SAS[®] Metadata Audit Reporting Transition to Modern BI & Analytics

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Abstract In today's world, there has been huge transition from traditional BI (Business Intelligence) and Analytics to the modern one. In the past, we used to have a countable number of canned reports and analytical models; in modern BI (Self-Help reporting/In-memory/Tonnes of data) and Big Data Analytics space, the volumes have been growing very fast from a few Giga Bytes to Zeta Bytes of data. Starting from sourcing the data from disparate sources, housing them in various formats (structured to unstructured to text to streams) and finally landing them at Big Data/Data Lake platform for BI, Reporting, Visualization and Analytics use; IT change impact analysis and maintenance has been a challenge. That's when auditing and reporting metadata bring values to the problems. In every organization, Group IT requires a strategy to track data utilization or system adaptation in order to accelerate their decision-making process from time-to-time towards the growth and maturity. SAS[®] 9 has various auditing features and solutions like SAS[®] Audit, Performance and Measurement Package, SAS[®] Environment Manager Audit Reporting and SAS[®] VA (Visual Analytics) Administrator's Usage Reports. In this paper, an in-house and out-of-the-box users audit and metadata reporting approach has been depicted. It includes features like tracking number of SAS users and their usage of various client applications and the contents. It has also capability of capturing details like the various dormant SAS users/groups among the total registered SAS users/groups, an automatic housekeeping, scheduling and so on. If you are seeking for a solution for quick turn-around, it would help you to guide your organization whereby Enterprise BI & Analytics softwares like SAS[®] (EBI) Enterprise BI, SAS[®] EDI (Enterprise Data Integration) and/or SAS[®] Visual Analytics have already been deployed.

Keywords Log Parsing, Metadata Reporting, Business Intelligence, Visual Analytics, Audit, Data Governance, Operation Risk, Architecture

1. Introduction

In today's scenario, there has been a big ask from any organization's top management that their success, growth and maturity should be Data and Analytics driven whereby faster data origination, maintenance and governance of various forms of data like raw or unstructured or processed data rested at OLTP/ODS/Data Marts/Data Warehouse/Data Lake or streaming data or formatted data rendered through Canned/Self-Help Reports/Scorecards/Analytical models. Regular IT Application User's Audit or Operation Risk Assessment is a common practice of the IT department for any organization. Generally audit would be conducted by internal or external parties or regulators. For any organization, EIM(Enterprise Information Management) and Analytical applications like SAS[®] Enterprise BI and/or SAS[®] Visual Analytics activity would be monitored on Quarterly or Half-yearly or Yearly basis. The users would be spread across the globe and registered in a centralized SAS[®] Metadata Repository hosted in AD/LDAP or PAM or Kerberos Servers or so. The objectives here are to find out what type of contents one department has been interested in, have these been duplicated due to silos, are these critical for their business, what the usage patterns are and how to improve the overall Operation and Governance and so on. In turn, either this solution has been helping or would help in cost saving and new service offerings in near future. The approach has been adopted in this paper would depict an out-of-the-box and automated solution in order to save FTE (Full Time Employee) or manual efforts. The original study was performed and implemented for SAS[®] 9.2. It was then extended to SAS[®] 9.3 Enterprise BI, Enterprise DI environments (e. g. reference to document et al. [4]) and also deployed in SAS[®] 9.4 Enterprise BI, Enterprise DI environments with minimal changes. The framework is an alternative and cost-effective solution to SAS[®] EPM (Audit, Performance and Measurement Package), SAS[®] Environment Manager Audit Reporting and SAS[®] Visual Analytics Administrator Usage Reports related solutions which are either being purchased and/or packaged

separately along with other SAS® 9 software bundle. The Metadata Reporting and Data Lineage is one of the key aspects of today's BI, Data Analytics and Data Governance horizon. As a part of the solution, it helps us to capture, track and report the usage of the key applications or the reports or the types of data usage for the specific users. This in turn would help a department to focus on their future data strategy and roadmaps. The paper has been written for the benefits of the Analysts, SAS Administrators, Architects, Project Managers, Risk & Compliance Managers, Regulators/Auditors and Data Stewardship professionals; including HOD of EIM, CDO(Chief Data Office) and Analytics for ROI and key decision making process.

