Getting started with Civilian Topographic Map (CTM)

**Introduction**

Civilian Topographic Map (CTM) is a product designed to allow users to easily create civilian style topographic data and maps using Esri Production Mapping. CTM includes a geodatabase data model as well as sample configurations for editing, quality assurance, and cartography. CTM can also be configured as a sample map product for Product on Demand (POD), a web application that allows users to create high quality cartographic products through a light weight web interface.

The schema of CTM is based on the National System for Geospatial Intelligence Feature Data dictionary (NFDD). The NFDD is a comprehensive dictionary and coding scheme for feature types, feature attributes, and attribute values. The NFDD conforms to a subset of ISO 19126, Geographic information - Feature concept dictionaries and registers, and its information schema. Esri has chosen a subset of NFDD feature types and attributes for CTM that are appropriate for those doing topographic mapping in a civilian context.

For more information about the NFDD specification visit: <https://nsgreg.nga.mil/fdd/registers.jsp?register=NFDD>. On this page you will see links that allow you to browse or search the NFDD specification for a complete list of feature and attribute types.

The CTM product files are distributed through GitHub.  For the latest product files visit - <https://github.com/Esri/CTM/releases>.  It is recommended that you only use released product files.  The CTM development branches, including master, may contain updates that are not fully tested and therefore may not be functional.  The product files and sample scripts in the development branches contains functionality that may not be in final form so using them could result in products that do not meet specifications and could cause data corruption.

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## Getting started

Download and Extract the appropriate Civilian Topographic Map release to a local folder. Once extracted, the CTM files are organized in a directory structure.

Civilian Topographic Map is divided into a number directories:

|  |  |
| --- | --- |
| **Directory** | **Description** |
| MapGeneration | Contains a python toolbox with tools used to automate the generation of the 25K and 50K civilian topographic map product. |
| Generalization | Contains the models and scripts used to generalize the 25K data to 50K. |
| Fixed50K | Contains the configurations used to collect data and make civilian topographic map products at a scale of 1:50,000. |
| Fixed25K | Contains the configurations used to collect data and make civilian topographic map products at a scale of 1:25,000. |
| Product Library | The product library database which contains the business rules for editing and cartography that are needed to produce civilian topographic data and maps at any scale. |
| Styles | Contains the symbology style for all scales of civilian topographic map products. |

The specific content of each directory and how to use the files are explained in detail below. Regardless of the products you choose to implement, always begin by following the steps for setting up the styles and product library as these are required for all products.

## Styles

The Styles directory contains the symbology style for all scales of civilian topographic map products.

### Setting up CTM style

By default, the style path is set to **<install drive>:\Program Files\ArcGIS\Desktop<release number>\Styles**, which is the location where the styles that are installed with ArcGIS are stored. In order for all users on the machine to have access to the style and in order for Production Mapping configurations using the style to work correctly, you must copy the style file to the default style path.

1. Copy the **Civilian Topographic Map (CTM).style** file from the CTM\Styles directory and paste it to the following directory:

* <install drive>:\Program Files\ArcGIS\Desktop<release number>\Styles

*Note: You may need administrative access to the machine to copy files to this location*

1. Repeat step one for all machines that will be used to create Civilian Topographic Map products.

## Product Library

The product library contains many of the business rules for editing and cartography that are needed to produce civilian topographic data and maps at any scale.

The product library is typically a single, centralized database to which all members of the organization can go to access the configuration files used to produce a product. Having one centralized product library ensures that when changes are made to the configurations, everyone has immediate access to the updates. If multiple versions of the product library exist within your organization, there is no way to guarantee that everyone is using the latest version.

When setting up the product library in SDE, best practice documents are available to help you appropriately configure the SDE repository.

* + For more information about administering your product library in **SQL Express** see: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/introduction-to-configuring-the-product-library-in-sql-server-express.htm>
  + For more information about administering your product library in **SQL Server** see: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/introduction-to-configuring-the-product-library-in-sql-server.htm>
  + For more information about administering your product library in **Oracle** see: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/introduction-to-configuring-the-product-library-in-oracle.htm>

### Setting up the CTM product library

To begin using the product library provided with CTM.

