ORACLE ENTERPRISE MANAGER 12c

An Oracle Hands-on Lab Workbook
February, 2013

Database Performance Testing, Data Masking, and Data Subsetting Workshop

The objective of this lab to provide exercises designed to showcase the new Real Application Testing and Test Data Management capabilities in Oracle Enterprise Manager Cloud Control 12c.

Database Performance Testing (70 minutes)

A. SQL Performance Analyzer Optimizer (SPA) Statistics Refresh Validation (20 minutes)

A1. Overview of Gathering Statistics Option

A2. SPA Optimizer Statistics Refresh Validation

B. Real Application Testing and Data Masking (50 minutes)

B1. Generate Application Data Model

B2. Define Data Masking Definition

B3. Replay Masked Workload

Test Data Management (50 minutes)

C. Data Masking (30 minutes)

C1. Generate Application Data Model

C2. Create Data Masking Definition

D. Data Subsetting (20 minutes)

D. Define and Execute Subset Based on Application Data Model

Getting Started

I-Pre-requites -

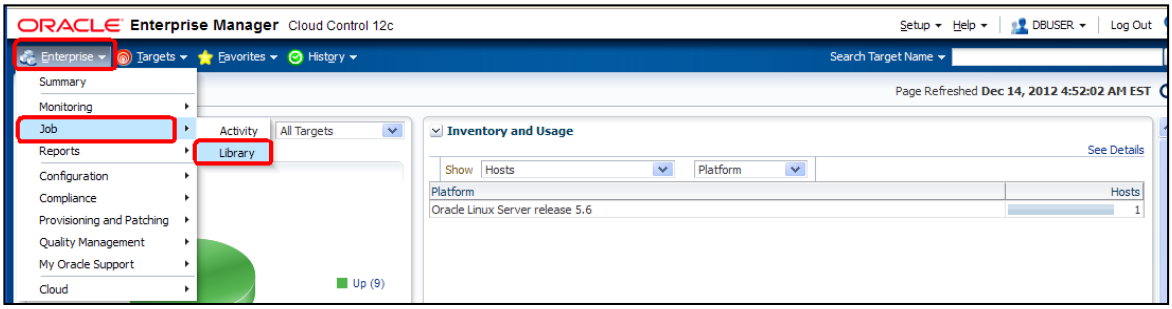
Enterprise Manager (EM) should be running on your lab VM. To verify that EM is running - go to the EM URL provided, you should get the EM login page. If you get an error page, please contact your lab administrator or start Enterprise Manager yourself by following the instructions provided in the lab cheat sheet.

II- Starting lab environment.

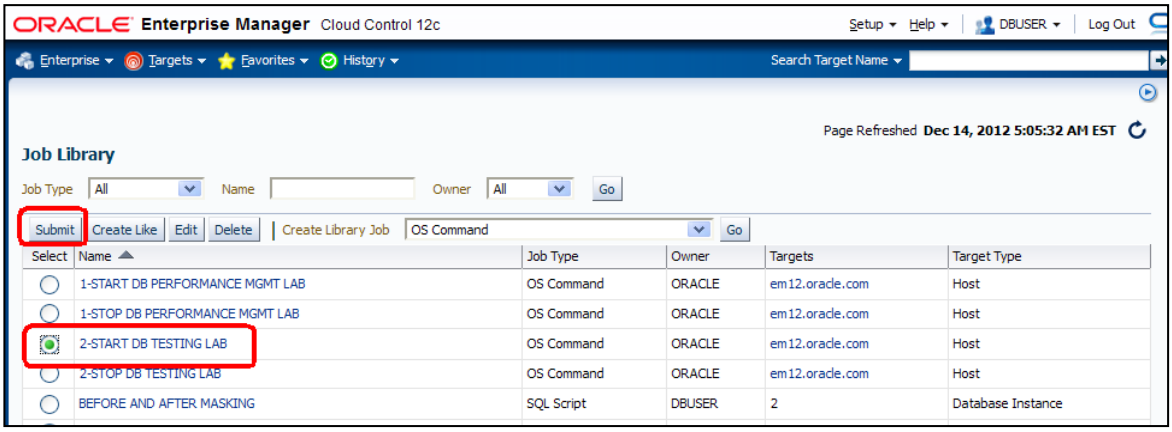
Before you start with this lab, you'll need to start the necessary targets and other processes (as applicable). All the steps have been automated in an EM job **'2-START DB TESTING LAB'**. To execute this job follow the following steps.

