.

   The default path where the files are deployed is `/opt/IBM/IS_ManEquipAuto_AssetAnalytics_1.0/` .
3. Copy the `PMQ_solution_definition.xml` files from the Scripts directory (`/opt/IBM/IS_ManEquipAuto_AssetAnalytics_1.0/Scripts`) to the `/var/mqsi/shared-classes` directory.
4. Copy the `PMQ_orchestration_definition_batch.xml` file from the Scripts directory (`/opt/IBM/IS_ManEquipAuto_AssetAnalytics_1.0/Scripts`) to the `/var/PMQ/MQSIFileInput/properties` directory on the IBM Integration Bus node.
5. Copy the `PMQ_orchestration_definition_mea.xml` file from the Scripts directory (`/opt/IBM/IS_ManEquipAuto_AssetAnalytics_1.0/Scripts`) to the `/var/mqsi/shared-classes/orchestrations` directory on the IBM Integration Bus Node.

Updating the orchestration files

You must update the orchestration files to include the server name and port number for your IBM SPSS Collaboration and Deployment Services server that is running on your IBM Predictive Maintenance and Quality Analytics node.

Procedure

1. On the Integration Bus node computer, go to the `/var/PMQ/MQSIFileInput/properties`, and open the `PMQ_orchestration_definition_batch.xml` file in a text editor.
2. To configure and schedule the SPSS training Job invocation, in the <MEATraining> identifier section, In the <webservice> section, change the <url> value to the server name and port number for your IBM SPSS Collaboration and Deployment Services server.
3. In the MEA identifier section, do the following steps for configuring the SPSS analytics Job invocation:
   a. In the <webservice> section, change the <url> value to the server name and port number for your IBM SPSS Collaboration and Deployment Services server.

b. In the <scheduler> section, Update the scheduled_time and duration_in_days.

4. Save and close the file.

Creating queues

Procedure

1. Copy the IBMPMQ_Queues.mqsc file from the Scripts directory to /var/PMQ/MQSIFileInput/properties and Navigate to the IBMPMQ_Queues.mqsc location.
2. Type runmqsc pmqmanager, and press **Enter**.
3. Copy and paste the content of IBMPMQ_Queues.mqsc

Deploying BAR files

Bar files must be deployed to the broker **pmqbroker** with the execution group **pmqgroup1**.

Procedure

1. Log on to the Integration Bus node computer as the **mqm** user.
2. Navigate to the /opt/IBM/IS_ManEquipAuto_AssetAnalytics_1.0/BAR/ directory.
3. Enter the following command for PMQEventDataLoad.bar:

   ```
   mqsideploy pmqbroker –e pmqgroup1 –a PMQEventDataLoad.bar
   ```

4. Enter the following command for MEAIntegration.bar:

   ```
   mqsideploy pmqbroker –e pmqgroup1 –a MEAIntegration.bar
   ```

Source code files

The MEAIntegration_PI.zip file and PMQEventDataLoad_PI.zip file provide the source code for the IBM Integration Bus flow and code.

Note: All of the activities on the ESB node must be done using the **mqm** id. You must restart the **pmqbroker** service after you complete the activities.

Procedure

1. Copy both the MEAIntegration_PI.zip and PMQEventDataLoad_PI.zip files from the /opt/IBM/IS_MandEquipAuto_AssetAnalytics_1.0/Source directory.
2. Place the source files on the IIB node at /var/PMQ/MQSIFileInput/PMQSource.
3. Restart the **pmqbroker** service.

Deployment and Configuration of the SPSS Analytics Node

To prepare SPSS Collaboration and Deployment Services, you must set up links between the data in the database and the data used in the enterprise and in the application.

Before you begin

Ensure that following things are in place before importing content:

- IBM SPSS Collaboration and Deployment Services Deployment Manager is installed on any client (windows) computer.
- Copy the IS_MEA_CDS.pes file from the location where you deployed the solution on the Analytics node computer to the computer where IBM SPSS Collaboration

and Deployment Services Deployment Manager is installed. The default installation directory for this file is `/opt/IBM/xxxx/Analytics/`. (Where xxxx is the installation directory provided at the time of installation)

`/<...>/CN82XEN/SolutionInstaller/NodeRoot/Downloads/IS_ManEquipAuto_AssetAnalytics_1.0/Analytics`

- You know the admin credentials for the Predictive Analytics node, IBM DB2, and IBM SPSS Collaboration and Deployment Services.
- An ODBC Connection for the PMQ database is created in the name of IBMPMQ in the Analytics node. If not then complete the following steps:

1. Right-click **Data Sources**, and click **New** > **Data Source Definition**.
2. In the **Name** box, enter `IBMPMQ`.
3. In the **Type** box, select **ODBC Data Source**.
4. Click **Next**.
5. In the **DSN** box, enter `IBMPMQ`.
6. Click **Finish**.

Note: An ODBC Connection for the PMQ database is created in the name of IBMPMQ in the Analytics node. This step is done by the content installer of PMQ. If there are issues related to ODBC connectivity, see the information on IBM SPSS Modeler - ODBC Configuration Best Practices and Troubleshooting in the IBM DeveloperWorks article: http://www.ibm.com/developerworks/library/ba-pp-spss-page660/

Procedure

1. Start Deployment Manager.
2. Click **File** > **New** > **Content Server Connection**.
3. In the Connection Name field, enter a name that identifies the Predictive Analytics node.
4. In the Server URL field, enter `http://<analytics_node_IP>:<9080>/` and click **Finish**.
5. Right-click **Content Repository**, and click **Import**.
6. Browse to and select the `IS_MEA_CDS.pes` file.
7. Click **Open**.
8. Accept the default options in the Import window, and click **OK**. The `Auto_Manufacturing_AA` folder, two jobs in the `Jobs` folder, and two streams in the `Modeler Streams` folder are created.
   - Update the credential information for the Admin, db user (db2inst1), and root users so that the job and streams run successfully.
   - In the Content Explorer tab, under Resource Definitions, open the Credentials folder.
   - Update the Admin user with the credentials for the SPSS Collaboration and Deployment Services user that has access to the content repository and runs the job.
   - Update the db user (db2inst1) with the credentials for the user that has access to the IBM DB2 database.
   - Update the root user with the credentials for the user that has access to the Modeler Server.
9. Open the job in the `Jobs` folder and ensure that the user credentials match the credentials of the IBM DB2 instance on the **ODBC** tab.

10. There are two jobs that need to be executed. The Training Job creates the predictive models to be used by the Scoring Job. Therefore, the training job must be executed first.

Onboard equipment data

Custom flows are provided with the Asset Analytics for Manufacturing Equipment in Automotive solution. You use the custom flows to onboard equipment data and to trigger training and scoring models.

Master data and metadata must be loaded into the IBM Predictive Maintenance and Quality database, and you must also load the event data before you can run the analytic training or the scoring models.

Master data and metadata for the solution

You must provide the master data and metadata for the Asset Analytics for Manufacturing Equipment in Automotive solution. You must prepare the CSV files before you can load them into the environment.

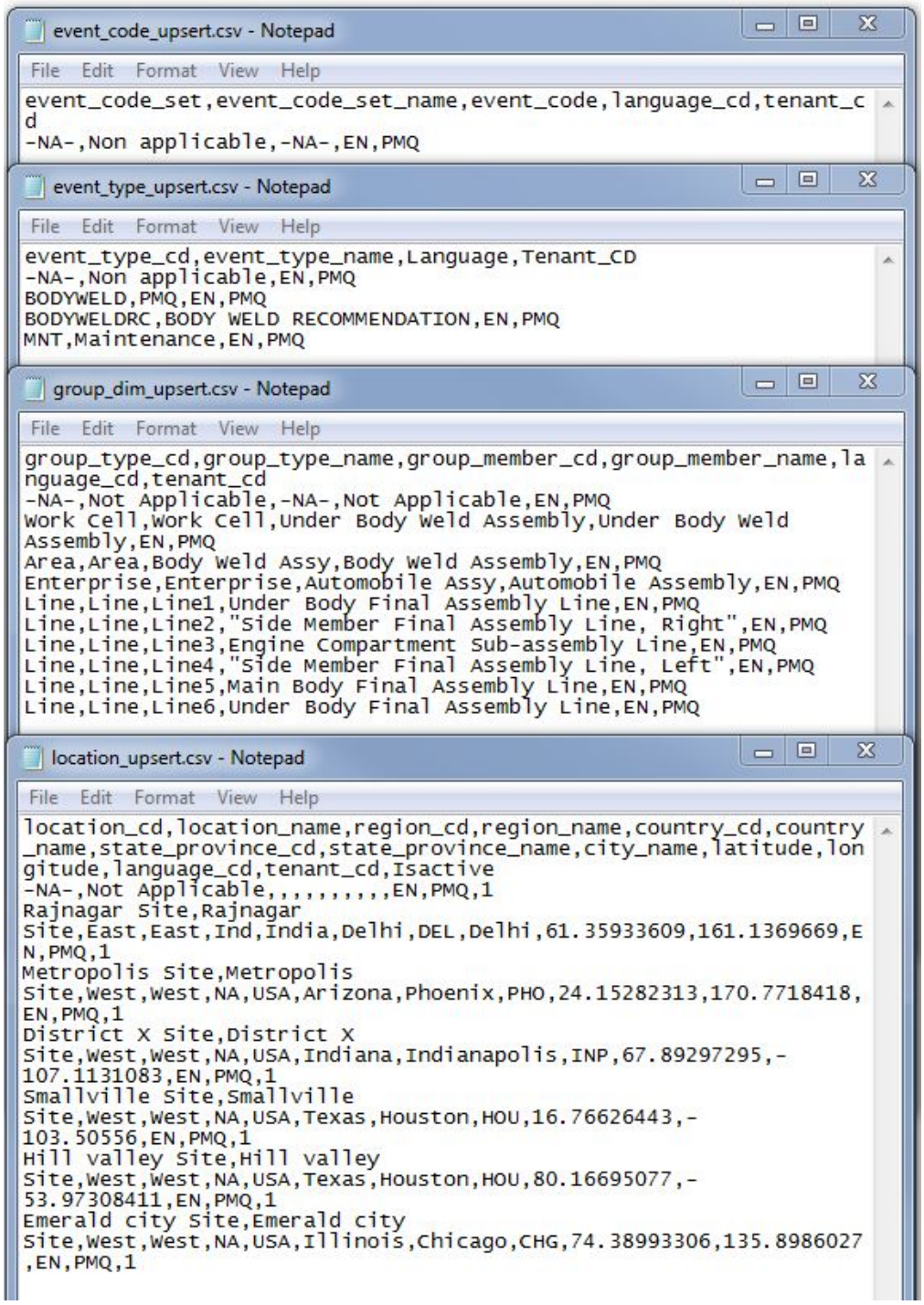
The master data and metadata must be provided in the following CSV files:

