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Evolution of Best Practices for Metadata Change Control in SAS®9

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ABSTRACT

The concepts for change control around the SAS® Metadata Server have remained fairly constant throughout the releases across SAS®9. The best practices for how to manage the change process, though, have evolved as the tools have evolved. This paper identifies some best practices for implementing processes using the metadata promotion tools, comparing SAS® 9.1.3, SAS® 9.2, and SAS® 9.3. The paper is intended for SAS system administrators who are familiar with the SAS architecture and the role that the metadata server plays. We focus on how to structure the metadata environment, the tools available for handling changes in metadata, and best practice processes that control how change occurs.

INTRODUCTION

"Change control" is the process of controlling change—from change requests to approval to execution and validation. Change control differs from "change management," which includes the process for managing changes in your IT environment. In general, "change control" is focused on content, whereas "change management" includes the hardware and software deployment. SAS provides specific capabilities around change control to help you minimize risk in your production environment.

The need for change control hasn't changed over the years. It is still a tried-and-true process for managing risk in your environment. In fact, it is highly recommended that you implement a change control process if you have not done so already. The SAS architecture allows you to support either a simple change control process within a single environment or a more traditional process across multiple SAS deployments on different machines.

A paper published several years ago, _Best Practices for SAS®9 Metadata Server Change Control_, covered what were then new capabilities around partial promotion. These capabilities, which were part of our SAS 9.1.3 release, supported a change control process that moved content from development (DEV) to test/QA (TEST) to production (PROD). Since then, additional promotion capabilities have been added to SAS 9.2 and SAS 9.3 to simplify and automate the process. This paper focuses on the change control capabilities that are provided as part of the SAS platform. SAS solutions might have additional capabilities in this space, but they are not discussed here.

SAS METADATA

The SAS Metadata Server continues to be at the core of the SAS 9 architecture. It provides a central metadata repository that stores information about assets created through SAS interfaces (Figure 1). The SAS Metadata Server facilitates the sharing of content across SAS applications to provide a consistent representation of the business to all constituents in your organization. As a result, it is critical that the information that is surfaced to end users in a production environment be rigorously protected from the impacts of change.
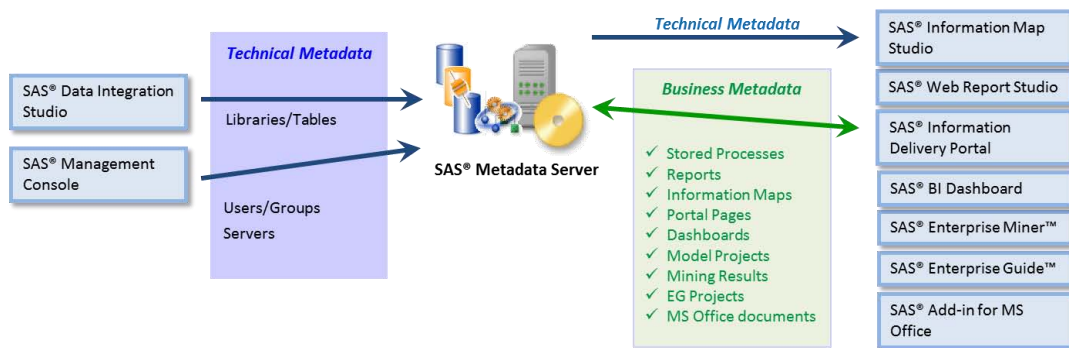

Figure 1. SAS Metadata Server

At a high level, the metadata server stores two categories of metadata: technical metadata and business metadata. Technical metadata refers to information about the SAS environment itself. This metadata includes definitions for servers, libraries, users, and user groups. Business metadata includes anything that is typically created by a business domain expert, such as reports, mining projects, and stored processes.

CHANGE CONTROL PROCESS

It is important to have a change control process for SAS metadata-based content. The more business analytics becomes ingrained into standard daily operations, the more critical it is that the system stays reliable, accurate, and timely. The goals of an effective change control process for SAS metadata-based content are:

- to minimize the impact of changes on metadata integrity and service levels

- to allow coordination and planning of changes to provide a stable production environment

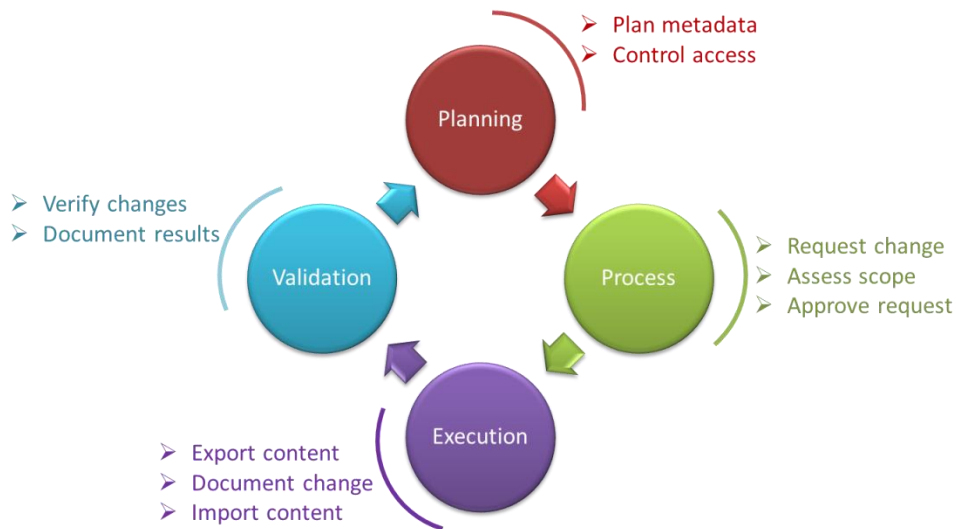- to maximize productivity of the personnel involved in the change management process