1. Login to Enterprise Manager using username and password dbuser / oracle12.

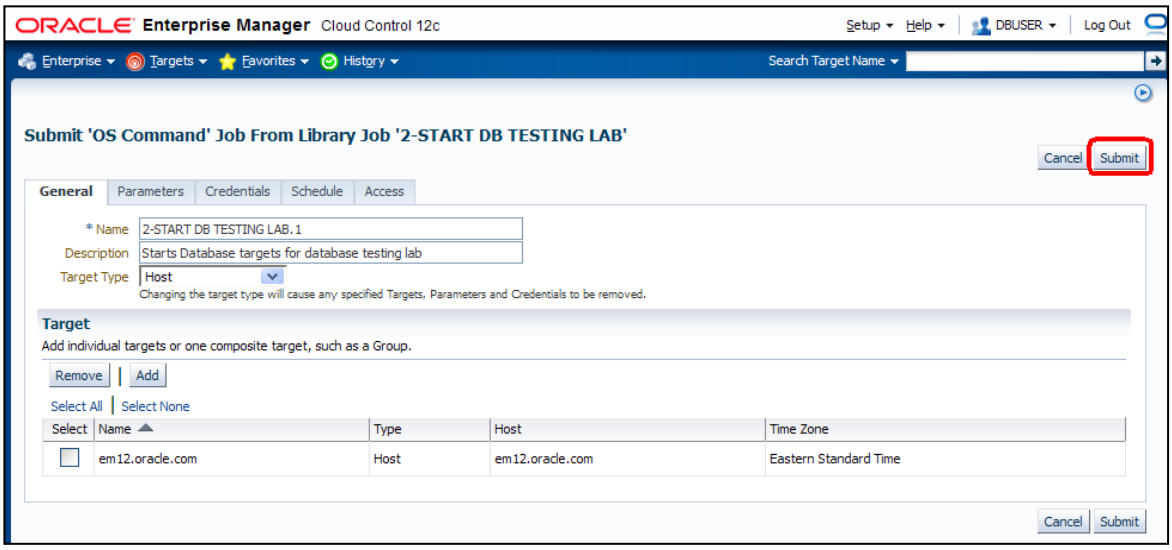
2. Navigate to 'Job Library' page by clicking on menu – Enterprise → Job → Library



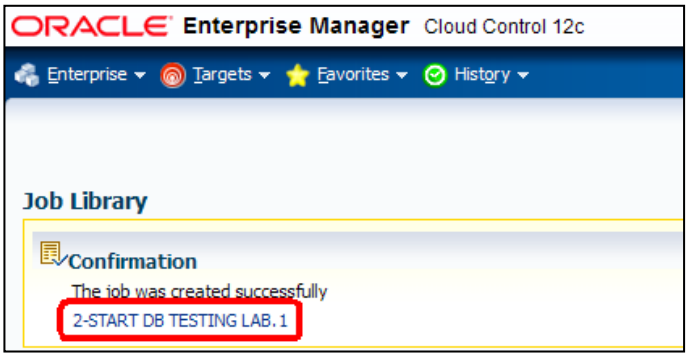
3. Select job '2-START DB TESTING LAB' and click 'Submit' button.