- `language_upsert.csv`
- `tenant_upsert.csv`
- `event_code_upsert.csv`
- `event_type_upsert.csv`
- `group_dim_upsert.csv`
- `location_upsert.csv`
- `material_type_upsert.csv`
- `measurement_type_upsert.csv`
- `process_upsert.csv`
- `product_upsert.csv`
- `profile_calculation_upsert.csv`
- `resource_type_upsert.csv`
- `source_system_upsert.csv`
- `supplier_upsert.csv`
- `value_type_upsert.csv`
- `material_upsert.csv`
- `production_batch_upsert.csv`
- `profile_variable_upsert.csv`
- `resource_upsert.csv`

The following examples show the contents that each of the CSV files that you prepare must contain.

The files `group_dim_upsert.csv`, `location_upsert.csv`, and `resource_upsert.csv` should be based on the equipment details, including its hierarchical relationship to other entities, and suited to your environment.

language_upsert.csv - Notepad
File Edit Format View Help
language_cd,language_name,isdefault
EN,ENGLISH,1
tenant_upsert.csv - Notepad
File Edit Format View Help
tenant_cd,tenant_name,isdefault
PMQ,PMQ,1



event_code_upsert.csv - Notepad

File Edit Format View Help

```
event_code_set,event_code_set_name,event_code,language_cd,tenant_c
d
-NA-,Non applicable,-NA-,EN,PMQ
```

event_type_upsert.csv - Notepad

File Edit Format View Help

```
event_type_cd,event_type_name,Language,Tenant_CD
-NA-,Non applicable,EN,PMQ
BODYWELD,PMQ,EN,PMQ
BODYWELDRC,BODY WELD RECOMMENDATION,EN,PMQ
MNT,Maintenance,EN,PMQ
```

group_dim_upsert.csv - Notepad

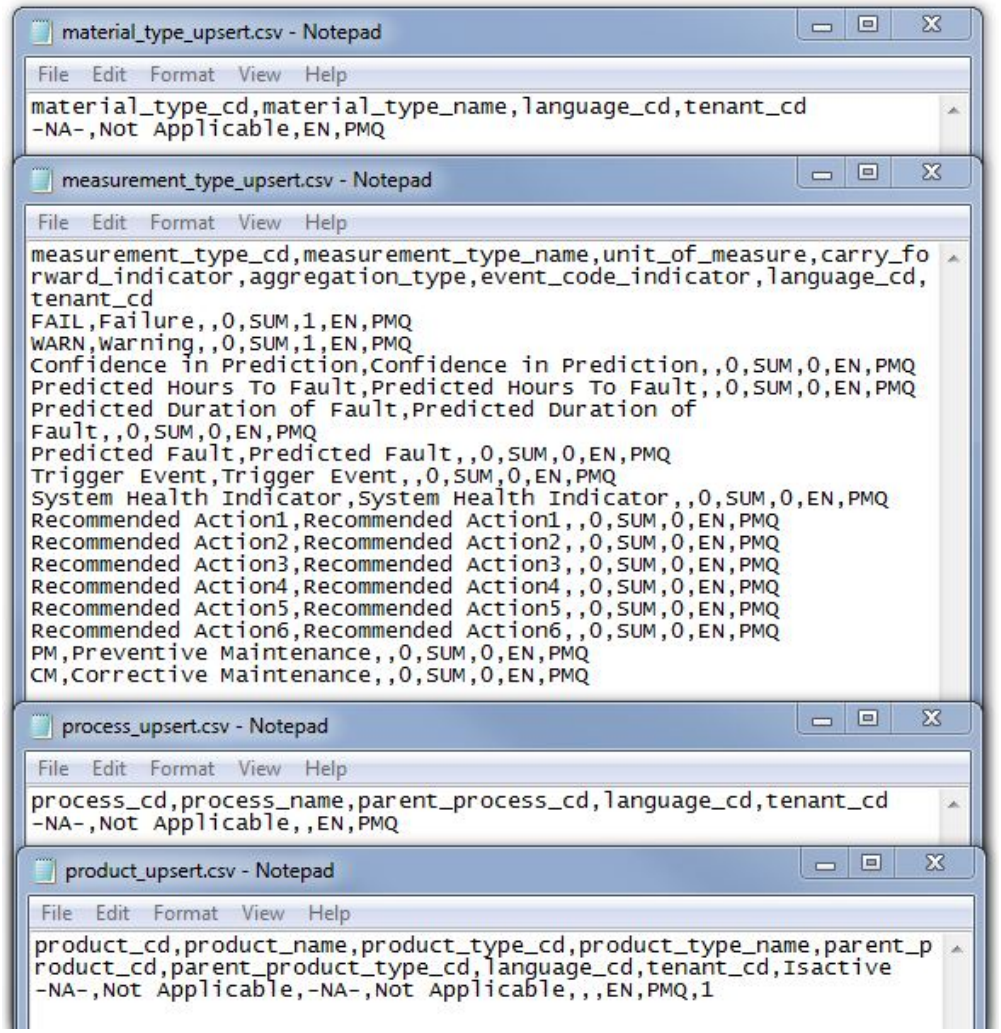
File Edit Format View Help

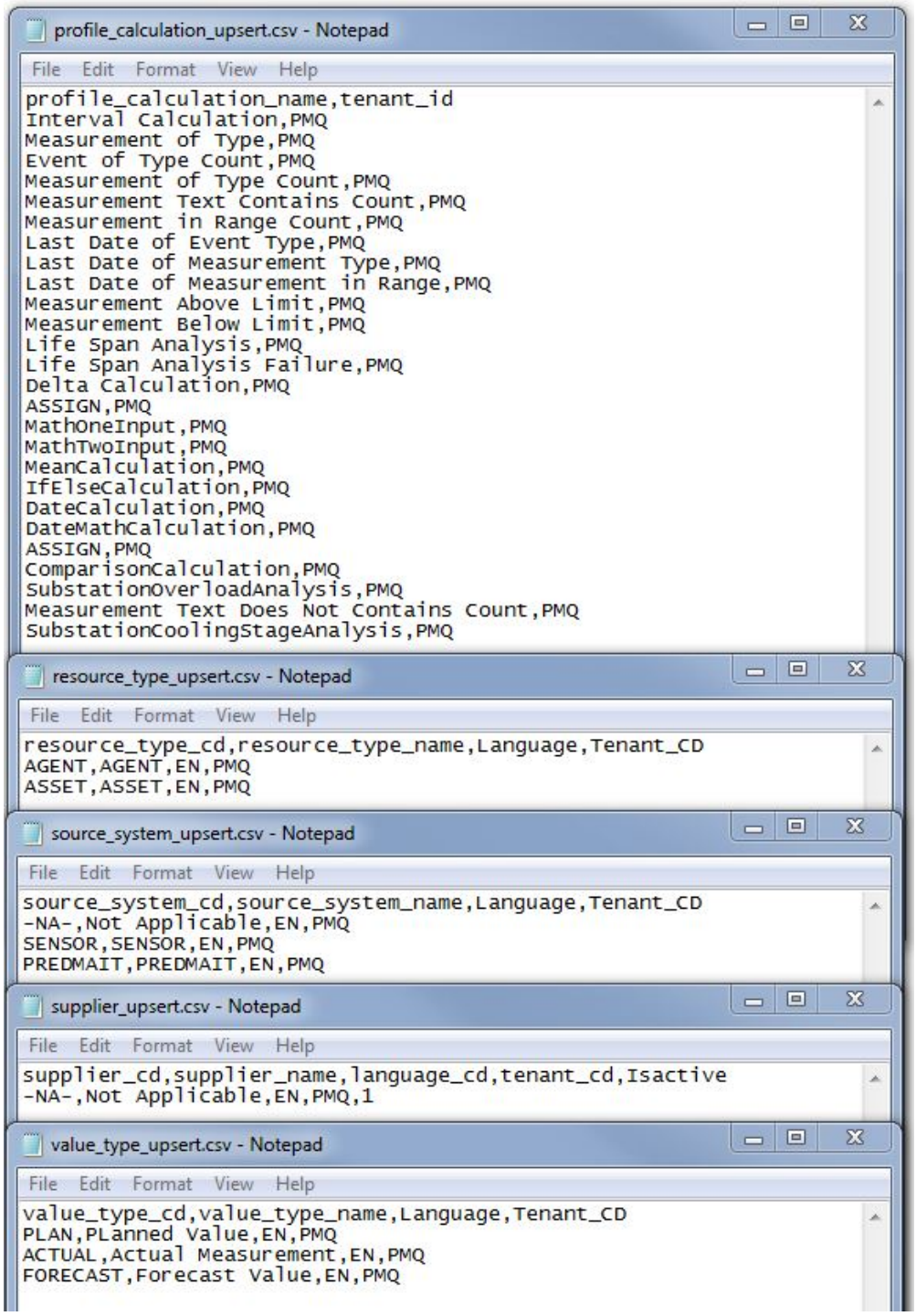
```
group_type_cd,group_type_name,group_member_cd,group_member_name,la
nguage_cd,tenant_cd
-NA-,Not Applicable,-NA-,Not Applicable,EN,PMQ
Work Cell,Work Cell,Under Body Weld Assembly,Under Body Weld
Assembly,EN,PMQ
Area,Area,Body Weld Assy,Body Weld Assembly,EN,PMQ
Enterprise,Enterprise,Automobile Assy,Automobile Assembly,EN,PMQ
Line,Line,Line1,Under Body Final Assembly Line,EN,PMQ
Line,Line,Line2,"Side Member Final Assembly Line, Right",EN,PMQ
Line,Line,Line3,Engine Compartment Sub-assembly Line,EN,PMQ
Line,Line,Line4,"Side Member Final Assembly Line, Left",EN,PMQ
Line,Line,Line5,Main Body Final Assembly Line,EN,PMQ
Line,Line,Line6,Under Body Final Assembly Line,EN,PMQ
```