2. Purpose and Benefits

The primary objective is to devise a framework to track usages of SAS® Enterprise BI toolsets which was customized and implemented for many organizations. This solution was provided as a part of the Regulatory or Operation Risk or Compliance requirements (including InfoSec like GDPR/PDPA or so) from them. For a Telco's case, the EIM team had invested on SAS® Enterprise BI and Analytics platform that was a strategic move. They would like to track the adaptability of the systems and types of data being used. They were also looking at a strategy for BI systems migration from SAS® to other platforms without major impacts. The solution supported them greatly in order to track: total registered users/groups, how many of them active and inactive (not using SAS® applications for not a single instance) and then perform clean-ups to reduce maintenance cost. It had also been helping them to identify the list of users using different types of data, reports, dashboards, scorecards and models along with the SAS tool like SAS® Enterprise Guide, SAS® Add-in for Microsoft Office, SAS® Web Report Studio, SAS® Model Manager and SAS® BI Dashboard. It had enabled their decision making process - strategy and roadmaps in line with Group IT functions. The solution is almost an automated approach that had furnished saving manual efforts like FTE. Earlier it used to take about 7 business days in order to complete the entire audit process manually. It was possible to complete the entire audit reporting process by 3 business days post automation. At times, it had been helping SAS Administrator greatly in order to find out - how many users actively using SAS® applications and thereby plan or manage their support time effectively in some other activities. It, in turn, helped them migration of the inactive SAS® users and their contents to some other BI tools phase by phase with the help of the usage/metadata reports. The framework can be used for other industry with almost zero-cost and minimal customization efforts. The solution has potential commercial aspects for its reusable components, robustness and ease of deployment. The said framework

can also be showcased as part of their EIM BI & Analytics CoE (Center of Excellence). Currently, the solution has been deployed successfully in SAS® 9.2, SAS® 9.3 and SAS® 9.4 environments without any migration, support or maintenance issue. In fact, this concept and idea was used elsewhere like public sectors for their regulatory requirements where SAS® 9 Software was also deployed. With extending the framework from traditional to modern BI & Analytics scenario, there have been huge benefits whereby lots of data visualizations and reporting activities have been monitored through the audit reports. It is also capable of analyzing end users interest on various data usage through metadata reports and proposes future solution offerings to the respective user's departments. Its huge relief to the administrators in order for them to better manages or monitors the systems and resources. In short, Metadata Management and Data Governance is the key in oceans of data. It is possible to achieve the success amidst the challenges like organization silos, data quality issues, various stakeholders buy-ins, legacy systems, not utilizing the right tool and so on. The log parsing technique can be used other areas like if you try to scan/parse logs for checking any passwords, IP Address, data truncations and any other types of Compliance/Operational Risk requirements. The framework can also be extended to CRM arena where SAS® applications like SAS® Customer Intelligence, SAS® Real-Time Decision Manager or so in order to track campaign related activities and so on. Once you are able to identify the inactive or dead metadata objects like Users, Groups, Reports, Stored Process, Tables, Columns, Models etc through the Metadata Reports, it would help us to reduce the overall system resources and improve system performance and finally their overall ROI.

SAS® 9 Architecture – Evolutions

With the new SAS® 9 architecture: SAS® Open Metadata Architecture and SAS® Intelligence Platform (e. g. the features were introduced et al.[1]) and it's continuous evolutions, SAS® multi-tier deployment was smooth and had improved over the times in order to resolve issues around Scalability, High-availability, Fault-tolerance/Load Balancing, Authentication/Security, Multi-tiers deployments: Client – Server (SMP) or distributed computations (MPP/Grid) and so on.

Origination of the foundations of this framework for SAS users audit was for SAS® 9.2 based on the existing SAS® environments (e. g. SAS Audit and Logging was introduced et al. [1]) and this was later customized, optimized and deployed in SAS® 9.3 and SAS® 9.4 respectively. Here, various SAS® 9 architectures have been visualized in order to show SAS® 9 clients-servers communications which in turn would help us to understand SAS®9 audit and logging framework better. It does help us to take us through the evolution of SAS® architectures over the years under various versions of SAS® 9. In particular,

the Modern BI World, the built-in audit features, various logging, recording and reporting users' activities and such users' artifacts - how efficiently stored, accessed and managed in par with the latest cutting-edge technology

suite. It also takes us through an example of modern BI and Analytics deployment where SAS® Visual Analytics has been deployed under Hadoop ecosystem with or without SAS® Grid computing (Fig 6).