Figure 2. Change Control Process

The main steps making up a change control process (see Figure 2) include:

- Planning – determine how change control is managed

- Process – establish a clear set of processes to handle, communicate, and approve requests

- Execution – establish best practices for using SAS tools to conduct the promotions

- Validation – incorporate clear validation rules and tests to ensure metadata integrity

How you deal with each of these steps will differ slightly depending on the version of SAS you are using. The high-level differences among versions are shown in the following table (Table 1):

Step	SAS 9.1.3	SAS 9.2	SAS 9.3
Planning	Fixed structure based on BIP Tree	Synchronized metadata folders between environments	Flexible metadata folder structure
	Promotion support only for a subset of business metadata	Promotion support for business metadata only	Promotion support for both business metadata and technical metadata
Process	Manual	Manual or batch	Manual or batch; SAS® Data Integration Studio versioning

Step	SAS 9.1.3	SAS 9.2	SAS 9.3
Execution	BI Manager SAS® Management Console plug-in	SAS Management Console metadata tree plus filtering	SAS Management Console metadata tree plus filtering and search
Validate	Manual	Manual	SAS Management Console package comparison

Table 1. Differences between SAS 9.1.3, SAS 9.2, and SAS 9.3

SAS 9 BASELINE SUPPORT FOR CHANGE CONTROL

Change control is managed primarily through the export/import framework for metadata promotion that is surfaced interactively in SAS Management Console. From the metadata content tree, you can select one or more objects or folders and export a copy of the content into an .spk file. The .spk file, which is similar to a .zip archive, can contain both metadata and physical file content. You can then import the .spk file into the target environment, whether that is on the same metadata server or a different metadata server.

PLANNING

> ➢ Plan metadata
> ➢ Control access
>
> Planning

Your organization's needs and system architecture will have an impact on how you should configure the metadata that is associated with your SAS environment. It is imperative that SAS system administrators clearly define and restrict where changes can be made throughout the reporting environment.

To control the impact of changes from multiple constituencies, it is a best practice that metadata be organized to segregate corporate content from ad hoc content. Changes to corporate content should occur only via established change control processes. Ad hoc content driven by business users should be separated in such a way that ongoing changes do not impact any corporate content. Ideally, the folder structure should also reflect how change will be managed within your organization. If different departments will have specific content that needs to participate in the promotion process, then folders should be created specifically for those departments. If change will be managed via projects, then folders should be created for each project.

You can use metadata permissions to restrict the ability to change corporate content. The specific settings can vary among the DEV, TEST, and PROD environments, depending on your promotion process. However, all environments will need to restrict non-authorized users from writing and updating content.

SAS 9.1.3 SP4

With the release of SAS 9.1.3 Service Pack 4, the tools that support partial promotion were enhanced to integrate both data integration (DI) and business intelligence (BI) generated content. As a result, more options are available to manage content in the SAS metadata environment.

- **BI Manager plug-in version 1.4 for SAS Management Console:** The BI Manager plug-in was introduced with SAS 9.1.3 Service Pack 3. This plug-in consolidates the functionality of and replaces the Stored Process Manager and Business Report Manager plug-ins, as well as extending functionality into the area of partial promotion. Partial promotion is supported by the ability to export selected metadata content from one repository and import it into another (or the same) repository. The export results in a SAS package file (similar to a .zip archive) that contains the selected content from the source metadata repository. A user interface is provided to remap properties to match the properties in the target repository. This mapping accounts for different paths, library names, and server names.

  In SAS Management Console, the BI Manager plug-in version 1.4 was extended to support DI-related content. The plug-in now provides partial promotion for the following metadata objects:

  - **BI-related content:** Reports, stored processes, information maps, and data explorations

  - **DI-related content:** SAS® Data Integration Studio jobs, libraries, tables, generated transformations, notes, documents, and external files

  - **Other content:** Mining results and metadata tree folders

- **SAS Data Integration Studio 3.4:** SAS Data Integration Studio 3.4 integrated the same underlying framework as the BI Manager plug-in as it relates to partial promotion. The functionality includes copy/paste-special, which provides the ability to copy and paste metadata objects within a single repository as well as across repositories.