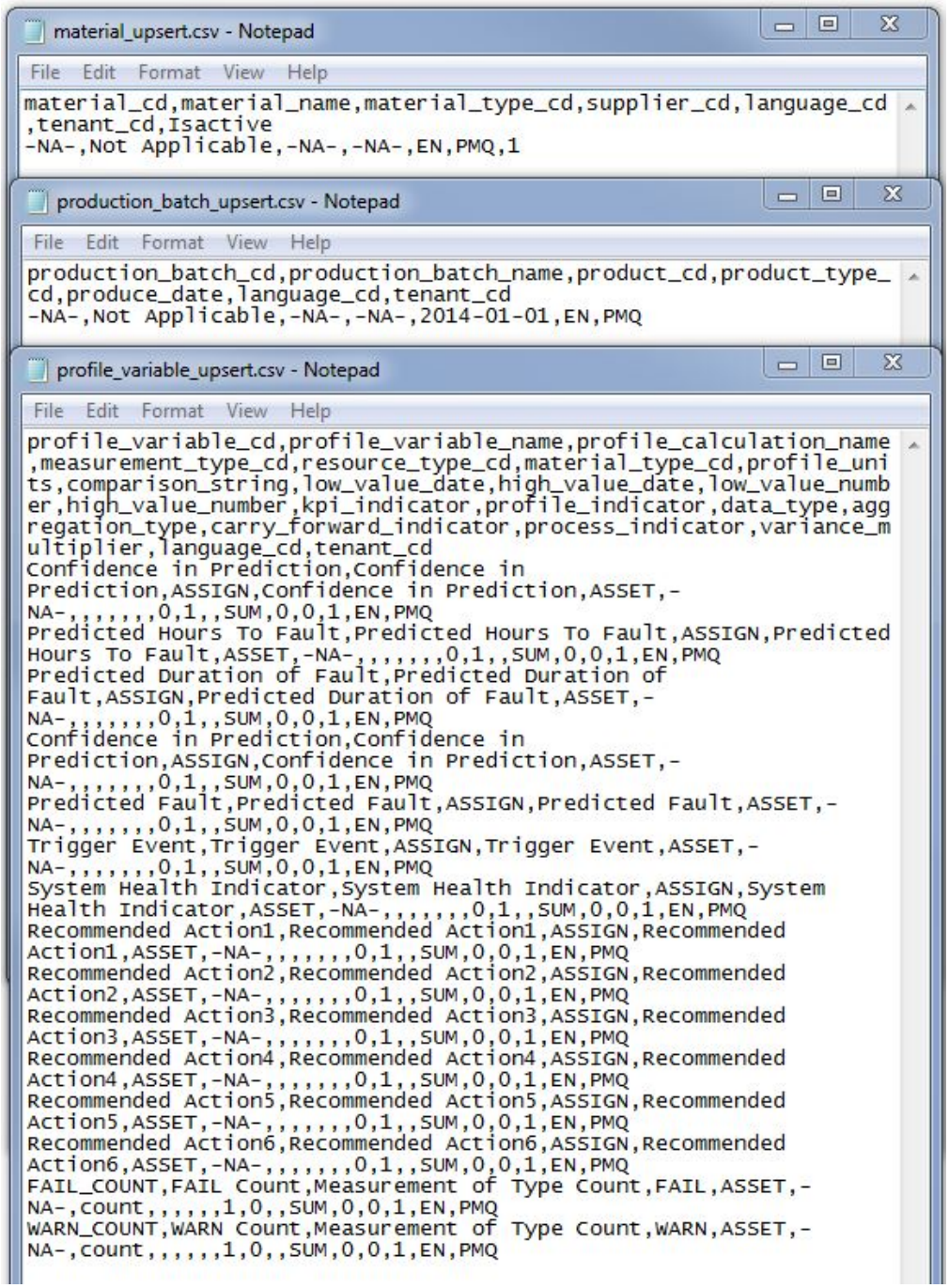
location_upsert.csv - Notepad

File Edit Format View Help

```
location_cd,location_name,region_cd,region_name,country_cd,country
_name,state_province_cd,state_province_name,city_name,latitude,lon
gitude,language_cd,tenant_cd,Isactive
-NA-,Not Applicable,,,,,,,,,EN,PMQ,1
Rajnagar Site,Rajnagar
Site,East,East,Ind,India,Delhi,DEL,Delhi,61.35933609,161.1369669,E
N,PMQ,1
Metropolis Site,Metropolis
Site,West,West,NA,USA,Arizona,Phoenix,PHO,24.15282313,170.7718418,
EN,PMQ,1
District X Site,District X
Site,West,West,NA,USA,Indiana,Indianapolis,INP,67.89297295,-
107.1131083,EN,PMQ,1
Smallville Site,Smallville
Site,West,West,NA,USA,Texas,Houston,HOU,16.76626443,-
103.50556,EN,PMQ,1
Hill valley Site,Hill valley
Site,West,West,NA,USA,Texas,Houston,HOU,80.16695077,-
53.97308411,EN,PMQ,1
Emerald city Site,Emerald city
Site,West,West,NA,USA,Illinois,Chicago,CHG,74.38993306,135.8986027
,EN,PMQ,1
```


material_type_upsert.csv - Notepad
File Edit Format View Help
material_type_cd,material_type_name,language_cd,tenant_cd
-NA-,Not Applicable,EN,PMQ
measurement_type_upsert.csv - Notepad
File Edit Format View Help
measurement_type_cd,measurement_type_name,unit_of_measure,carry_forward_indicator,aggregation_type,event_code_indicator,language_cd,tenant_cd
FAIL,Failure,,0,SUM,1,EN,PMQ
WARN,Warning,,0,SUM,1,EN,PMQ
Confidence in Prediction,Confidence in Prediction,,0,SUM,0,EN,PMQ
Predicted Hours To Fault,Predicted Hours To Fault,,0,SUM,0,EN,PMQ
Predicted Duration of Fault,Predicted Duration of Fault,,0,SUM,0,EN,PMQ
Predicted Fault,Predicted Fault,,0,SUM,0,EN,PMQ
Trigger Event,Trigger Event,,0,SUM,0,EN,PMQ
System Health Indicator,System Health Indicator,,0,SUM,0,EN,PMQ
Recommended Action1,Recommended Action1,,0,SUM,0,EN,PMQ
Recommended Action2,Recommended Action2,,0,SUM,0,EN,PMQ
Recommended Action3,Recommended Action3,,0,SUM,0,EN,PMQ
Recommended Action4,Recommended Action4,,0,SUM,0,EN,PMQ
Recommended Action5,Recommended Action5,,0,SUM,0,EN,PMQ
Recommended Action6,Recommended Action6,,0,SUM,0,EN,PMQ
PM,Preventive Maintenance,,0,SUM,0,EN,PMQ
CM,Corrective Maintenance,,0,SUM,0,EN,PMQ
process_upsert.csv - Notepad
File Edit Format View Help
process_cd,process_name,parent_process_cd,language_cd,tenant_cd
-NA-,Not Applicable,,EN,PMQ
product_upsert.csv - Notepad
File Edit Format View Help
product_cd,product_name,product_type_cd,product_type_name,parent_product_cd,parent_product_type_cd,language_cd,tenant_cd,Isactive
-NA-,Not Applicable,-NA-,Not Applicable,,,EN,PMQ,1