Figure 1. SAS® Intelligence Platform (taken from SAS® 9.1.3 document et al.[1])

SAS® 9.1.3 Architecture

Figure 2. SAS® 9.1.3 Architecture scenario (taken from SAS® Support website)

SAS® 9.2 Architecture

Figure 3. SAS® 9.2 Architecture (taken from SAS® 9.2 document et al. [3])

SAS® 9.3 Architecture

Figure 4. SAS® 9.3 Architecture (taken from SAS® 9.3 document et al. [8])

SAS® 9.4 Architecture

P.S.: SAS® SPDS Server, SAS® Help Viewer, SAS® Forecast Studio, SAS® JMP, SAS® Workflow Studio, Mobile Device applications are out of scope in a EBI deployments.

Figure 5. SAS® 9.4 Architecture (taken from SAS® 9. 4 document et al. [9])

SAS® 9.4 HPA Architecture - SAS® Visual Analytics

Figure 6. SAS® 9.4 Modern BI Scenario, High Performance Analytics & VA (taken from SAS® 9. 4 VA document et al. [13])

SAS® Log Analysis and Parsing

In this section, the logging difference across SAS® 9.2, SAS® 9.3 and SAS® 9.4 have been discussed in details. Starting with SAS® 9.3 (e. g. refer document et al. [4]), it was possible for a client application (e. g., a desktop application or a web application) to pass its name to a SAS® IOM Server (introduced in SAS® 9 – Integration Technologies et al. [2]). The server can use the name of the client for logging and auditing. The new default behavior is for the name of your application to appear in IOM server logs whenever your application causes a connection to be made to an IOM server. For example, when SAS® Web Report Studio causes a connection to a Workspace/Pooled Workspace server, it results in messages similar to below.

SAS 9.2 Object Spawner Log

Here SAS logs do not display any application name.

2014-01-17T09:55:03,461 INFO [00022106] sas - New out call client connection (3264) for launched server (child 1227). Peer IP address and port are [::ffff:10.44.36.15]:47677.

SAS 9.3 Metadata Server Log

Here SAS logs do not display any application name.

2015-01-23T11:40:19,785 INFO [00026316]:sastrust@saspw - New client connection (383) accepted from server port 8561 for user sastrust@saspw. Encryption level is Credentials using encryption algorithm SASPROPRIETARY. Peer IP address and port are [::ffff:10.44.36.9]:37851.

SAS 9.3 Workspace Server Log

2015-03-19T16:31:21,332 INFO [00000009]:prdckmp9 - 48 %LET _CLIENTVERSION = '4.3.0.10196';

2015-03-19T16:31:21,332 INFO [00000009]:prdckmp9 - 49 %LET _CLIENTAPP = 'SAS Enterprise Guide'

SAS 9.3 Object Spawner Log

2013-06-18T02:40:57,342 INFO [00004088] sastrust@saspw - New client connection (451) accepted from server port 8701 for SAS token user sastrust@saspw. Encryption level is Credentials using encryption algorithm AES. Peer IP address and port are [::ffff:10.4.36.174]:56189 for APPNAME=WRS.

SAS 9.3 Metadata Server Log

2013-06-18T22:07:05,766 INFO [00166206]:sastrust@saspw - New client connection (486)

accepted from server port 8561 for user sastrust@saspw. Encryption level is Credentials using encryption algorithm AES. Peer IP address and port are [::ffff:10.4.36.174]:60175 for APPNAME=WRS. 2013-07-08T09:09:48,454 INFO [00000028]:sasdev@XXXXXXX - 6% LET _CLIENTVERSION = '5.100.0.12269';

SAS 9.3 Workspace Server Log

2013-07-08T09:09:48,454 INFO [00000028]:sasdev@XXXXXX - 7 %LET _CLIENTAPP = 'SAS

Enterprise Guide'

2013-07-09T14:59:32,939 INFO [00000028]:sasdev@XXXXXX - 37 %global applName;

2013-07-09T14:59:32,941 INFO [00000031]:sasdev@XXXXXX - 38 data _null_;

2013-07-09T14:59:32,941 INFO [00000031]:sasdev@XXXXXX - 39 applName="SAS Data Integration Studio"

2013-07-09T14:59:32,941 INFO [00000031]:sasdev@XXXXXX - 40 call symput('applName',%nrstr(applName));

2013-02-03T14:42:30,177 INFO [00000756]:etluser - New client connection (16) accepted from server port 63583 for SAS token user etluser. Encryption level is Credentials using encryption algorithm SASPROPRIETARY. Peer IP address and port are [::ffff:10.96.9.148]:57780 for APPNAME=Web Report Studio 4.3.