1. Unzip the **CTM\_Product\_Library.gdb.zip** in the CTM\ProductLibrary directory. The product library can be shared in a location where everyone has access or the contents can be copied into an SDE repository. If using SDE, see the best practices listed above.
2. Start ArcMap.
3. If necessary, open the **Product Library** window by clicking **Customize > Production > Product Library** on the main menu.
4. Right-click the **Product Library** icon and click **Select Product Library**…
5. Browse to the location where you unzipped the **CTM\_Product\_Library.gdb**
6. Click OK

## Fixed 25K

#### Contents

The Fixed 25K directory contains subdirectories with all of the files and configurationsrequired to collect data and make a civilian topographic map product at a scale of 1:25,000.

The following files are provided as part of the fixed 25K product:

|  |  |  |
| --- | --- | --- |
| **Directory** | **Sub Directory** | **Description** |
| Batch Jobs |  | Contains Reviewer Batch Jobs which are used to validate the attributes, geometry, and spatial relationships of data in the Civilian Topographic Map schema. |
| Cartography | Grids | Contains Grid XML files used by the Grids and Graticules GP tool to create cartographic grids appropriate for the 25K civilian topographic map product. |
| Map Generation | Contains a python toolbox with tools used to automate the generation the 25K civilian topographic map product. |
| Map Templates | Contains a sample MXD which contains the template layout used to produce 25K civilian topographic map products. |
|  | The CTM\_Production\_PDF.xml contains the color mappings used to produce a color separated pdf with the Production PDF exporter. |
| Sample Data |  | Contains a zipped file geodatabase with sample data in the CTM schema as well as a map document that can be used when editing data. Data covers four 25K map sheets near Salt Lake City, UT. |
| Schema |  | Contains a workspace XML file along with topology rules that can be used to generate an empty geodatabase with the civilian topographic map schema. |

### Editing Civilian Topographic Map Data

Editing configurations for CTM are provided help to ensure the quality of the data as it is being created and modified using Production Mapping. These configurations are stored in the product library and include editing templates, field configurations, feature level metadata, and validation rules.

#### Accessing the sample data

Sample data near Salt Lake City, UT is provided as part of CTM and can be used to explore and understand how CTM is configured for data collection and maintenance.

1. Unzip the **SaltLakeCity.zip** in the CTM\Fixed25K\SampleData directory.
2. Open the CTM\_25K\_DataEdits.mxd from the CTM\Fixed25K\SampleData directory.
3. If necessary, set the product library to the CTM\_Product\_Library.gdb. See [Setting up the CTM product library.](#_Setting_up_the)

#### Viewing the field configurations

Field Configurations customize the way that attributes are displayed. Fields can be grouped, hidden, or made bold to help you easily understand which attributes are important for each type of feature and which attributes are optional.

1. Start an Edit Session by clicking the **Production Start Editing** button.
2. Select any template from the template list in the Create Tab.
3. In the Create Attributes window, the attributes for the feature will be grouped and otherwise organized.
4. To toggle between the organized view and the full unorganized list of attributes, right-click anywhere in the Create Attributes window and click **Enable Field Configurations**.

#### Setting a feature level metadata favorite

Feature Level Metadata are attributes on feature classes that store information about the feature such as who created it, when it was last modified, and what source was used. When using feature level metadata, you set a favorite at the beginning of your edit session and the values are automatically applied with every edit. You must remember to set the metadata favorite each time you close and reopen ArcMap.

1. If necessary, turn to the **Metadata tab** in the Manage Features dialog.
2. If the + button at the top of Manage Features is disabled, right-click in the Feature Manager window and choose **Use FCT Metadata**.
3. Select the **2012 Imagery** - **High Resolution 30cm Imagery** metadata favorite in Manage Features. The attributes of the metadata favorite are displayed in the Metadata Attributes window.   
   CDT and MDT are the Creation Date and Time and Modification Date and Time fields. These fields are disabled and display a value of #date# which indicates that they will be automatically populated with the current date and time when a feature is created or modified. Srt, sdp, and sdv fields are fields that are used to describe the source used to collect features.
4. As you create new features or modify existing features, the feature level metadata attributes will be automatically populated with the values from the selected metadata favorite.