profile_calculation_upsert.csv - Notepad
File Edit Format View Help
profile_calculation_name,tenant_id
Interval Calculation,PMQ
Measurement of Type,PMQ
Event of Type Count,PMQ
Measurement of Type Count,PMQ
Measurement Text Contains Count,PMQ
Measurement in Range Count,PMQ
Last Date of Event Type,PMQ
Last Date of Measurement Type,PMQ
Last Date of Measurement in Range,PMQ
Measurement Above Limit,PMQ
Measurement Below Limit,PMQ
Life Span Analysis,PMQ
Life Span Analysis Failure,PMQ
Delta Calculation,PMQ
ASSIGN,PMQ
MathOneInput,PMQ
MathTwoInput,PMQ
MeanCalculation,PMQ
IfElseCalculation,PMQ
DateCalculation,PMQ
DateMathCalculation,PMQ
ASSIGN,PMQ
ComparisonCalculation,PMQ
SubstationOverloadAnalysis,PMQ
Measurement Text Does Not Contains Count,PMQ
SubstationCoolingStageAnalysis,PMQ
resource_type_upsert.csv - Notepad
File Edit Format View Help
resource_type_cd,resource_type_name,Language,Tenant_CD
AGENT,AGENT,EN,PMQ
ASSET,ASSET,EN,PMQ
source_system_upsert.csv - Notepad
File Edit Format View Help
source_system_cd,source_system_name,Language,Tenant_CD
-NA-,Not Applicable,EN,PMQ
SENSOR,SENSOR,EN,PMQ
PREDMAIT,PREDMAIT,EN,PMQ
supplier_upsert.csv - Notepad
File Edit Format View Help
supplier_cd,supplier_name,language_cd,tenant_cd,Isactive
-NA-,Not Applicable,EN,PMQ,1
value_type_upsert.csv - Notepad
File Edit Format View Help
value_type_cd,value_type_name,Language,Tenant_CD
PLAN,PLanned Value,EN,PMQ
ACTUAL,Actual Measurement,EN,PMQ
FORECAST,Forecast Value,EN,PMQ



material_upsert.csv - Notepad

File Edit Format View Help

```
material_cd,material_name,material_type_cd,supplier_cd,language_cd
,tenant_cd,Isactive
-NA-,Not Applicable,-NA-,-NA-,EN,PMQ,1
```

production_batch_upsert.csv - Notepad

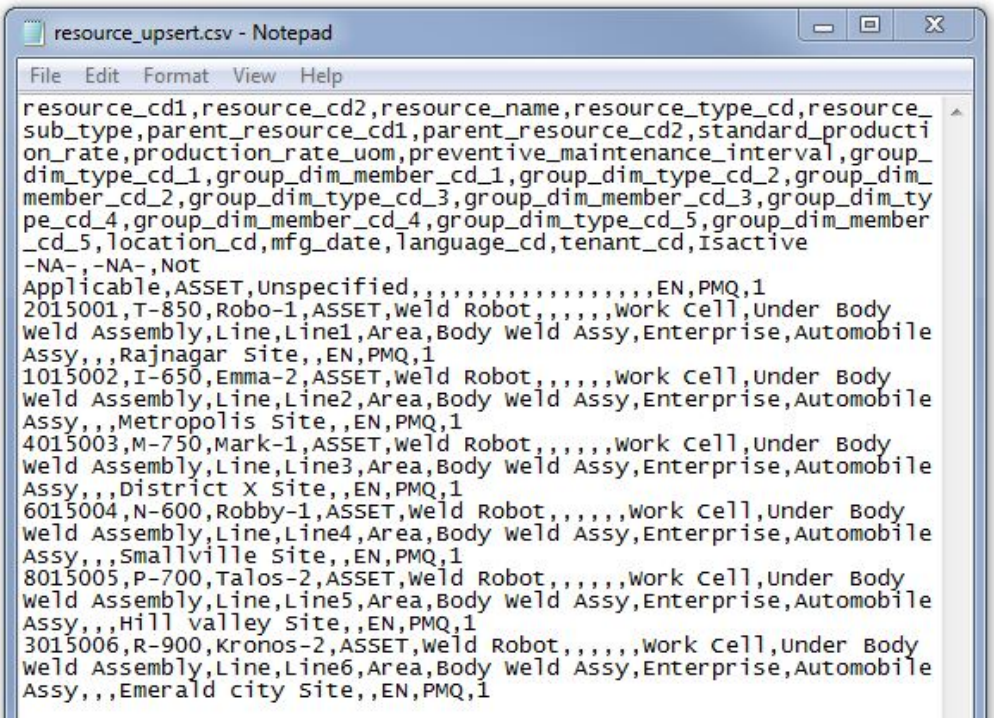
File Edit Format View Help

```
production_batch_cd,production_batch_name,product_cd,product_type_
cd,produce_date,language_cd,tenant_cd
-NA-,Not Applicable,-NA-,-NA-,2014-01-01,EN,PMQ
```

profile_variable_upsert.csv - Notepad

File Edit Format View Help

```
profile_variable_cd,profile_variable_name,profile_calculation_name
,measurement_type_cd,resource_type_cd,material_type_cd,profile_uni
ts,comparison_string,low_value_date,high_value_date,low_value_numb
er,high_value_number,kpi_indicator,profile_indicator,data_type,agg
regation_type,carry_forward_indicator,process_indicator,variance_m
ultiplier,language_cd,tenant_cd
Confidence in Prediction,Confidence in
Prediction,ASSIGN,Confidence in Prediction,ASSET,-
NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Predicted Hours To Fault,Predicted Hours To Fault,ASSIGN,Predicted
Hours To Fault,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Predicted Duration of Fault,Predicted Duration of
Fault,ASSIGN,Predicted Duration of Fault,ASSET,-
NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Confidence in Prediction,Confidence in
Prediction,ASSIGN,Confidence in Prediction,ASSET,-
NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Predicted Fault,Predicted Fault,ASSIGN,Predicted Fault,ASSET,-
NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Trigger Event,Trigger Event,ASSIGN,Trigger Event,ASSET,-
NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
System Health Indicator,System Health Indicator,ASSIGN,System
Health Indicator,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Recommended Action1,Recommended Action1,ASSIGN,Recommended
Action1,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Recommended Action2,Recommended Action2,ASSIGN,Recommended
Action2,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Recommended Action3,Recommended Action3,ASSIGN,Recommended
Action3,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Recommended Action4,Recommended Action4,ASSIGN,Recommended
Action4,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Recommended Action5,Recommended Action5,ASSIGN,Recommended
Action5,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
Recommended Action6,Recommended Action6,ASSIGN,Recommended
Action6,ASSET,-NA-,,,,,,,0,1,,SUM,0,0,1,EN,PMQ
FAIL_COUNT,FAIL Count,Measurement of Type Count,FAIL,ASSET,-
NA-,count,,,,,1,0,,SUM,0,0,1,EN,PMQ
WARN_COUNT,WARN Count,Measurement of Type Count,WARN,ASSET,-
NA-,count,,,,,1,0,,SUM,0,0,1,EN,PMQ
```



The solution provides for defining multilevel resource hierarchies that are augmented by group dimensions. A number of associations and relationships between resources and attributes can be defined. Any number of units of equipment can be defined, and associations can be defined to group them by any dimension; for example, OEM or Vendor can be defined as a dimension and associated with a unit of equipment.

Loading the master data and metadata

You must load the master data and metadata for the Asset Analytics for Manufacturing Equipment in Automotive solution in a specific order.

Procedure

1. Log in to the Integration Bus node computer as the **mqm** user.
2. Copy the files to the `/var/PMQ/MQSIFileInput/masterdatain` directory in the order that is shown in the following table:

Order	File name
1	`language_upsert.csv`
2	`tenant_upsert.csv`
3	`event_code_upsert.csv`
4	`event_type_upsert.csv`
5	`group_dim_upsert.csv`
6	`location_upsert.csv` This file should be based on the location of the equipment.
7	`material_type_upsert.csv`
8	`measurement_type_upsert.csv`
9	`process_upsert.csv`

Order	File name
10	product_upsert.csv
11	profile_calculation_upsert.csv
12	resource_type_upsert.csv
13	source_system_upsert.csv
14	supplier_upsert.csv
15	value_type_upsert.csv
16	material_upsert.csv
17	production_batch_upsert.csv
18	profile_variable_upsert.csv
19	resource_upsert.csv

Important: The files must be copied one at a time.

For more information about master and metadata for IBM Predictive Maintenance and Quality, see the following topics in IBM Knowledge Center under Predictive Maintenance and Quality 2.5.1 :

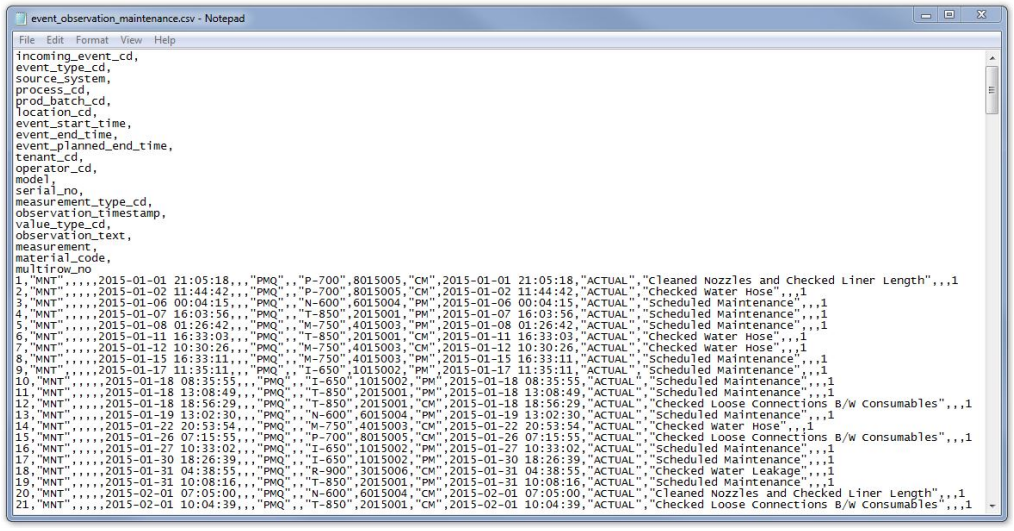
- Master data process
- File format and location
- The flat file API

Event data

Event data must also be loaded for the Asset Analytics for Manufacturing Equipment in Automotive solution.