Because this was new feature in SAS® 9.3, it is used only in a select number of client applications (e. g. similar features were introduced and referred as et al. [11]). In SAS® 9.4, almost all client applications pass their name to the servers, so it will be a lot easier to track them!

For example, in SAS® 9.3 there is no way to tell if an access to the SAS® Metadata Server belongs to SAS® Management Console or to other clients like SAS® Information Map Studio or SAS® OLAP Cube Studio, just to name the most used.

In SAS® 9.4, there is a clear distinction. Even with the default log, you can find SAS® Management Console entries from the user (in this case sasadm@saspw) as shown in.

SAS 9.4 Metadata Server Log

2015-09-20T20:33:01,031 INFO [00067581]:xxxxx@xxxxxx- New client connection (4250) accepted from server port 8561 for user xxxxx@xxxxxx. Encryption level is Credentials using encryption algorithm SASPROPRIETARY. Peer IP address and port are [::ffff:10.44.58.119]:51758 for APPNAME=Web Report Studio 4.4.

2015-09-21T14:06:52,594 INFO [00241754]:sasadm@

saspw - New client connection (13700) accepted from server port 8561 for user sasadm @ saspw. Encryption level is Credentials using encryption algorithm SASPROPRIETARY. Peer IP address and port are [::ffff:10.130.129.154] :50015 for APPNAME = SAS Management Console 904200.

SAS 9.4 Object Spawner Log

```
2015-09-22T00:13:32,287 INFO
[00046746] :xxxx@xxxx - New client connection (4547)
accepted from server port 8701 for SAS token user
xxxxxx@xxxx. Encryption level is Credentials using
encryption algorithm SASPROPRIETARY. Peer IP
address and port are [::ffff:10.44.58.119]:55677 for
APPNAME= Web Report Studio 4.4.
```

SAS 9.4 Workspace Server Log

```
2015-09-22T15:47:12,182 INFO [00000009] :xxxxxx -
6 %LET_CLIENTVERSION = '7.100.0.1966';
2015-09-22T15:47:12,182 INFO [00000009] :xxxxxx -
7 %LET_CLIENTAPP = 'SAS Enterprise Guide'
```

By default, the SAS® Audit, Performance and Measurement Package track these logs and parse the APPNAME parameter/value pairs. The package artifacts and audit_transactions SAS data sets contain a wealth of data that will drive insightful report (e. g. as explained in et al. [3]).

Likewise if we consider modern BI – SAS® Visual Analytics platform, there are built-in audit capabilities which help to track various resources like SAS LASR™ tables, VA Reports, environment related resource details like CPU, IO, memory (RAM), about various node's health status and not limited to access control (ACT) changes or any other type of auditable metadata or related artifacts.

Below log would show SAS® Visual Analytics logging pattern.

```
2017-06-18T02:40:57,342 INFO [00004088] xxxx -
New client connection (501) accepted from server port
8821 for SAS token user xxxx. Encryption level is
Credentials using encryption algorithm AES. Peer IP
address and port are [::ffff:10.2.36.144]:56189 for
APPNAME=Web Infra Platform Services – Visual
Analytics Designer 7.3.
```

```
2017-06-18T02:40:59,355 INFO [00004088] xxxx -
New client connection (5098) accepted from server port
8861 for SAS token user xxxx. Encryption level is
Credentials using encryption algorithm AES. Peer IP
address and port are [::ffff:10.2.36.147]:56189 for
APPNAME=Web Infra Platform Services – Visual
Analytics Explorer 7.3.
```

Analyzer Code Sample

The critical part of the framework is to develop a pattern matching algorithm (e. g. reference taken from et al. [14])

which is available through SAS® 9 Software. The code snippets will show as to how to scan logs for various desktop applications like SAS® DI, SAS® EG (Enterprise Guide), SAS® VA through various SAS logs.