#### Working with edit templates

Editing templates are provided as a starting point for collecting common types of topographic features. By default, when editing templates are created in ArcMap, one template is created for each symbol. Editing templates are pre-populated with the mandatory attributes for each type of feature.

1. If necessary, turn to the **Create tab** in the Manage Features dialog
2. Right-click anywhere in the template list in the Create Tab and choose **Select Views Workspace**…
3. Ensure that the Views Table Location is set to the **Product Library**. Click OK.
4. Right-click anywhere in the template list in the Create Tab and click **Load Templates from View > CTM\_25K\_EditTemplates**

See: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/loading-feature-templates-from-a-view.htm>

#### Validating features

Validation rules are provided to ensure that features being collected or modified meet the attribute and spatial integrity rules for the data. Validation rules can be run on-the-fly as you make edits or in a quality control stage after editing is completed.

Attribute rules stored in the product library can be run using the Apply button in Feature Manager. Anytime you change attributes and click the Apply button the attributes are checked against the attribute validation rules before the attribute change is committed. To validate features using CTM Attribute Validation rules:

1. Select any template from the template list in the Create Tab. For example, **Building / important** from the StructureSurfaces layer.
2. Change an attribute in the Create Attributes window. For example, set the Feature Function (**FFN**) attribute to **931 – Place of Worship**.
3. Click the **Apply** button. If the attribute combination fails a validation rule, a message will popup reporting the issue.
4. Change the value for the Religious Designation (**REL**) attribute to **4 - Christian**.
5. Click the **Apply** button. The Validation Results dialog is closed and no errors are displayed. You can now use your template to create new features.
6. For more information about on-the-fly validation see:

<http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/validating-attributes-using-a-batch-job.htm>

Spatial rules stored in the product library can be run using the Run Selected Batch Jobs tool on the Production Editing toolbar. Anytime you edit feature geometries, you can run the tool on the selected features or the current extent to validate the spatial accuracy of the edits. To validate features using CTM Spatial Validation rules:

1. From the Bookmarks menu, choose the **Validation Extent** bookmark.
2. From the Production Editing toolbar, click the down arrow next to the Run Selected Batch Jobs tool and choose Select Batch Jobs.
3. Set the Choose Extent option to **Current Extent**.
4. Click OK.
5. Click the **Run Selected Batch Jobs** tool.
6. For more information about the Run Selected Batch Jobs tool see:

<http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/validating-a-selected-set-of-features-with-batch-jobs.htm>

### Creating a new Civilian Topographic Map database

When you are ready to begin data production for your own data, you will want to start by creating a new geodatabase with the CTM schema. In Production Mapping, we call this the production database. Once the production database is created, a link must be created between the production database and the product library that contains the editing configurations you explored in the previous section.

The following steps describe how to create a production database as a file geodatabase, however, these steps can also be used if creating a new SDE geodatabase. When setting up the production database in SDE, best practice documents are available to help you appropriately configure the SDE repository.

* + For more information about administering your production database in **SQL Server** see:

<http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/introduction-to-storing-the-production-mapping-workspace-in-sql-server.htm>

* + For more information about administering your production database in **Oracle** see: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/introduction-to-storing-a-production-mapping-geodatabase-in-oracle.htm>

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#### Create a new CTM database

If you do not wish to use the sample CTM geodatabase provided which includes data near Salt Lake City, UT, you can create a new geodatabase that has the CTM schema and topology rules but does not include any data.