Event data includes information such as maintenance data, and operational data.

The following image provides an example of the contents that each of the CSV files that you prepare must contain. The CSV files that you use should reflect your environment.



The example custom flows expect event and other supporting operational data in the formats shown in the image.

Onboarding event data

You must load the event data for the Asset Analytics for Manufacturing Equipment in Automotive solution.

Procedure

1. Log in to the Integration Bus node computer as the **mqm** user.
2. Copy the event data files that you created to the directory: `/var/PMQ/MQSIFileInput/eventdatain`.

Deploying the IBM Cognos content

For IBM Cognos Business Intelligence, you must catalog the database, create a data source connection, and then deploy the content files for the IBM Asset Analytics for Manufacturing Equipment in Automotive solution.

Cataloging the IBMPMQ database

You must create a database connection to the **IBMPMQ** database in IBM Cognos Business Intelligence. Before you can create the connection, you must catalog the database in the IBM DB2 client.

Procedure

1. Log on to the Business Intelligence node computer, and change to the db2inst1 user.

   For example, in a terminal window, type `su db2inst1`.
2. Enter the following command to catalog the database server:

   `db2 "catalog tcpip node OP(<Nodename>) remote DB2_server_name server DB2_port_number"`

   Note: The **Nodename** cannot be more than 8 characters.
3. Enter the following command to catalog the **IBMPMQ** database:

   `db2 "catalog database IBMPMQ as IBMPMQ at node OP(<Nodename>)"`
4. Enter the following command to ensure that the database was cataloged correctly:

   `db2 list database directory`

   IBMPMQ should appear in the list.

Creating a data source connection to the IBMPMQ database

You create a data source connection using IBM Cognos Administration.

Procedure

1. Open a web browser.
2. Go to the IBM Cognos® BI portal URL.

   For example, go to `http://binodename/ibmcognos/`.
3. On the **Welcome** page, click **Administer IBM Cognos Content**.
4. Click the **Configuration** tab, and click **Data Source Connections**.
5. Click the **New Data Source** icon .
6. In the **Name** box, type `IBMPMQ`, and then click **Next**.
7. In the connection page, select **IBM DB2**, ensure that **Configure JDBC connection** is selected, and click **Next**.

8. In the **DB2 database name** field, type `IBMPMQ`.
9. Leave **DB2 connect string** blank.
10. Under **Signons**, select both **Password** and **Create a signon that the Everyone group can use**, and then type the user ID and password for the DB2® instance owner user that you used to create the database, and click **Next**.

    For example, enter `db2inst1` and the appropriate password.

    Tip: To test whether the parameters are correct, click **Test the connection**. After you test the connection, click **OK** to return to the connection page.
11. In the **Server name** box, enter the name or IP address of your IBM DB2 server computer.
12. In the **Port number** box, enter the DB2 port number. The default is 50000.
13. In **Database name**, type `IBMPMQ`.

    Tip: To test whether the parameters are correct, click **Test the connection**. After you test the connection, click **OK** to return to the connection page.
14. Click **Finish**.

Moving the IBM Cognos content

As a **root** or **sudo** user, you must copy the IBM Cognos content for the IBM Asset Analytics for Manufacturing Equipment in Automotive application to the appropriate locations in your IBM Cognos installation to be able to deploy the content.

Procedure

1. Copy the IBM Cognos content from the computer where you deployed the Asset Analytics for Manufacturing Equipment in Automotive Business Intelligence content to the *<BI_Install_location>*`\deployment` folder on the Business Intelligence node computer.

   The Asset Analytics for Manufacturing Equipment in Automotive IBM Cognos content file is named `MEA_BIContent.zip`.
2. Copy the IBM Cognos report image file to the *<BI_Install_location>*`\webcontent\Images` directory on the Business Intelligence node computer and decompress it.

   You must create the `Images` directory if it does not already exist.

   The report images file is named `MEA_Images.zip`.
3. Copy the IBM Cognos map specification file to the Business Intelligence node install location.
4. Copy the IBM Cognos Framework Manager model file to the Business Intelligence node install location.
5. If you want to edit the Framework Manager models, you must catalog the Asset Analytics for Asset Analytics for Manufacturing Equipment in Automotive database on the computer where Framework Manager is installed.

Deploying the IBM Cognos reports

You must deploy the Asset Analytics for Manufacturing Equipment in Automotive reports by using IBM Cognos Administration.

Procedure

1. Open a web browser.

2. Go to the IBM Cognos BI portal URL (`http://<ibmcognos_node_IP>/ibmcognos/`).
3. On the **Welcome** page, click **Administer IBM Cognos Content**.
4. On the **Configuration** tab, click **Content Administration**.
5. On the toolbar, click the **New Import** button.
6. In the **Deployment Archive** pane, select the deployment archive, and click **Next**.

   The deployment archive is named `MEA_BIContent.zip`.
7. In the **Specify a name and description** pane, accept the default or enter a new name, and click **Next**.
8. In the **Select the public folders and directory content** pane, select all of the packages in the table, leave the **Options** as default, and click **Next**.

   Note: Ensure that the **Disable after import** option is cleared.
9. In the **Specify the general options** pane, accept the defaults, and click **Next**.
10. On the **Review the summary** page, click **Next**.
11. On the **Select an action** page, select **Save and run once**, and click **Finish**.
12. On the **Run with options** page, accept the defaults, and click **Run**, and then click **OK**.
13. Select **View the details of this import after closing this dialog** and click **OK**.

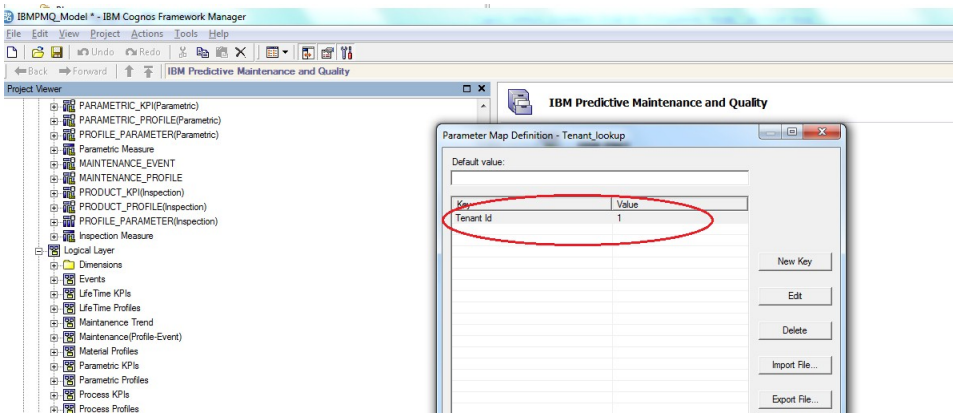
    Note: RAVE content is also imported as part of the `MEA_BIContent` import.

Opening the Framework Manager model

You can view the Asset Analytics for Manufacturing Equipment in Automotive dashboard model in IBM Cognos Framework Manager. The Framework Manager project file (.cpf) for the Capacity Management Analytics model is included in the `MEA_FMProject.zip` file.

Procedure

1. Start IBM Cognos Framework Manager.
2. From the **Welcome** page, click **Open a project**.
3. Navigate to the folder where you decompressed the `MEA_FMProject.zip` file, and select the `IBMPMQ_Model.cpf` file.
4. Click **Open**.
5. If you must republish the packages, you must update the **`Tenant_Id`** in the **`Tenant_lookup`** parameter in the model.



You can find the **Tenant_Id** in the **IBMPMQ** database by using the following database query:

```
Select Tenant_Id from pmqsch.tenant where Tenant_cd='B&W'
```

6. After you have made changes to the model, you can republish the package.
   a. In the **Project Viewer** pane, expand **Packages**.
   b. Right-click the package, and click **Publish Package**.

   After publishing, the package should be available in **Public Folders** > **MEA_AssetAnalytics** in the IBM Cognos Business Intelligence portal.

Chapter 3. Data flows and orchestration

This section describes the data model and data flows that are used for the IBM Asset Analytics for Manufacturing Equipment in Automotive solution.

Data mapping

This topic provides data mapping information for the IBM Asset Analytics for Manufacturing Equipment in Automotive solution.

Tables used in the solution

Table 1. Tables used in the Solution

Table Name	Comments
CALENDAR	Auto populated during content installation.
EVENT_TIME	Auto populated during content installation.
TENANT	PMQ as the default tenant will be populated in this table.
LANGUAGE	English (EN) will be populated as the default language in this table.
MASTER_LOCATION	Site information will be populated in this table.
MASTER_SOURCE_SYSTEM	This table will be populated with the following values: • SENSOR – To be used for sensor data. • PREDMAIT – To be used for model output.