The import process mirrors the folder structure that is included in the export package. Therefore, the folder structure that is used in DEV must be identical to the folder structures in TEST and PROD. In SAS 9.1.3, it is easier to manage promotion across different environments for DEV, TEST, and PROD. The BIP tree can be configured to support "virtual" environments that reflect different top-level folders (that is, a folder for DEV, a folder for TEST, and a folder for PROD), but the folder structure that is required to support SAS® Web Report Studio makes it difficult to set up and manage this environment.

SAS 9.2

In SAS 9.2, we enhanced the partial promotion framework to provide more flexibility for incorporating existing change management processes. We made it easy to organize and select a subset of objects based on specific criteria. For example, you can select only new objects created since a certain date, only objects of a specific type (such as reports or SAS Data Integration Studio jobs), or only objects that have been modified since the last promotion process.

The partial promotion framework in SAS 9.2 adds support for a wider range of business metadata objects. Additional objects supported in addition to those supported in SAS 9.1.3 include:

- **BI-related content:** SAS® Enterprise Guide® projects, SAS® Add-In for Microsoft Office documents, and prompts

- **DI-related content:** OLAP schemas and OLAP cubes

- **Other content:** Channels, subscribers, and message queues

Dashboard content is also supported via promotion, but only between separate physical environments. Portal content can also be promoted, but it is performed via a different mechanism using provided APIs.

The metadata folder tree that was introduced in SAS 9.2 provides much greater flexibility for organizing folders. A specific folder structure is no longer required to support applications such as SAS Web Report Studio. In addition, any objects stored in the metadata tree are governed by authorizations applied to the metadata tree, thus streamlining authorization inheritance.

As a result, it is much easier to configure DEV, TEST, and PROD environments within a single metadata server by setting up top-level folders and organizing content within those folders. Folder structures still must be mirrored between the environments, as the import process still copies the exact folder structure to the target location.

SAS 9.3

In SAS 9.3, we've added the ability to promote more business metadata content, as well as technical metadata such as:

- SAS Application Servers
- users, groups, and roles
- access control templates

In SAS 9.3, it is not necessary to keep metadata folders mirrored between environments. The import process in SAS Management Console enables you to reorganize content by specifying new folder locations for individual objects that you are importing. The connections among objects are maintained.

To use this feature, select an object (for example, an information map) on the Select Objects to Import wizard page. Then select the **Properties** tab, as shown in Display 1:
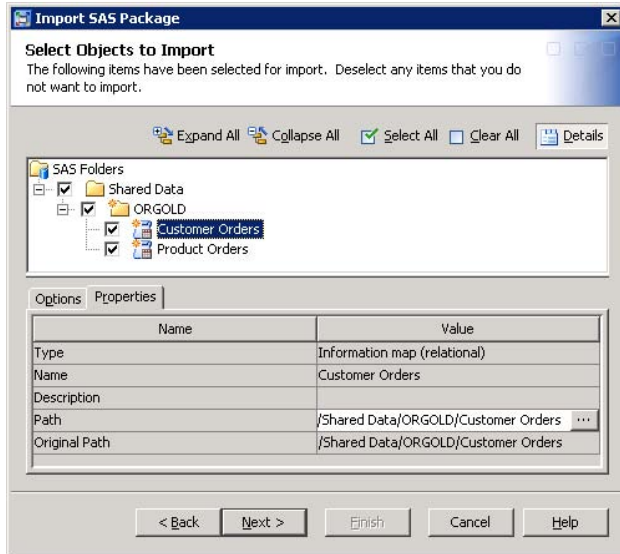
Display 1. Import SAS Package Wizard: Properties Tab on the Select Objects to Import Page

In the Value column of the Path field, click the **Browse** button. When the Select a Location dialog box appears, select a target location in the SAS Folders tree. You can use the **New Folder** button in this dialog box to create a new folder.

You must repeat these steps for each object that you want to move. This feature allows you to move any folders except the highest-level folder that you are importing. Technical metadata, such as metadata for servers and access control templates, uses "virtual" folders to package the content. Therefore, you cannot change the folder location of these objects. The batch import process has also been updated to support the movement of objects into different folders.

PROCESS

> ➤ Request change
> ➤ Assess scope
> ➤ Approve request

Written change control processes are required to prevent inappropriate changes from happening. Inappropriate changes include changes made without complete review and approval from stakeholders in the organization. Having established processes ensures the quality and integrity of the impacted content. Therefore, as a best practice, it is important to establish a consistent change control process that addresses:

- Request for change – including communication to stakeholders

- Assessment of the scope of the change – including testing of the requested changes

- Approval of appropriate changes

The request for change should be the first step of the process. This starts the change control process by identifying what needs to be changed (that is, promoted) and communicating the request to all stakeholders. The request should clearly state who is requesting the change, what objects are to be changed, when the changes should occur, and the justification for the change. All stakeholders impacted by the proposed change should receive notification of the request. Gather as much detail up front as possible so that expectations can be measured against the results of the promotion.

The scope of the change should be assessed to determine if the change can be contained to a single parent folder. If the change crosses multiple peer folders without a clear parent (below the root of the metadata tree), then justification must be provided on the need for a wide-scope change. This situation should generate a warning. A change of this magnitude could impact the entire repository, so it must be reviewed closely before being considered.