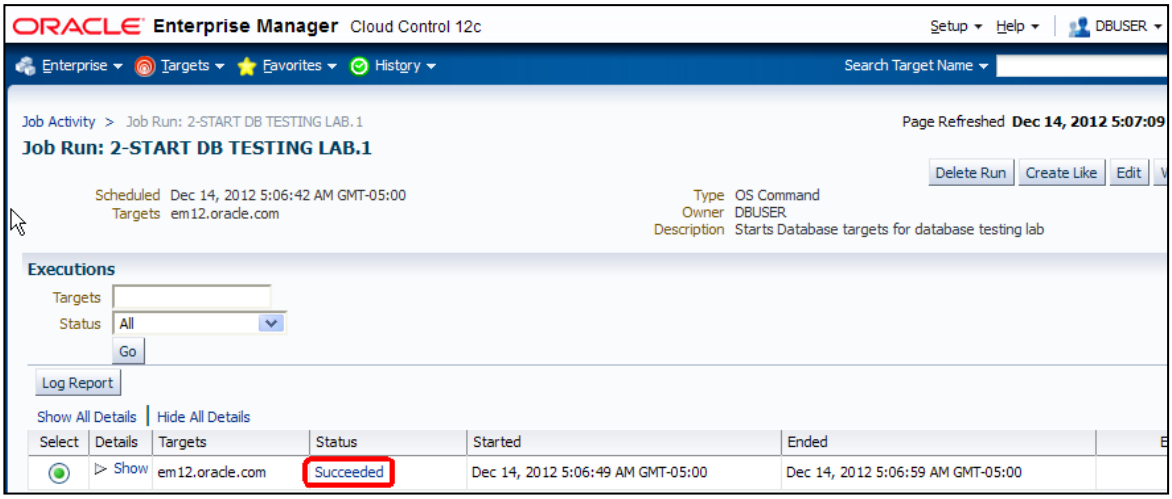
4. Click on 'Submit' button again.



5. To ensure that job ran successfully, click on the job activity link provided in the confirmation message.



6. Look for the status 'Succeeded'. Job takes ~30 seconds. Therefore you might need to refresh page a few times.



7. You can now move on to the lab exercises. Enterprise Manager login has been provided at the beginning of exercise.

III- Shutting down lab environment

After you complete this lab and before moving to next lab, please make sure to stop this lab environment by running the EM job '2-STOP DB TESTING LAB'. To run this EM job you can follow the steps for starting lab environment, and select stop job.

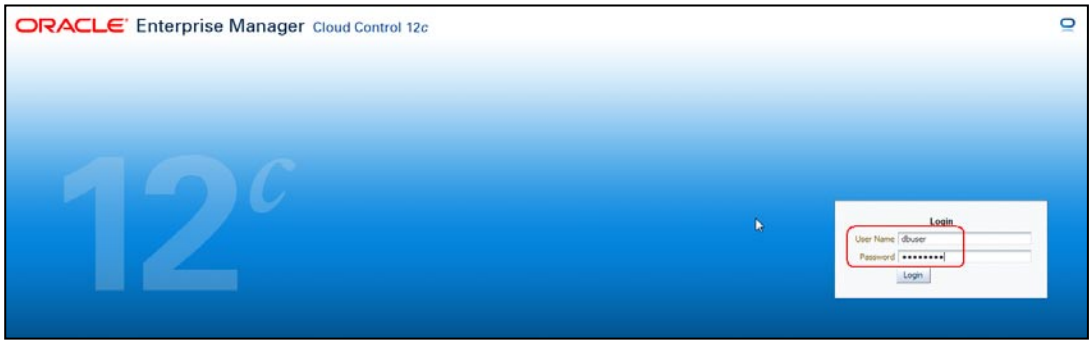
A1. Overview of Gathering Statistics Option