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Table 1. Tables used in the Solution (continued)

Table Name	Comments
MASTER_MEASUREMENT_TYPE	This table will be populated with the following values: • FAIL – For capturing failure event of the robot. • WARN– For capturing warning event of the robot • PM – For capturing Preventive Maintenance performed on the robot. • CM – For capturing Corrective Maintenance performed on the robot. • Confidence in Prediction - For capturing SPSS model output • Predicted Hours To Fault – For capturing SPSS model output. • Predicted Duration of Fault – For capturing SPSS model output. • Predicted Fault – For capturing SPSS model output. • Trigger Event – For capturing SPSS model output. • RECOMMENDED_ACTION – For capturing recommended actions. Currently six variables are created to capture six actions.
MASTER_EVENT_TYPE	This table will be populated with the following values: • BODYWELD – Used to identify failure and warning input events. • MNT – Used to identify maintenance input events. • BODYWELDRC – Used to identify SPSS output events.
MASTER_EVENT_CODE	The table will be populated with the observation text (type of failure/warning) associated with failure and warning events. This table will be populated automatically when the event data is loaded.
MASTER_VALUE_TYPE	The table will be populated with ACTUAL and FORECAST values.
MASTER_PROFILE_CALCULATION	This table will be populated with ASSIGN and Measurement of Type Count calculation.

Table 1. Tables used in the Solution (continued)

Table Name	Comments
MASTER_PROFILE_VARIABLE	This table will be populated for capturing failure and warning count based on the type of failure and warning respectively. It will capture the most recent values of SPSS model output. The following variables will be created: • FAIL_COUNT • WARN_COUNT • Confidence in Prediction • Predicted Hours To Fault • Predicted Duration of Fault • Predicted Fault • Trigger Event • System Health Indicator • RECOMMENDED_ACTION1 • RECOMMENDED_ACTION2 • RECOMMENDED_ACTION3 • RECOMMENDED_ACTION4 • RECOMMENDED_ACTION5 • RECOMMENDED_ACTION6
MASTER_GROUP_DIM	The following group dimension levels of resources are used for capturing the hierarchy of resource: • Group Type 1 – Work Cell • Group Type 2 – Manufacturing Line • Group Type 3 – Area • Group Type 4 – Enterprise
MASTER_RESOURCE_TYPE	The table will be populated with ASSET and AGENT values.
MASTER_RESOURCE	Used to capture robot details including model and serial number.
KEY_LOOKUP	Will be auto populated by PMQ during insertion of master data.
EVENT & EVENT_OBSERVATION	Maintenance data available will be populated in these tables.
RESOURCE_KPI	Daily aggregated count of failure and warning event for each resource based on the type of failure and warning is populated in this table.
EVENT_PROFILE	Output values from SPSS model for the profile variables such as Confidence in Prediction and Predicted Hours To Fault are populated in this table.
RESOURCE_PROFILE	Most recent output values from SPSS model are populated here.

Data input flow

For input data loading, standard master data and event data loading flows are used. The orchestration file `PMQ_orchestration_definition_mea.xml` placed under `/var/mqsi/shared-classes/orchestrations` on the IIB node orchestrates the flow of output data.

1. Load master data by copying master data files in appropriate sequence to the `/var/PMQ/MQSIFileInput/masterdatain` folder.
2. Load event data by copying event data files to the `/var/PMQ/MQSIFileInput/eventdatain` folder.

Data output flow

Output from the analytical model is stored in the PMQ data store through standard event loading IIB flows as provided by IBM Predictive Maintenance and Quality 2.5.1. The orchestration file `PMQ_orchestration_definition_mea.xml` placed under `/var/mqsi/shared-classes/orchestrations` on the IIB node orchestrates the flow of output data.

Training model triggering flow

Training invocation is scheduler based.

Schedule the training of SPSS streams by setting the appropriate scheduler/webservice configuration (scheduled_time, duration_in_days, url) in `PMQ_orchestration_definition_batch.xml` for orchestration with identifier *MEATraining*.

MEAIntegration along with standard batch orchestration is used for training model invocation.

Scoring model triggering flow

The scoring model is responsible for generate the Health Score for the set of equipment based upon the maintenance and event data associated with that equipment.

- Invocation of scoring model will done at the end of every input file (Failure and Warning data file) loading.
- Invocation of scoring model will happen sequentially by using a queue based mechanism in IIB after verifying that previous job invocation has ended.
- *MEAIntegration* along with standard batch orchestration is used for scoring model invocation.
- For scoring model, set the Webservice configuration (url) in `PMQ_orchestration_definition_batch.xml` for orchestration with identifier MEA.
- For the first time data load, invocation of the scoring model will wait until the training is complete.

Chapter 4. Overview of the analytics model

IBM Predictive Maintenance and Quality 2.5.1 is used as the underlying platform for the solution. IBM SPSS Modeler 17.0, which is part of the Predictive Maintenance and Quality 2.5.1 platform, is used as the predictive modeling tool. There are two SPSS streams which are created. One stream for the training and creation of the predictive model and another stream for using the predictive models and scoring the new incoming events.

Training model

Predictive models must be trained to determine which data is useful and which data is not needed.

Input tables used by predictive models

The following input tables are used for the creation and scoring of the predictive models:

- **PMQSCH.EVENT** – Provides all the Input Event Ids
- **PMQSCH.EVENT_OBSERVATION** – Provides the observation values related to the events
- **PMQSCH.MASTER_RESOURCE** – Provides the resource details of the assets
- **PMQSCH.MASTER_VALUE_TYPE** – This table along with event observation is used to identify only Actual Values for predictive models
- **PMQSCH.MASTER_MEASUREMENT_TYPE** – This table along with event observation is used to identify only Warnings and Failures from the Event observation

Modeling approach

The observation from each event is collected and summarized with all the events that occurred from the previous fault. This information is then used to identify the next fault that is to occur. The **Auto Classifier** node is used to identify the next likely fault.

The **Auto Classifer** node provides the next likely fault failure and the confidence associated with the prediction. The **Auto Classifier** node estimates and compares models for all the faults as targets, using a number of different methods in a single modeling run. The node explores every possible combination of options, ranks each candidate model based on the measure specified, and saves the best models for use in scoring or further analysis.

An **Auto Numeric** node is used to estimate the time to fault. The **Auto Numeric** node estimates and compares models for the time to fault using a number of different methods. The node explores every possible combination of options, ranks each candidate model based on the correlation, and saves the best for use in scoring or further analysis.

The SPSS Stream is orchestrated by the SPSS Script. The SPSS Script initially runs the Job Status Update to identify the orchestration that a SPSS stream is running. The SPSS stream then joins all the relevant tables and prepares the data for modeling. After all the input data is present, the Stream creates derived variables

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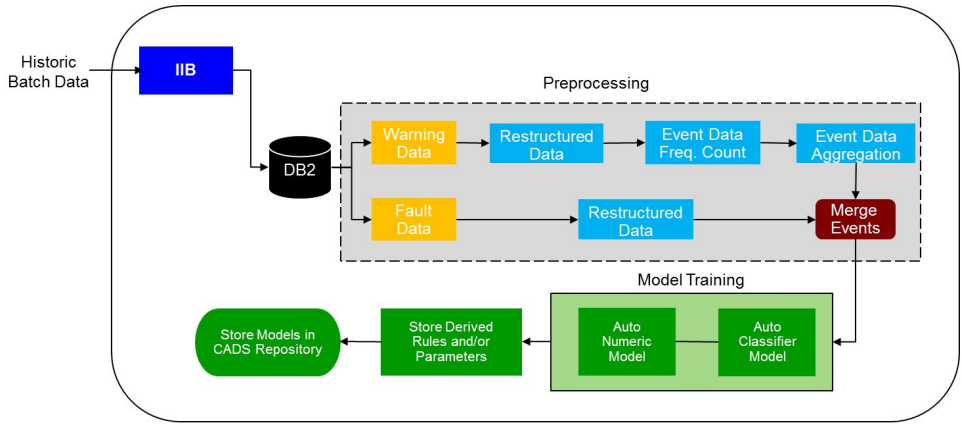
which will serve as the target. The first derived variable scans all the variables and identifies the next Fault and calculates the duration taken for the fault to actually occur. Then the time taken for the system to come up is also calculated.

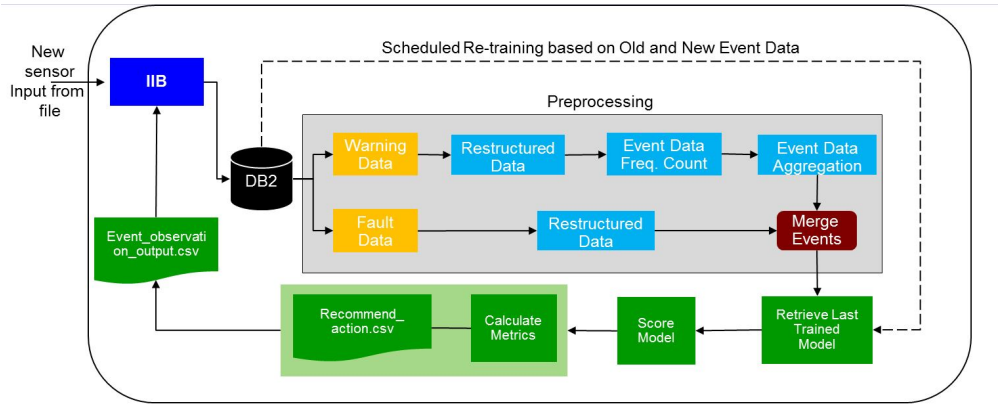
Then the SPSS Script refreshes the **type** node and **restructure** node, which creates the derived variables for prediction. After columns for each failure are created, a running counter is set for each column. After all the derived variables are created, the predictive models are created based on the training data.