Approvals from all stakeholders should be required before the promotion can occur. This ensures that the request has been communicated appropriately and that everyone has agreed on the expected outcome. Approvals should be documented for auditing and traceability. Systematic tracking of these approvals is not provided today by the SAS platform. You should implement a tracking process based on your organization's best practices.

SAS 9.1.3 SP4

When changes are requested, you might want to require that the content to be promoted be consolidated into a SAS package file (via the BI Manager plug-in) before the request is submitted. You could require the package file to be included as part of each request. Preparing the package up front helps with documenting exactly what is to be changed. The downside is that the changes might still continue to be fluid until the actual promotion occurs. In this case, an export file that was created earlier would not be accurate. You should account for potential fluidity as part of your change control process. This is also relevant for other versions, but more of a best practice for SAS 9.1.3.

SAS 9.2

SAS 9.2 includes a command line interface that enables you to promote a collection of public objects (for example, a collection of folders, stored processes, jobs, and tables) from one metadata server to another in batch mode without any user interaction. The interface provides the same functionality as the export and import wizards in SAS Management Console. You can use the command line interface to create a repeatable and scheduled process for moving metadata and associated content across environments. The two command-line tools, ExportPackage.exe and ImportPackage.exe, are located within the "commands" directory of your SAS Management Console installation.

Specific code examples can be found in [documentation](#) and in the paper *[Metadata Promotion in SAS® 9.2](#)*.

BATCH EXPORT

The batch export tool enables you to export a collection of objects from a source metadata server to a SAS package file (.spk). It is possible to export individual objects as well as entire folder structures using this tool. This process exports the metadata for the public objects as well as any content files (for example, .sas files and .srx files) associated with the public objects. The package file can then be imported to a target metadata server, either with the new batch import tool or the Import Wizard.

When you run the batch export tool, three files are created: the SAS package file containing all metadata and associated content, an export log file, and a substitution properties file. You can use the substitution properties file to specify different target objects to which you want to connect during the import operation. You can also use this file to modify object-specific values, such as an object's physical path or description. When it is time to run the import command, you can use the substitution properties file in conjunction with the SAS package file to import the package contents along with the modified object connections and properties.

BATCH IMPORT

The batch import tool can import any SAS package file that was created with the batch export tool, the Export Wizard in SAS Management Console, or the Export Wizard in SAS Data Integration Studio to a target system. As with using the Import Wizard, ensure that your target environment contains the necessary dependencies. For example, all server definitions, directories, and so on need to exist on the target in order for the import process to run as expected. Missing content on the target system could potentially cause the import to be incomplete or fail altogether.

If the source and target environments have the same setup, then a package file can be imported without any additional work. In this case, the package file can be imported using all of its default settings. For example, if a stored process was associated to the SASApp server on the source system, it will be connected by default to the SASApp server on the target system.

The batch import tool uses a substitution properties file in which you can map any differences in naming between the source and target environments. The file can contain two types of properties: connection properties and substitution properties. Connection properties are used to describe the connections between objects being imported and existing objects on the target metadata server. Substitution properties allow for modifications to object-specific values such as descriptions, physical paths, and port numbers.

SAS 9.3

SAS 9.3 continues to support both the manual and the batch processes that are available in SAS 9.2. New in SAS 9.3 is the ability to link SAS Data Integration Studio with a content versioning system such as the Concurrent Versions System (CVS) or Apache™ Subversion®.

Version control enables you to track changes to SAS Data Integration Studio objects over time. Versioning works by moving content such as jobs and other objects into a file and archiving that file in a versioning system. SAS Data Integration Studio creates the file as a SAS package and writes it into the source management system. To bring content back into the repository, SAS Data Integration Studio retrieves the content stored in the source management system and places it back into the SAS metadata repository. In this way, you can create different versions of content and restore previous versions of content when needed.

Objects can be versioned independently, or they can be versioned with other objects to make up a package of related content. This ability enables you to archive sets of objects that are logically related, such as all of the content in a project. You can also choose to generate source code for a job and store it along with the job as text content. This function makes it easy to see the source code associated with a specific version of a job. You can view archived results of any object to see when it was last versioned. This function lets you identify previous versions of objects that you might want to restore and maintain a history of changes.