Estimated Time to Complete Use Case: *5 minutes*

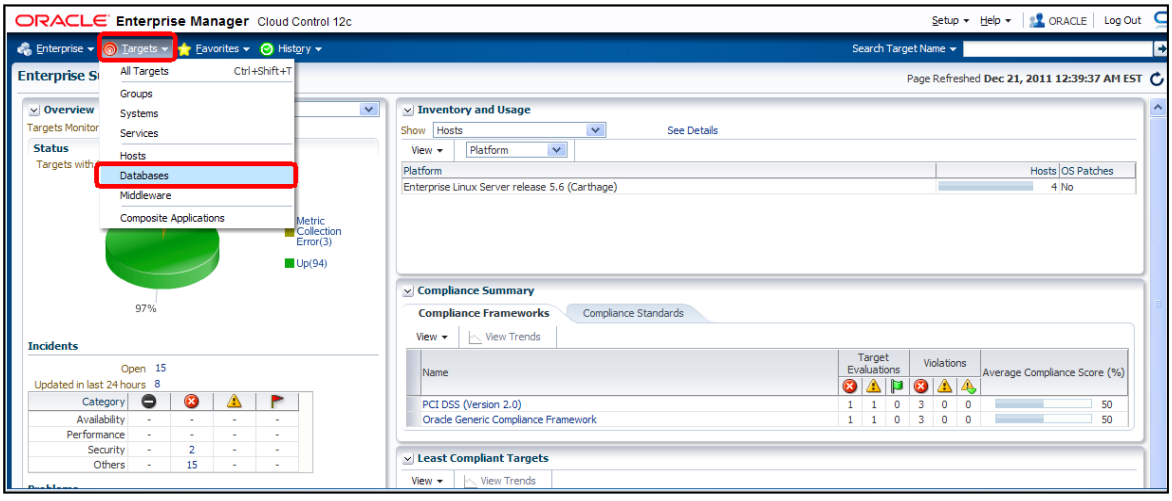
Business Problem/Use Case

This Use Case is intended to familiarize the user with how to use SQL performance analyzer and to manage changes in a confident manner. Users will also get familiar with how to manage Optimizer statistics though Enterprise Manager 12c

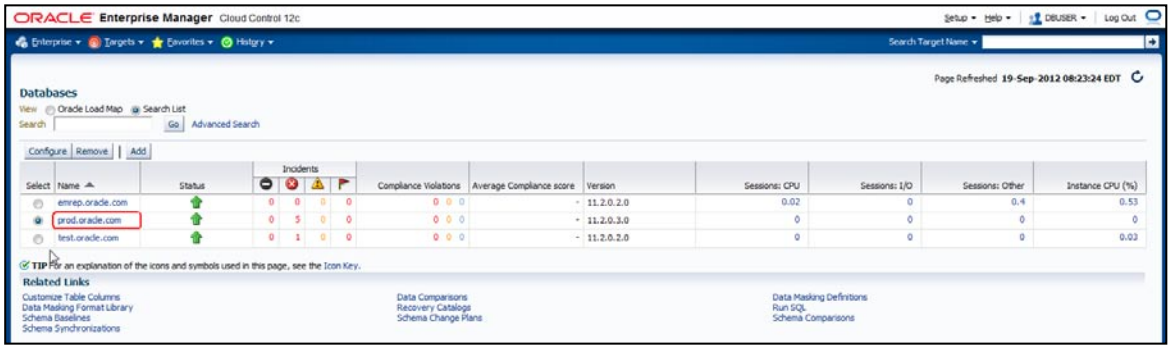
1.1 Login using username and password dbuser / oracle12



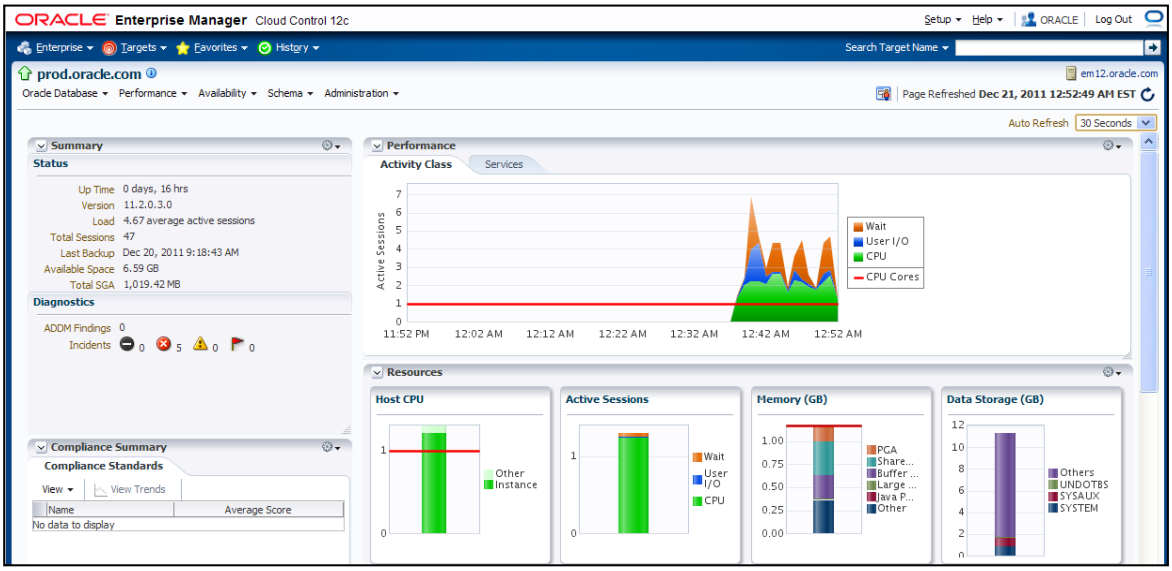
1.2 Navigate to Databases: From the menu, Targets -> Databases