Scoring model

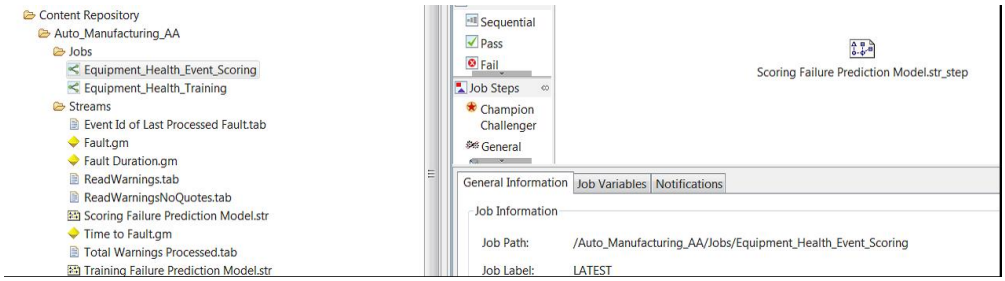
The SPSS Scoring Job is orchestrated by a script. The script retrieves the latest training models from the repository.

The Scoring model also keeps track of the last analyzed failure. The data from the last analyzed failure is used for future failure predictions. Once the data is scored, the data rows are prepared corresponding to the IBM Predictive Maintenance and Quality format so that IIB orchestrations can take the latest scores and update them in the database.



CADS Jobs

Two jobs are created in SPSS CADS. One is invoked for training the model, and another is invoked while scoring the job. The IIB flows use the Object URI in CADS to invoke these jobs.



Chapter 5. Using Asset Analytics for Manufacturing Equipment in Automotive

The IBM Asset Analytics for Manufacturing Equipment in Automotive solution provides insights into the functioning of robotic equipment. Dashboards provide maintenance operators with visualizations that indicate the status of equipment and provide predictions about when equipment will fail.

The solutions provides the following reports:

- Landing page, which provides a visual representation of the robotic equipment and an indication of the health of each piece of equipment.
- Maintenance Dashboard, which provides information about a selected piece of equipment, including the maintenance history, current health, and recommended actions.
- Equipment Specification, which provides specification details for the selected piece of equipment.

An example of using the solution

A maintenance operator can use the Asset Analytics for Manufacturing Equipment in Automotive to monitor the health of each piece of equipment and identify machines that are in need of maintenance.

About this task

This task describes how a maintenance operator uses the solution to identify a piece of robotic equipment that requires maintenance and determine the appropriate action. The screen shots shown are for example purposes and will vary depending on your implementation of the solution.

Procedure

1. Connect to the solution.

   The Landing page shows the status of each machine and the overall system health.

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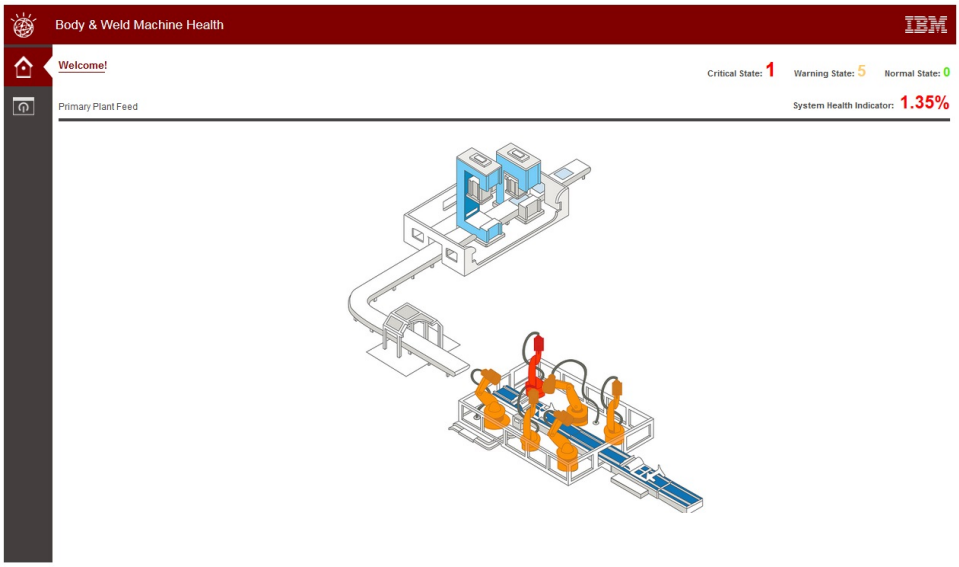
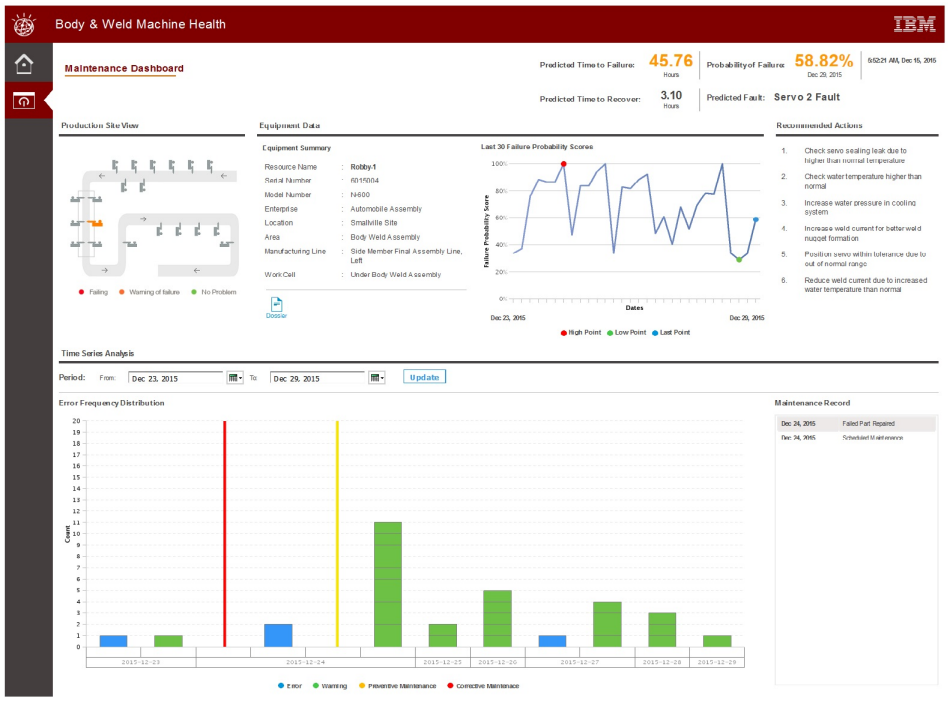


2. Click a machine to display its respective Maintenance Dashboard.

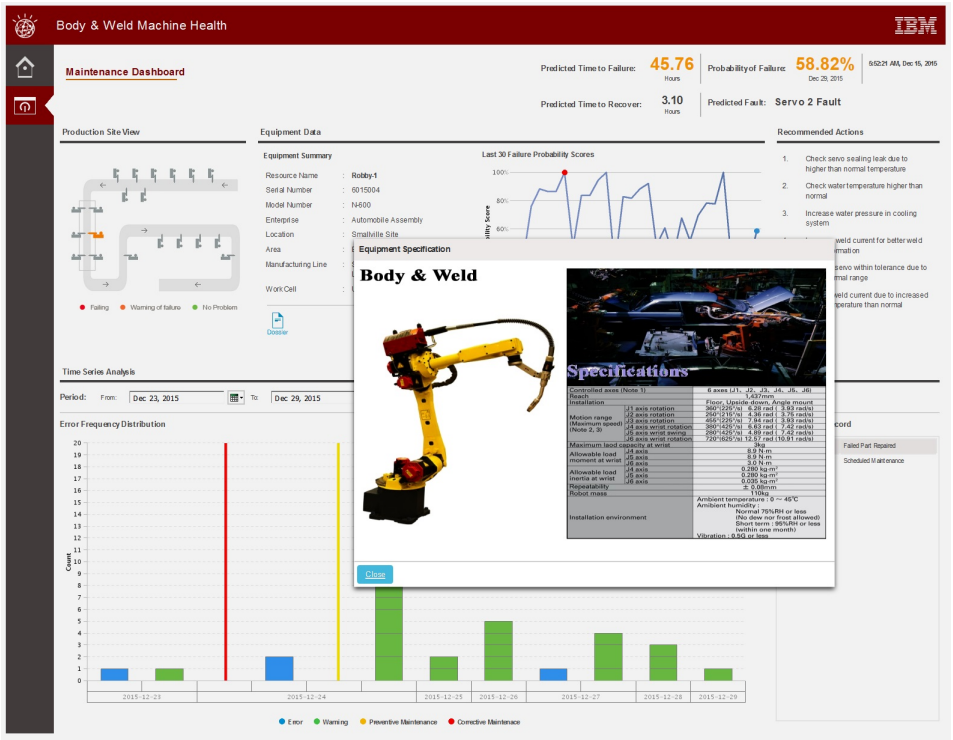


The Maintenance Dashboard provides the following details about the piece of equipment:

- **Production Site View**, which shows the layout and status of the equipment.
- **Equipment Data**, which provides equipment hierarchy data and equipment identifiers, including recent 30 failure probability scores, predicted time to failure, predicted faults, and so on.
- **Recommended Actions**
- **Time Series Analysis**, which includes error frequency distribution and maintenance record. You can set the period to filter the information shown on this report.

3. To view specifications for the selected piece of equipment, click the **Dossier** button.

   The Equipment Specification report is shown.



Appendix A. Accessibility features

Accessibility features help users who have a physical disability, such as restricted mobility or limited vision, to use information technology products.