After you have created versions of a selected object, you can access the versioned objects in the Archived SAS Packages window in SAS Data Integration Studio. The window displays a list of all the versions of all the archived objects so that you can access and maintain the versions. You can select an object and view the differences between versions of the selected object, or the differences between an archived version and the current version of that object (Display 2).
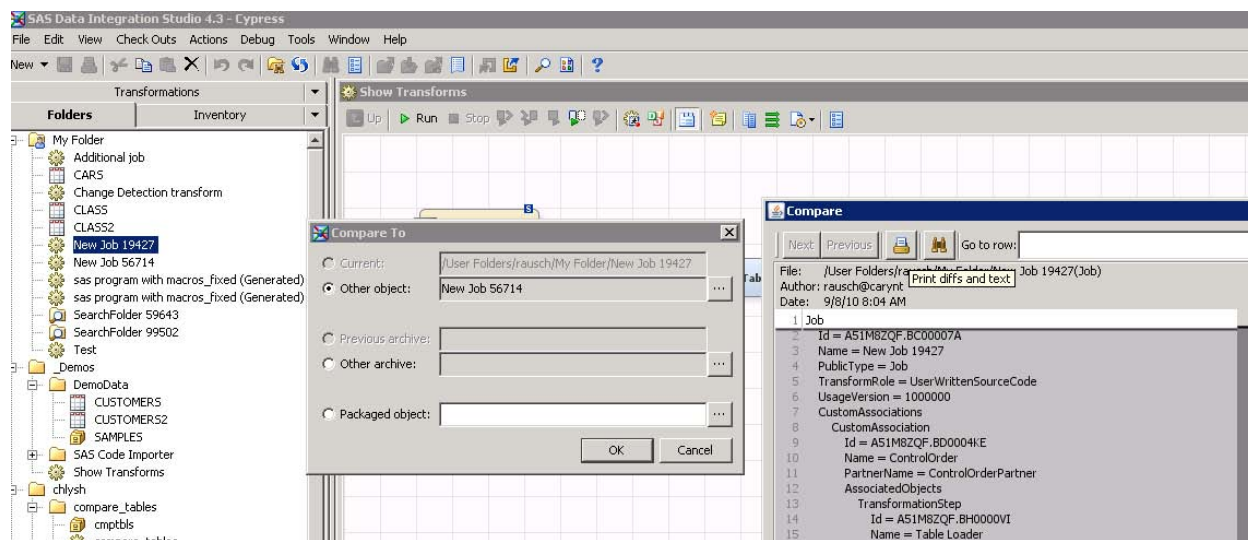

Display 2. View Difference in Versions in SAS Data Integration Studio 4.3

To launch the wizard for archiving metadata, simply click the right mouse button on an object (Display 3). The archive wizard uses the existing import/export metadata wizard with enhancements. It helps you specify a version number, a user, the date and time modified, and a name and description. SAS Data Integration Studio creates a SAS package (.SPK) file and then registers it with the third-party versioning software. It can also be integrated with other versioning and source code management software through the provided documentation and APIs.

7
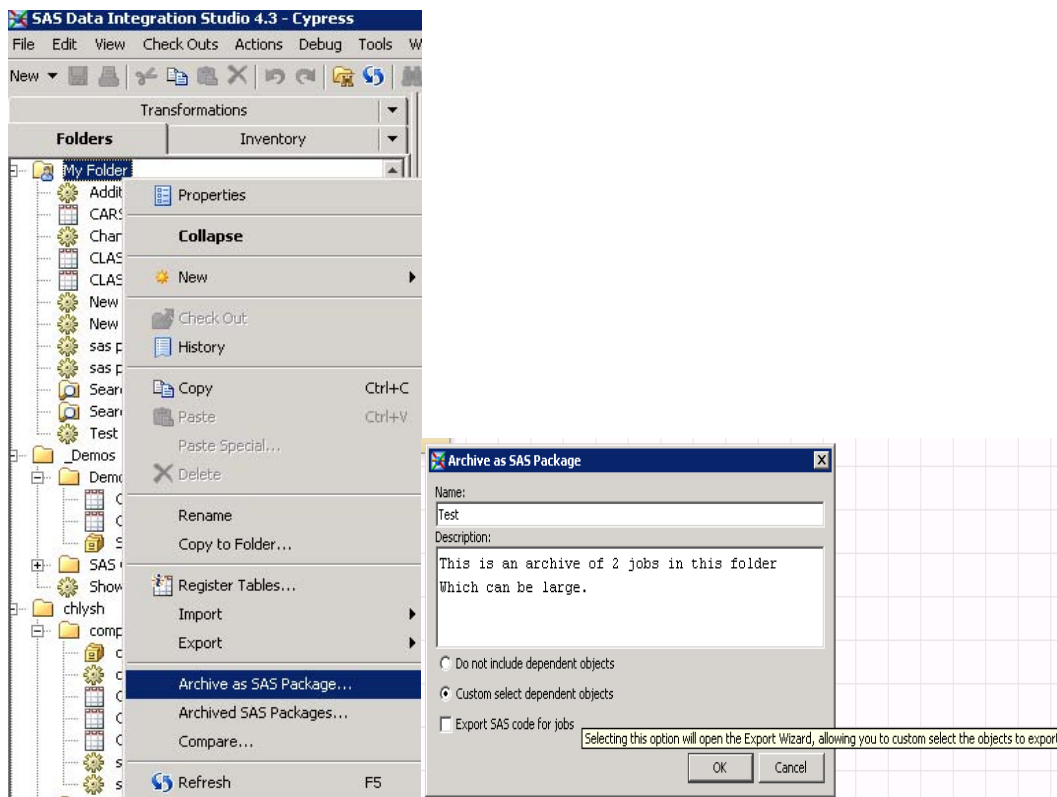
Display 3. Archive Option in SAS Data Integration Studio 4.3

EXECUTION
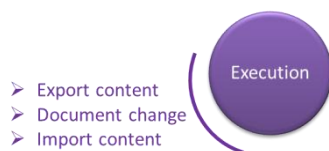
When you actually promote content between environments, the following steps ensure smooth execution within the SAS environment.