1. Open ArcMap
2. In the Catalog window, navigate to the CTM directory.
3. Create a new file geodatabase and give it a name such as My\_CTM.gdb
   * See: <http://desktop.arcgis.com/en/desktop/latest/manage-data/administer-file-gdbs/create-file-geodatabase.htm>
4. <your location>\Fixed25K\Schema\CTM\_1\_0.xml is a geodatabase schema workspace xml which contains the data model schema for CTM. Import the CTM schema into your new geodatabase.
   * See: <http://desktop.arcgis.com/en/desktop/latest/manage-data/geodatabases/importing-a-geodataase-schema-from-an-xml-workspace-document.htm>
5. If you have existing data that you wish to load into your new CTM database, use the appropriate tools to load the data.
6. <your location>\Fixed25K\Schema\TopologyRules.rul is a topology rules file which contains the rules that will be used to constrain the CTM data. Create a new topology in the CTM dataset in your new geodatabase.
   * See: <http://desktop.arcgis.com/en/desktop/latest/manage-data/topologies/creating-a-topology.htm>
   * When prompted to select feature classes to include, click the Select All button.
   * When prompted to specify rules for the topology, click the Load Rules… button and browse to the TopologyRules.rul file.

#### Loading data into CTM

If you are planning to produce your own data using CTM, you will likely have existing data that you would like to migrate into the CTM schema. There are many ways to load data using ArcGIS. Choosing the appropriate tool for data migration will be based on many factors like the existing data format and if this will be a one-time load or a repeated process. CTM does not include any pre-configuration data migration files. However, if your existing data is already in an Esri format (coverage, shapefile, or geodatabase), the Data Loader tools in Production Mapping can be used to help you create a mapping file and load your data. See <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/production-mapping/data-conversion-in-production-mapping.htm> for more information.

#### Link the CTM database to the configuration rules

All of the editing configuration rules used in Production Mapping are stored in the product library. In order for the rules to be applied, a link must be created between the data you are editing and the product library.

1. If necessary, Open ArcMap
2. If necessary, set the product library to the CTM\_Product\_Library.gdb. See [Setting up the CTM product library.](#_Setting_up_the)
3. Add data from the **My\_CTM.gdb** to ArcMap, this is the database you created following the [Create a new CTM geodatabase](#_Create_new_a) steps above.
4. In the Product Library window, if necessary, expand **Production Data**.
5. Right-click the **My\_CTM.gdb** and click **Create Production Database**.
6. Once the process is finished, right-click the **My\_CTM.gdb** and click **Choose Data Model Versions**.
7. Choose **CTM (1.0.0.0)** and click OK

### Validating Civilian Topographic Map data

Quality control is an important part of producing authoritative data. Data Reviewer allows you to encapsulate data quality rules in a batch job which can be automatically run against your data. Data Reviewer also provides a framework for data validation which allows you to track data errors an anomalies as they are found, fixed, and verified. A number of quality control rules have been pre-configured for validating the quality of the CTM data. If you already executed the [Validating features](#_Validating_features) steps above, you learned how on-the-fly validation of features can happen as part of your data editing workflow. In this section you will learn how to perform systematic quality control on CTM data. The same set of validation rules can be used for by on-the-fly validation and quality control.

#### Create a Reviewer Workspace and Session

A Reviewer Workspace is used as a location for storing information about errors in your data. Each person performing quality control can have their own local Reviewer Workspace or a central Reviewer Workspace can be created in an enterprise geodatabase. The following steps describe how to create a Reviewer Workspace as a file geodatabase, however, these steps can also be used if creating a new SDE workspace. When setting up the Reviewer Workspace in SDE, best practice documents are available to help you appropriately configure the SDE repository.

* + For more information about administering your Reviewer Workspace in **SQL Server** see: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/data-reviewer/introduction-to-storing-the-data-reviewer-workspace-in-an-enterprise-geodatabase-in-sql-server.htm>
  + For more information about administering your Reviewer Workspace in **Oracle** see: <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/data-reviewer/introduction-to-storing-the-reviewer-workspace-in-a-geodatabase-oracle.htm>

A single Reviewer Workspace can have many errors. Reviewer Sessions are used to organize the errors. Reviewer Sessions can be created based on any criteria you choose such as by user, by date, or by the geographic area being validated.