For information about the commitment that IBM has to accessibility, see the IBM Accessibility Center (www.ibm.com/able).

IBM Cognos HTML documentation has accessibility features. PDF documents are supplemental and, as such, include no added accessibility features.

Report output

In IBM Cognos Administration, you can enable system-wide settings to create accessible report output. For more information, see the *IBM Cognos Business Intelligence Administration and Security Guide*. In IBM Cognos Report Studio, you can enable settings to create accessible output for individual reports. For more information, see the *IBM Cognos Report Studio User Guide*. You can access the previously mentioned documents at IBM Knowledge Center (http://www.ibm.com/support/knowledgecenter).

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Appendix B. Troubleshooting

This section contains troubleshooting information for the Asset Analytics for Manufacturing Equipment in Automotive installation.

Troubleshooting a problem

Troubleshooting is a systematic approach to solving a problem. The goal of troubleshooting is to determine why something does not work as expected and how to resolve the problem.

Review the following table to help you or customer support resolve a problem.

Table 2. Troubleshooting actions and descriptions

Actions	Description
A product fix might be available to resolve your problem.	Apply all known fix packs, or service levels, or program temporary fixes (PTF).
Look up error messages by selecting the product from the IBM Support Portal, and then typing the error message code into the **Search support** box (http://www.ibm.com/support/entry/portal/).	Error messages give important information to help you identify the component that is causing the problem.
Reproduce the problem to ensure that it is not just a simple error.	If samples are available with the product, you might try to reproduce the problem by using the sample data.
Ensure that the installation successfully finished.	The installation location must contain the appropriate file structure and the file permissions. For example, if the product requires write access to log files, ensure that the directory has the correct permission.
Review all relevant documentation, including release notes, technotes, and proven practices documentation.	Search the IBM Knowledge Center to determine whether your problem is known, has a workaround, or if it is already resolved and documented.
Review recent changes in your computing environment.	Sometimes installing new software might cause compatibility issues.

If the items in the table did not guide you to a resolution, you might need to collect diagnostic data. This data is necessary for an IBM technical-support representative to effectively troubleshoot and assist you in resolving the problem. You can also collect diagnostic data and analyze it yourself.

Troubleshooting resources

Troubleshooting resources are sources of information that can help you resolve a problem that you are having with an IBM product.

Support Portal

The IBM Support Portal is a unified, centralized view of all technical support tools and information for all IBM systems, software, and services.

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The IBM Support Portal lets you access all the IBM support resources from one place. You can tailor the pages to focus on the information and resources that you need for problem prevention and faster problem resolution. Familiarize yourself with the IBM Support Portal by viewing the demo videos (https://www.ibm.com/blogs/SPNA/entry/the_ibm_support_portal_videos).

Find the content that you need by selecting your products from the IBM Support Portal (http://www.ibm.com/support/entry/portal).

Before contacting IBM Support, you will need to collect diagnostic data (system information, symptoms, log files, traces, and so on) that is required to resolve a problem. Gathering this information will help to familiarize you with the troubleshooting process and save you time.

Service request

Service requests are also known as Problem Management Reports (PMRs). Several methods exist to submit diagnostic information to IBM Software Technical Support.

To open a PMR or to exchange information with technical support, view the IBM Software Support Exchanging information with Technical Support page (http://www.ibm.com/software/support/exchangeinfo.html).

Fix Central

Fix Central provides fixes and updates for your system's software, hardware, and operating system.

Use the pull-down menu to navigate to your product fixes on Fix Central (http://www.ibm.com/systems/support/fixes/en/fixcentral/help/getstarted.html). You may also want to view Fix Central help.

IBM developerWorks

IBM developerWorks® provides verified technical information in specific technology environments.

As a troubleshooting resource, developerWorks provides easy access to the most popular practices, in addition to videos and other information: developerWorks (http://www.ibm.com/developerworks).

IBM Redbooks

IBM Redbooks® are developed and published by the IBM International Technical Support Organization, the ITSO.

IBM Redbooks (http://www.redbooks.ibm.com) provide in-depth guidance about such topics as installation and configuration and solution implementation.

Software support and RSS feeds

IBM Software Support RSS feeds are a quick, easy, and lightweight format for monitoring new content added to websites.

After you download an RSS reader or browser plug-in, you can subscribe to IBM product feeds at IBM Software Support RSS feeds (https://www.ibm.com/software/support/rss).

Log files

Log files can help you troubleshoot problems by recording the activities that take place when you work with a product.

Error messages

The first indication of a problem is often an error message. Error messages contain information that can be helpful in determining the cause of a problem.

Supported web browsers

The solution installer runs on Google Chrome 44, or later, or Mozilla Firefox 38 or later web browsers.

Solution users who choose to use IE 10 as the browser of preference, is highly recommended to follow the steps documented in the technote below, for best visualization. https://technet.microsoft.com/en-us/library/dn872481.aspx

Note: Please make sure to have set the correct path of the `xml` file create, in the registry entry (If you have opted to turn ON the Enterprise Mode using the registry).

Tip: For more information, see http://www-01.ibm.com/support/docview.wss?uid=swg21672432

Appendix C. Solution extensions

This appendix provides information on extensions to the Asset Analytics for Manufacturing Equipment in Automotive solution.

Addition of new equipment and assets

Other equipment and assets can be loaded for the IBM Asset Analytics for Manufacturing Equipment in Automotive solution so that Time-To-Failure metrics for them can be calculated.

Equipment or Asset other than weld robot includes pallet conveyor, material handling robot, inspection robot, lift truck, sensor, weld gun, welding fixture, pneumatic clamp, etc. Following steps need to be followed for configuring the system with the new asset:

- Master data for the new asset needs to be loaded.
  - Define Resource, resource type & attributes
  - In case the asset is located at a new location, define the new location

  Note: For more information on loading new master data into PMQ please refer to PMQ documentation: http://www-01.ibm.com/support/knowledgecenter/SSTNNL_2.5.1/com.ibm.swg.ba.cognos.pmq_solution_guide.2.5.1.doc/c_conf_md_pmq.html?lang=en
- Load historical failure data, warning data and maintenance data for the new equipment
- The resource landing page would need to be updated to reflect the new equipment

Note: In case of a different type of input event data altogether, a new predictive model has to be built and would also involve changes to orchestration.

Customize report or create new reports

Customers can customize reports or create new reports for a configured asset by using IBM Cognos Report Studio and IBM Cognos Framework Manager.

Verify whether the Business Intelligence layer supports the required Framework Manager model necessary for the report that is being developed. If it does not, you must make changes to the provided model by using IBM Cognos Framework Manager.

Some examples of customizations include:

- All error code occur in a month
- Particular error code happened over a time
- Particular error code (FALT / WARNING) repeated for preventive maintenance over a time
- Inclusion of other useful metrics and graphical representation for the predictive model

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Customers can as well use any other reporting technology and leverage PMQ data model for retrieving data information. For more details on PMQ data model schema, please refer to the PMQ Solution guide at: http://www-01.ibm.com/support/knowledgecenter/SSTNNL_2.5.1/com.ibm.swg.ba.cognos.pmq_solution_guide.2.5.1.doc/c_conf_md_pmq.html?lang=en

Customize predictive models

You can develop your own predictive models using any other modeling tools and input data. Input data other than the warning and faults includes information such as parametric data, repair data, product data, environmental data, and so on. According to your data mapping needs, the orchestration can be customized.

The current solution's predictive model uses fault data, warning data, and maintenance data for predictions. The predictability of the model can be enhanced further by identifying new parametric data. If such new parametric data is available, then complete the following steps:

- Load the meta-data related to this parametric data. For more information about loading master data into IBM Predictive Maintenance and Quality, refer to the Predictive Maintenance and Quality Solution guide at: http://www-01.ibm.com/support/knowledgecenter/SSTNNL_2.5.1/com.ibm.swg.ba.cognos.pmq_solution_guide.2.5.1.doc/c_conf_md_pmq.html?lang=en
- Load actual parametric data. For more information about loading event data into Predictive Maintenance and Quality, refer to the Predictive Maintenance and Quality Solution guide at: http://www-01.ibm.com/support/knowledgecenter/SSTNNL_2.5.1/com.ibm.swg.ba.cognos.pmq_solution_guide.2.5.1.doc/c_conf_measure_pmq.html?lang=en
- Use IBM SPSS Modeler to retrieve the model from IBM SPSS Collaboration & Deployment Services' deployment manager. Open and modify the training and scoring streams of this solution as necessary.
- Again use IBM SPSS Collaboration & Deployment Services to redeploy the updated stream into the environment. Save the respective jobs.

Note: It is best to verify and test any change in the model or orchestration flows thoroughly in a staging environment before moving it to a production environment.

Integration with asset management and manufacturing execution systems

Customers can extend the solution to integrate with Asset management solutions

Integrating the solution with other asset management systems can be done by using the connectivity and data transformation capabilities of IBM Integration Bus (IIB). This involves creation of new message flows in IIB. The solution includes a prebuilt adapter for integration with the IBM Maximo asset management system. For more details, refer to the Predictive Maintenance and Quality documentation on IBM Knowledge Center.

System health indicator

The system health indicator is an indicator of overall health of the automotive assembly that consists of more than one asset. The system is assumed to consist of several independent components and a failure of any one component results in a failure of the system. The system is represented by a series reliability block diagram. In general, for a series of *n*independent assets or equipment, the system health indicator or system reliability is as show below. This is known as the product rule.

System health = Π Ri, where i = 1 to *n* and R is the reliability of an asset (probability that the asset doesn't fail for a given time)

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