- Export content

- Document changes

- Import content

SAS 9.1.3

In SAS 9.1.3, partial promotion is supported through the BI Manager plug-in for SAS Management Console, which enables you to export selected metadata content from one repository and import it into another (or the same) repository. The export results in a SAS package file (similar to a .zip file) that contains the content that was selected from the source metadata repository. A user interface enables you to re-map properties to match the properties in the target repository. This mapping accounts for different paths, library names, and server names.

SAS 9.2

In SAS 9.2, we incorporated the promotion functionality into the metadata content tree view. As shown in Display 4, the **Folders** tab surfaces the metadata content tree.
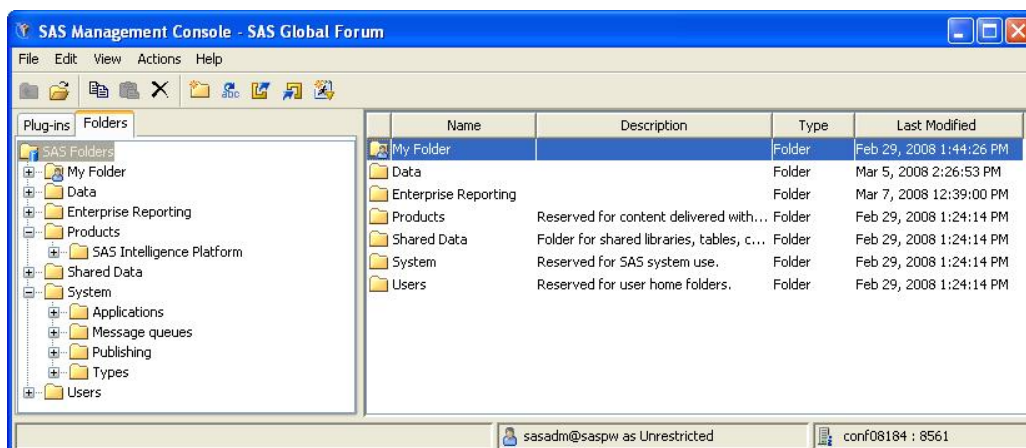
Display 4. SAS Management Console in SAS 9.2

Right-clicking on a folder in the SAS Folders tree displays a menu from which you can select the option to export or import a SAS package. This is the partial promotion framework. Selecting either option launches a wizard interface.

EXPORT FILTERING

The Export Wizard in SAS 9.2 has been enhanced to support a filtering capability (Display 5). Filtering enables you to subset the objects that are to be included in the export process. For example, if you are promoting a collection of objects from a development environment to a test environment, you can select only those objects that were modified during a given timeframe.
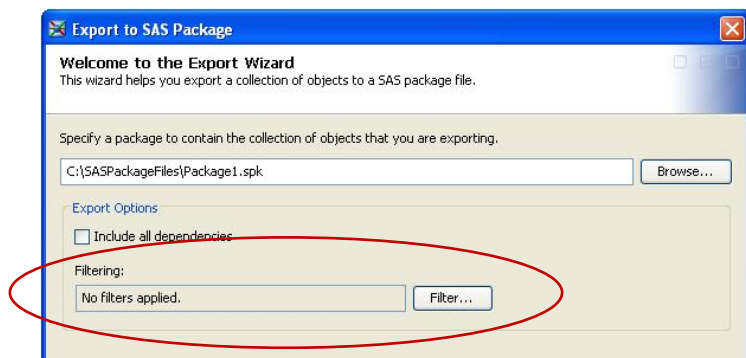
Display 5. Options Available in the Export Wizard

When creating a SAS package file, you can select the following types of filters: object name filters, type filters, and date filters.

- Object name filtering enables you to specify the name, or part of the name, of an object. You can select the **Include description** check box if you want to search the object's description as well as the name.

- Object type filtering enables you to choose from a list of object types the types that are to be included in the export. By default, all object types are selected.

  When exporting a folder structure, you generally do not need to include empty folders in the export process. If a folder doesn't contain any objects or subfolders, it will be excluded from the export. However, the filter dialog box allows you to override this setting by selecting the **Include empty folders** check box. This option is not selected by default.

- Date filtering enables you to filter objects based on when they were created or last modified. You can define your own date range or choose from a list of predefined ranges. Both absolute and relative dates are supported.