1.

```
data work.temp1(keep=date luser app);
set work.temp;
luser=scan(log,1,'-');
IF _N_ = 1 THEN DO;
PATTERN = PRXPARSE("/appName=");
/* IF MISSING(PATTERN) THEN DO; */
/* PUT "ERROR IN COMPILING REGULAR
EXPRESSION"; */
/* STOP; */
/* END; */
END;
RETAIN PATTERN;
LENGTH app $ 50;
/* INPUT STRING $CHAR80.; */
CALL
PRXSUBSTR(PATTERN,log,START,LENGTH);
/* IF START GT 0 THEN DO; */
app = SUBSTR(log,START+9,LENGTH+50);
/* app = SUBSTR(log,248,30); */
/* app = COMPRESS(app," "); */
OUTPUT;
/* END; */
/* To exclude internal SAS Users. */
/* where (luser not like "%sastrust@%") or (luser not like
"%sasadm@%") or (compress(luser) not like
"lasradm%"); */
run;
/*One-time setup for stacking all the logs together.*/
/*data work.users_90days;*/
/* set work.temp1(obs=0); */
/* label date="Login Date" luser="User Name"
app="Client Application"; */
/*run;*/
data work.users_90days;
set work.users_90days work.temp1(keep=date luser
app);
where app like "%SAS Data Integration Studio%";
run;
```

2.

```
data work.users_90days;
set work.users_90days work.temp2(keep=date luser
app);
/* To exclude internal SAS Users. */
where (compress(luser) <> "sastrust@saspw") and
(compress(luser) <> "sasadm@saspw");
where also app like "%SAS Enterprise Guide%";
run;
```

3.

```
data work.users_90days;
```



```

set work.users_90days work.temp3(keep=date luser
app);
/*To exclude internal SAS Users.*/
where (compress(luser) <> "sastrust@saspw") and
(compress(luser) <> "sasadm@saspw") and
(compress(luser) not like "lasradm%");
where also app like "%Web Infra Platform Services –
Visual Analytics Designer 7.3%";
run;

```

SAS® Metadata Reporting – Overall System Flow

Metadata Management, Data Quality and Data Governance are an integral part of any organization under EIM/CDO umbrella. In today's scenario, the world is moving very fast towards the humongous data platform like Big Data (Hadoop ecosystems), IoT where metadata management is a challenge in ocean of data. With the appropriate metadata management and reporting, this type of automated approach would help to solve the problems with providing right insight with the right data in the right place in the right time. Data could sit in tradition EDW (Enterprise Data Warehouse) or Data Lake or so with heterogeneous formats like flat files, streams, image, Blobs,

texts, logs etc.

The diagram (Fig 7) would depict the data flow for one of the SAS® environment - EDW/SAS® Enterprise BI Reporting streams across the organization. The metadata reporting for the SAS® users is also leveraged through SAS® Enterprise BI and SAS® Analytics Server tool. There were around 650+ users who were using SAS® 9.4 EBI reporting through various SAS® 9.4 clients in scope – predominantly SAS® WRS(Web Report Studio), SAS® AMO (Add-in for MS Office), SAS® EG(Enterprise Guide), SAS® (EM) Enterprise Miner and/or SAS® MM (Model Manager) were used whose usage was tracked through this solution. For a Telco's case, there have been many departments who have been using SAS® for various BI reports (AMO, WRS), EG/EM/MM Projects & BI Dashboards (Fig. 7).

Sample Audit Reports for a Telco

Registered SAS Users can be derived dynamically through this solution. Then the metadata reports will show the list of active SAS users versus registered users (Fig 8). If we deduct one from other list, we get the inactive/dormant SAS users.

Figure 7. SAS® 9.4 EBI & Analytics Server Deployments – Data Flow

List of Active SAS Users(LAST QTR):

Login Date	Active SAS User	Count
15SEP2015		1
15SEP2015		1
16SEP2015		1
16SEP2015		1
16SEP2015		1
16SEP2015		1
16SEP2015		1
16SEP2015		1
16SEP2015		1
16SEP2015		1

List of Registered SAS Users(LAST QTR):

SAS User Name	SAS Group Name	Count
	Marketing Normal Users	1
	ALL SAS Users	1
	Cons-Prod Normal Users	1
	Consumer Product Normal Users	1
	Consumer Product Normal Users	1
	TV Normal Users	1
	Consumer Finance Normal Users	1
	TV Normal Users	1
	TV Normal Users	1
	Consumer Ops Power Users	1
	Portalusers	1
	Regulatory Normal Users	1
	GA Normal Users	1
	Cust Mgmt-Churn Normal Users	1
	Cust Mgmt-Reten Normal Users	1
	Consumer Marketing Normal Users	1
	Portalusers	1
	BizLink	1
	Products Normal Users	1

Figure 8. Sample metadata reports - Active Users Vs Total Users

SAS® Enterprise Guide/Add-in for Microsoft Office Users

Let us go through today's scenario where SAS[®] Enterprise BI, SAS[®] Visual Analytics and SAS[®] Grid Manager were deployed together (Fig 6).