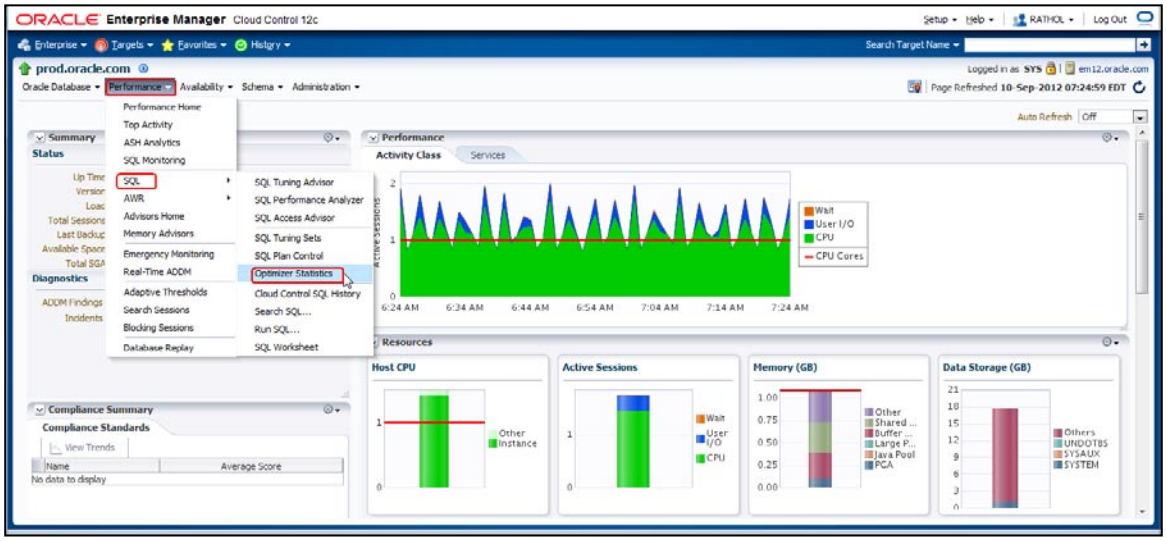
1.3 Click on Database Name: prod.oracle.com



1.4 This will take you to the database home page for prod.oracle.com



1.5 Navigate to Optimizer Statistics page "Performance -> SQL -> Optimizer Statistics"



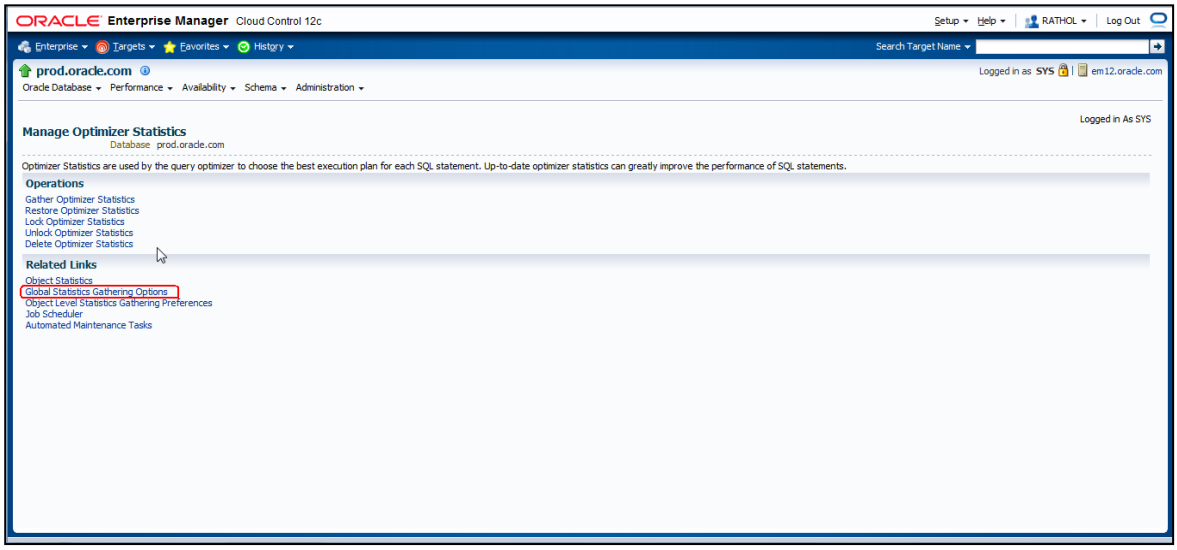
1.6 For Credentials select:

Preferred : SYSDBA Database

Click 'Login'

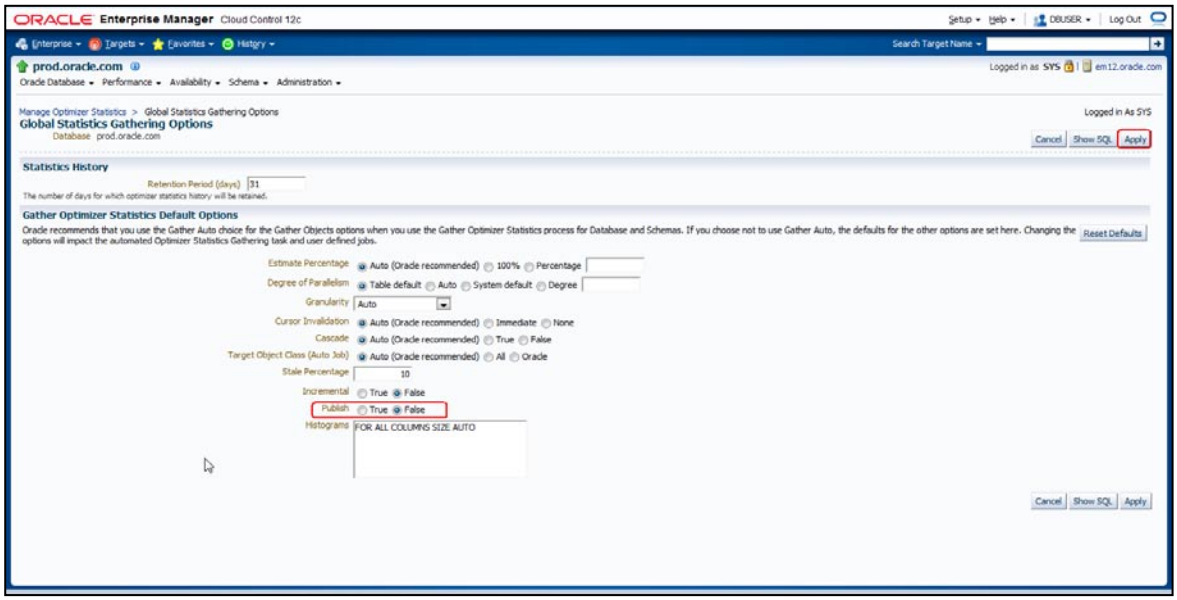
1.7 This is the home page for managing optimizer statistics. You have the ability to manage both old and new statistics as well as modify statistic gather option. First, we are going to take a look how to modify the statistics gathering option to make sure that new statistics don't give us any surprises like performance regression due to plan changes. We can either change preferences for the complete database or we can modify it for individual objects. We will first look at the global option