1. If necessary, open the **CTM\_25K\_DataEdits.mxd** from the CTM\Fixed25K\SampleData directory
2. In the Catalog window, navigate to the CTM directory.
3. Create a new file geodatabase and give it a name such as MyReviewer.gdb
4. On the Data Reviewer toolbar, click **Reviewer Session Manager**.
5. For the Reviewer Workspace, browse to the MyReviewer.gdb you just created.
6. If desired, change the User Name.
7. Click the New button.
8. For the Spatial Reference, choose the Use Active Data Frame Spatial Reference option.
9. Click OK.
10. Enter a Session Name such as CTM Validation.
11. Click Start Session.
12. Click Close.
13. Return to the Catalog window and right-click to refresh the MyReviewer.gdb

You will see that a feature dataset and a number of tables were added to the MyReviewer.gdb. The Reviewer Workspace is now setup so you can begin recording errors.

#### Validating data with a batch job

Batch jobs store quality control rules that are used to validate your data. A number of batch jobs have been pre-configured to ensure the integrity of data in the Civilian Topographic Map schema. To learn more about how to create a batch job see <http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/data-reviewer/batch-jobs-and-data-reviewer.htm>.

1. If necessary, open the **CTM\_25K\_DataEdits.mxd** from the CTM\Fixed25K\SampleData directory
2. From the Bookmarks menu, choose the **Validation Extent** bookmark.
3. Click the **Reviewer Batch Validate** button on the Data Reviewer toolbar.
4. Make sure the **Current Extent** option is chose for the Feature to Validate.
5. Click **Add from File…**
6. Browse to the <your location>\Fixed25K\BatchJobs directory.
   * In the BatchJobs directory you will see two folders: CTM\_Attribute\_Checks and CTM\_Spatial\_Checks. The CTM\_Attribute\_Checks folder contains a collection of batch jobs designed to validate that the attributes of features are populated correctly. The CTM\_Spatial\_Checks folder contains a collection of batch jobs designed to ensure the spatial integrity of individual features as well as ensuring the correct topological relationships between features.
7. Browse to the <your location>\Fixed25K\BatchJobs\CTM\_Attribute\_Checks folder and choose **CTM\_OnTheFly\_Validation\_Checks.rbj**. Click Open.
8. More than one batch job can be added for validation. Click **Add from File…** again.
9. Browse to the <your location>\Fixed25K\BatchJobs\CTM\_Spatial\_Checks folder and choose **CTM\_Geometry\_on\_Geometry\_Check.rbj**. Click Open.
10. Click Run.

The chosen batch jobs will run on the features within the Validation Extent bookmark. When validation is complete a message will popup indicating that a number of records were written to the Reviewer Table.

1. Click OK.

#### Exploring Errors

Data Reviewer supports the quality control lifecycle. When running a batch job, the data is reviewed and any errors are recorded to the Reviewer Workspace. This is the first step in the lifecycle. Once errors are recorded, you can use the Reviewer Table to visit the errors. If changes are required to the data you can edit the feature and update the status of the record in Reviewer. If desired, you can run the batch job again or have someone inspect the fixed feature in order to verify that the error has been resolved.

1. Click the **Reviewer Table** button on the Data Reviewer table.
2. If necessary, move or dock the Reviewer Table in a location where you can see the recorded errors.
3. Scroll through the errors in the Reviewer Table. The table records information about the feature that has the issue, what the issue is, and metadata about who found the error and when it was identified.
4. Select the **Source** column and drag it to the area labeled Drag a column header here to group by that column.
5. Expand the **Source: TransportationGroundCrv** group
6. Select a record and double-click.

When a record is double-clicked, the feature that has the error is selected and the map zooms to the location of the error. Based on the value in the Check Title, Check Notes and Description files, you can determine why the feature was returned as an error. You can use any standard editing tool to fix the issue but once the issue is fixed, you will need to update the status of the error in Reviewer.

1. Right-click on the record and choose **Enter Correction Status**.
2. Choose values for the Update Status and Correction Notes such as Resolved and Per Guidance.
3. Ensure that the Automatically verify results option is enabled.
4. Click OK.

The status of the record has been updated. Scroll to the right in the Reviewer table and you will see that values have been populated in the Correction and Verification fields.

### Creating Civilian Topographic Map Fixed 25K Cartographic Products

Once data is collected over an area, CTM provides the styles, map templates, and other cartographic configurations to make a compelling cartographic product at a scale of 1:25,000.