In today's scenario, Modern BI and Analytical users' data flow has been shown. The various users' actions have been tracked through the logs is part of the framework. There is built-in SAS® Environment Manager Data Mart also available (taken reference from et al. [13]). This can be used after enabling the audit features - would harness the benefits for SAS® Visual Analytics usage. The diagram (Fig 11) would visualize the data flow for auditing of data and metadata.

Login Date	WRS User Name	Description	Report Name	Report Rename To	Count
18MAR2015		Logon			5
18MAR2015		Logoff			30
18MAR2015		Logon			15
18MAR2015		Open	/User Folders/- My Folder/		5
18MAR2015		Logon			5
18MAR2015		Save	/User Folders/_My Folder/DD_Customers_Tfc_Day_Month		5
18MAR2015		Logon			10
18MAR2015		Logon			5

Figure 9. Sample metadata reports – Web Reports Users

Login Date	User Name	Client Application	Count
07SEP2015		SAS Enterprise Guide	1
08SEP2015		SAS Enterprise Guide	1
10SEP2015		SAS Enterprise Guide	1
14SEP2015		SAS Enterprise Guide	1
15SEP2015		SAS Enterprise Guide	1
21SEP2015		SAS Enterprise Guide	1
25AUG2015		SAS Enterprise Guide	1
28SEP2015		SAS Enterprise Guide	1
30SEP2015		SAS Enterprise Guide	1
31AUG2015		SAS Enterprise Guide	2
21SEP2015		SAS Enterprise Guide	4
02SEP2015		SAS Enterprise Guide	1
21AUG2015		SAS Add-In for Microsoft Office	1
25AUG2015		SAS Add-In for Microsoft Office	3
26AUG2015		SAS Add-In for Microsoft Office	1
25AUG2015		SAS Add-In for Microsoft Office	1
26AUG2015		SAS Add-In for Microsoft Office	2
29SEP2015		SAS Add-In for Microsoft Office	1
17SEP2015		SAS Enterprise Guide	1
28SEP2015		SAS Enterprise Guide	2
30SEP2015		SAS Enterprise Guide	2
01SEP2015		SAS Enterprise Guide	1

Data Security, Metadata Management & Data Governance

SAS EBI & Visual Analytics Systems

Limit

Exposure

Counterparty

Macroeconomic

Collateral

EDM

Metadata Reports

Figure 11. SAS® 9.4 EBI, High Performance Analytics & Visual Analytics – Data Flow

Flow of Audit Data

Figure 12. SAS® 9.4 Environment Manager, Visual Analytics Audit Reporting – Data Flow (taken from SAS® 9.4 VA document et al. [13])

The possible sever paths are shown below where audit data mart would be located. It can also available as pre-defined library - Environment Manager Data Mart LASR.

<SAS

Config >\Lev1\AppData\SASVisualAnalytics\VisualAnalyticsAdministrator\AutoLoad\EVDMLA\audit_visualanalytics.sas7bdat

<SAS

Config >\Lev1\AppData\SASVisualAnalytics\VisualAnalyticsAdministrator\AutoLoad\EVDMLA\relationships_visualanalytics.sas7bdat

SAS® Metadata folders would show here what are the various types of usage reports are available for the administrators.

SAS Folders\Product\SAS Visual Analytics Administrator\Reports\Usage

Sample SAS VA Admin Reports

Sample Mid-tier Servers Stats:

Figure 13. SAS® 9.4 Visual Analytics Administrators Reports

Figure 14. SAS® 9.4- Environment Manager Sample Reports

SAS® Environment Manager - ACM related Stored Process and Other (WIP Kits) Reports

Similarly, custom audit reports were built based on the audit database created out of SAS® Visual Analytics action logs through this framework. We have already seen the audit logs for SAS® Visual Analytics components like - Visual Analytics Designer, Visual Analytics Viewer & Visual Analytics Explorer etc.