SAS 9.3

The **Search** tab in SAS Management Console (Display 6), which is new with SAS 9.3, enables users to search for metadata objects based on object names, locations, descriptions, object types, creation or modification dates,

keywords, and responsibilities. After performing a search, click the **Save** button on the **Search** tab to specify a folder and location in which to store the search criteria. Opening a search folder causes the search to be rerun and updated search results to appear.
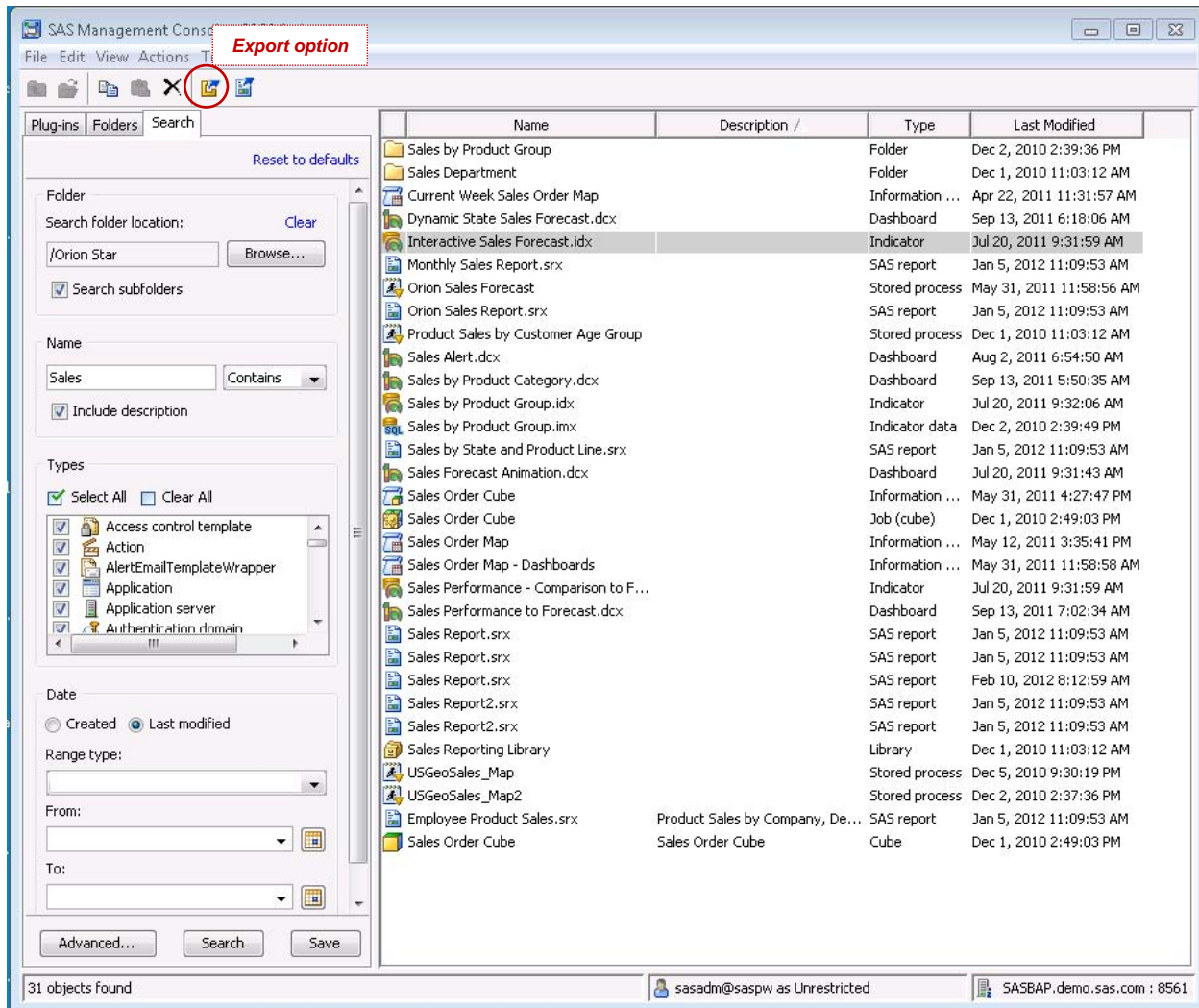
Display 6. Search Tab in SAS Management Console

VALIDATION

➢ Verify changes
➢ Document results

After the import is completed, the changes should be validated to ensure that the new content is functioning as expected, and that the legacy content has not been impacted. The results of the validation should be documented.

The owner of the change request should verify that the changes were imported appropriately and that the new content is functioning as expected. In addition, a standard regression test should be run to validate that any unchanged legacy content continues to function without problems. These steps need to be part of the standard change control process.

Whatever the results of the validation, they should be documented as part of the change control process. All stakeholders should be informed of the outcome. Any additional changes that might be required should be submitted through the change control process. Doing so provides essential documentation to understand what activity is taking place in the metadata repositories.

SAS 9.1.3

The Export Wizard in SAS 9.1.3 contains some basic object dependency features, but there are no out-of-the-box capabilities specifically designed for validation. Therefore, validation is essentially managed outside of the SAS environment. As a best practice, SAS recommends that after the promotion is completed, you should create detailed documentation of the promotion, including:

- a copy of the .spk file that was created

- the log file from the import process

- a complete record of the change request, including who requested the change, who made the change, where the change was made, reconnection parameters, and existing dependencies

SAS 9.2

The dependencies feature within the Export Wizard has been enhanced in SAS 9.2 to support two-directional impact analysis. This feature enables you to view and select the objects on which a specific object depends. The **Used By** tab can display which objects are used by an object that is being exported. For example, when a library has been selected for export, the **Used By** tab displays all tables contained in the library.