#### Exploring the 25K Map Template

The CTM25KTemplate.mxd is a map document that contains the cartography and layout for the 25K Civilian Topographic Map product.

1. If necessary, unzip the **SaltLakeCity.zip** in the CTM\Fixed25K\SampleData directory.
2. Open the **CTM25KTemplate.mxd** from the CTM\Fixed25K\Cartography\MapTemplates directory.

When the map document is opened, all of the data sources will be broken.

1. Update the data in the map document to point to the SaltLakeCity.gdb you unzipped in step 1.
2. Turn to Layout View and explore the contents of the map document.

#### Applying 25K symbology to the data

Civilian Topographic Map uses representations to symbolize the data. The SaltLakeCity sample data already has representations applied to the data. If you edit the sample data or create your own data, you will need to apply representations to the data before creating your cartographic products.

1. If necessary, install the **Civilian Topographic Map (CTM).style.** See [Setting up the CTM Style](#_Setting_up_CTM).
2. If necessary, open the **CTM25KTemplate.mxd.**
3. If necessary, set the product library to the CTM\_Product\_Library.gdb. See [Setting up the CTM product library.](#_Setting_up_the)
4. Browse to or search for the **Calculate Visual Specifications** geoprocessing tool. Calculate Visual Specifications is in the Production Mapping Tools\Symbology toolset.
5. Choose the appropriate Input Features. If you have updated data, make sure to select all the feature classes that had changes. To explore how the tool works, choose StructurePoints.
6. Ensure that the Visual Specifications Workspace is pointed to the CTM\_Product\_Library.
7. Choose CTM\_25K :: 25K VST for the CTM as the Visual Specification.
8. Leave the default values for the remaining parameters and click OK.
9. Representations will be applied to the chosen input features.

#### Creating cartographic products

Once the data sources in the template mxd have been updated and symbology has been applied to the data, you are ready to create output products. A Map Generation python script has been provided to automate the output of cartographic products in various formats. This tool can be used to create maps over any 25K map sheet extent. An area of interest (AOI) feature class is required for selecting the map sheet extents.

1. If necessary, close the CTM25KTemplate.mxd and open a new map document in ArcMap.
2. Add the **SLC\_AOIs** feature class from SaltLakeCity.gdb\Reference\_Layer to ArcMap.  
   The SLC\_AOIs feature class contains 4 polygons. These are the map sheets that contain the Salt Lake City sample data.
3. If desired, select one feature from the SLC\_AOIs feature class. If a feature is selected, maps will be created only for the selected features. If no features are selected, maps will be created for all of the features in the SLC\_AOIs feature class.
4. In the Catalog Window, browse to <your location>\Fixed25K\Cartography\MapGeneration.

In the MapGeneration directory there is a python toolbox that contains a tool that will automatically create the maps over the selected areas of interest.

1. Open the **Map Generation** tool from the Fixed25K\_MapGenerator.pyt
2. Choose the **SLC\_AOIs** layer from the map as the Map AOI.
3. Choose **QUAD\_NAME** as the Map Name Field.
4. Select the **CTM25KTemplate.mxd** as the Map Document Template.
5. Select the **CTM\_UTM\_WGS84\_grid.xml** in the <your location>\Fixed25K\Cartography\Grids directory as the Grids and Graticules XML.
6. Choose an export type such as **Production PDF**.
7. Browse to a directory on your machine as the Working Directory. You must have write access to the Working Directory as this will be the location where the output product is created.
8. If Production PDF is chosen as the export type, select the **CTM\_Production\_PDF.xml** in the <your location>\Fixed25K\Cartography directory as the Production PDF XML.
9. If you updated the data sources for the CTM25KTemplate.mxd when [Exploring the 25K Map Template](#_Exploring_the_25K) you do not need to specify a Production Workspace. If the map template has broken data sources or you wish to create a map using a database different from the one in the map template, you can browse to that database as the Production Workspace.
10. Click OK

A map product is created in the working directory. In addition to the extent of the map sheet being updated to match the extent of the feature chosen from the SLC\_AOIs feature class, other information in the layout such as the Sheet Name and Location Diagram are also updated.