Figure 15. SAS® 9.4- Environment Manager Others Sample Reports

Sample VA Administrator's Usage Reports

Figure 16. SAS® 9.4- Sample Usage Reports

Detailed Solution Design

Figure 17. SAS Log Analyzer Backbone - sets of SAS Programs and Shell scripts

The above diagram (Fig 17) has been portraying the overall solution that has been adopted for the SAS Metadata Audit Reporting that has also been extended to Modern BI & Analytics scenarios. SSH was enabled with per-built key-exchanges across the servers as a pre-requisite. Below are the various activities involved that have been enumerated and explained.

- SAS log files (each quarter/rolling 90 days) are downloaded automatically from the respective SAS Server Tiers using Shell Scripts.
- The logs are scan through 'Log Analyzer' where different log file has different formats for SAS® 9.2, SAS® 9.3 & SAS® 9.4.
- This would scan and parse logs through pattern matching algorithm - regular expression.
- One module would send query to SAS® Metadata Server in order to retrieve the list of users registered under SAS Metadata Repository and would store it in the SAS Audit Database.
- One module would capture list of active SAS Users and login details in the SAS Audit Database.
- Inactive/dormant SAS Users list is also generated dynamically through this framework and would store it in the SAS Audit Database.
- Application wise details are also captured through this framework like - SAS® EG, SAS® OLAP Cube Studio, SAS® Add-in for MS Office, SAS® Web Report Studio, SAS® Visual Analytics and SAS® BI Dashboard etc.
- SAS® Audit Information Maps are built for metadata reporting which is rendered through SAS® Web Report Studio (SAS® Enterprise Business Intelligence)
- Finally, every quarter SAS 'Log Analyzer' Framework has to be triggered first in order to refresh last quarter data and SAS® audit reports can be retrieved through SAS® Web Report Studio afterwards.
- The Audit Database was also accessible to SAS® Enterprise Guide, SAS® Visual Analytics, and SAS® Add-in for Microsoft Office without using SAS® EBI/Information Map for Audit Database.

3. Post-implementation and Regulators Reviews

After few rounds of audits, the framework was quite stabilized. The framework was so robust that customizing the logging features changes across various SAS® versions – 9.2, 9.3, 9.4 with minimal efforts was possible in order to support new capabilities and enhancements. It was able to extend the framework for Modern BI & Analytics related toolsets with minimal efforts addition of logging pattern matching conditions for SAS® Visual Analytics clients like SAS® Visual Analytics Designer, SAS® Visual Analytics

Explorer and so on. This had also showcased the saving of BAU support timing as this is quite automated whereas BAU support time had been utilized in some other activities. This framework was accepted and recognized by external auditors like Deloitte which was conducted quarterly and half-yearly basis. This idea/approach can be used and referred everywhere under the similar issues irrespective of IT applications (SAS®) and industry/sectors. At last, the audit data sets has to be cleaned up in order to remove any further noise or runaway SAS user's session related details towards the readiness – cleaning of data for Metadata Reporting and finally publishing the reports to the various stakeholders for their consumptions.

4. Conclusions

The current framework was running successfully under SAS®9.2 M2/M3 & SAS® 9.4 M2/M3 environments. For SAS®9.4, SAS logs can be generated with appropriate formats. Right now, the framework would be parsing "SAS® Workspace Server/SAS® Pooled Workspace Server", "SAS® Metadata Servers" and "SAS® Web Report Studio/ SAS® Visual Analytics Viewer /SAS® Object Spawner" logs for the overall audit. The framework is an almost automated approach since additional manual steps are performed - sending mail to user's SPOC and identifications of the inactive users which is a manual check in their Mailbox/Intranet Portal and then confirming from their respective SPOCs. Alternatively, SAS® APM Package and SAS® Environment Manager Data Mart for audit reporting like Visual Analytics are also available in order to generate World-Class SAS® Audit Reports - a product of SAS Institutes. SAS® Environment Manager/SAS® APM is more GUI-centric and available under commercial/licensed package. SAS® Visual Analytics auditing is available through built-in audit Data Mart with just enabling the minimal settings (e. g. refer options under et al. [13]). As an alternative to built-in reports, the framework was extended towards the modern BI & Analytics platform like SAS® Visual Analytics. This has been very relevant in today's world as we are living in digital world with application of cutting edge technology with Big Data/Hadoop, AI, ML, DL, IoT etc are in place – adopting the right approach/tool for Metadata/Data Management/MDM is the key to success. With referring metadata (audit) reports, organizations were benefitted towards achieving their goals.

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