In the following example (Display 7), a set of four information maps was originally selected for export. When a single information map is selected, the **Dependencies** tab displays all libraries and tables on which this information map depends. You can then select which of these objects to include in the export package. After a library is selected, the **Used By** tab can be used to discover all tables contained in this library.
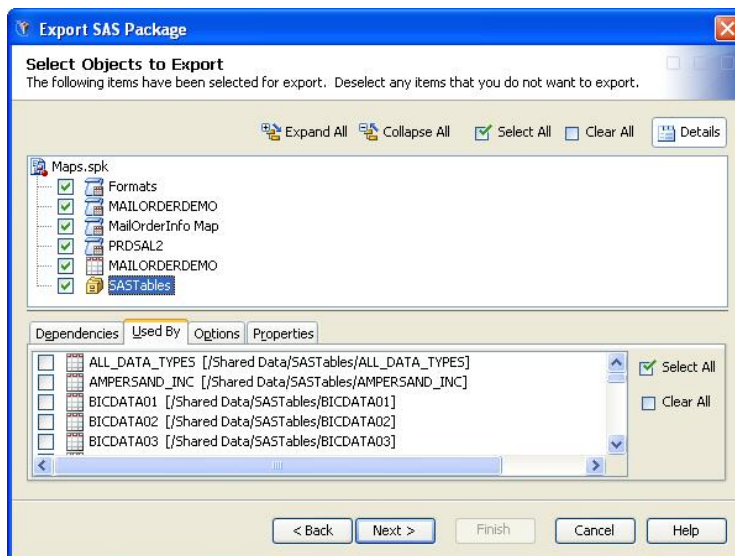
**Display 7. Used By Tab in the Export Wizard**

Rather than requiring you to select every object to retrieve its list of dependencies, SAS 9.2 provides an additional option that enables you to automatically retrieve all dependent objects during the export process. This option, called **Include all dependencies**, recursively retrieves all dependencies on the objects that were originally selected for export.

SAS 9.3

When you import metadata for a table or external file, and a table or external file of the same name already exists in the target folder, you can use the Change Analysis feature of the import wizard to identify and resolve differences in column metadata. This feature is new with SAS 9.3. Use the feature to control column handling on either a global or a fine-grained basis, as follows:

1. On the Select Objects to Import page, highlight one or more tables or external files that you are importing.

2. On the **Options** tab, you can select or deselect the following check boxes to specify how column differences are to be handled by default for this import:

- **Keep target columns not found in the source** is selected by default. This option retains columns in the target table if the columns are not present in the imported table. Deselect this check box if you want to delete columns from the target table if the columns are not also in the imported table. (In the next step, you will be able to override this action for individual columns.)

- **Include source columns not found in the target** is selected by default. This option adds columns from the imported table if the columns are not present in the target table. Deselect this check box if you do not want to add any new columns to the target table. (In the next step, you will be able to override this action for individual columns.)

3. Click the **Change Analysis** button to view column information for each table that you are importing. In the Change Analysis dialog box, you can update the check boxes as needed to specify how each column is to be handled during the import. Select a column to view its change analysis information, as shown in this example (Display 8):
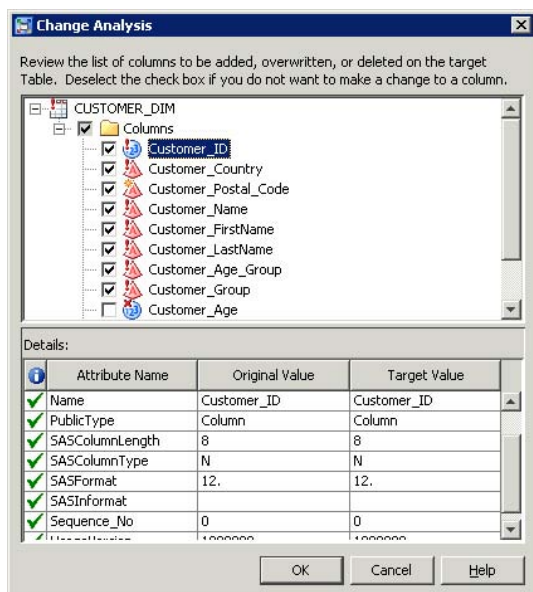
Display 8. Table Change Analysis Dialog

CONCLUSION

Establishing a formal change control process is essential for managing change within the SAS metadata architecture. Because the SAS Metadata Server is the central gateway for sharing content across SAS applications, it is critical that changes to the content be managed in a controlled environment. SAS has continually added enhancements to the out-of-the-box promotion capabilities to simplify and automate the process.

In SAS 9.3, you can also take advantage of workflow services (included as part of SAS® Integration Technologies) to create a custom application that automatically triggers a promotion process based on a set of rules and actions.

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