1.8 Click on "Global Statistics Gathering Option



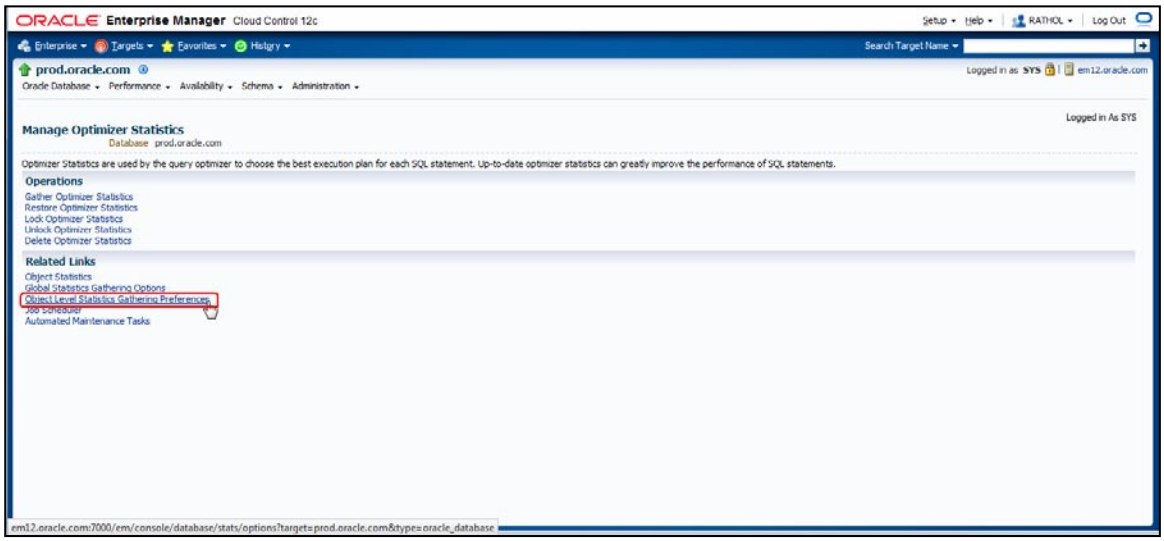
1.9 On this page we have all the options for how to manage statistics for the database in total. We are going to work with pending statistics. We have the option to gather statistics in pending mode, this together with SQL Performance Analyzer gives us the opportunity to validate how the optimizer will react and if there will be any new plans, and how they will impact application performance.

1.10 The option for pending statistics is "Publish". Currently the database has "Publish" set to FALSE so statistics will not change after a new gathering. Let us change it to TRUE. Then click on "Apply"

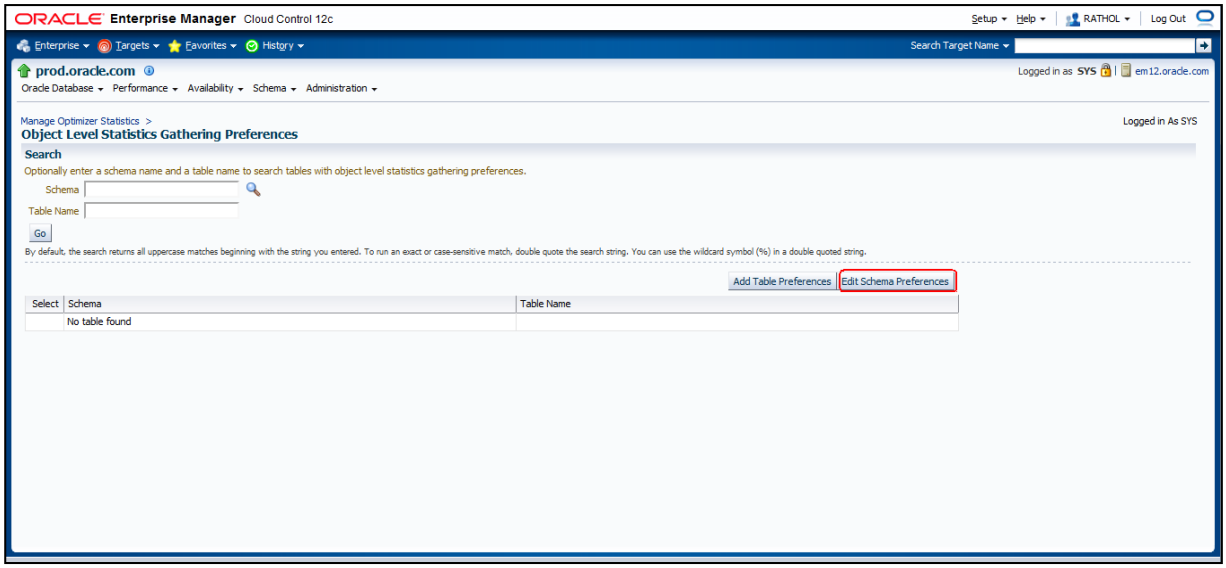


1.11 Unfortunately this database has one application where new statistics often cause performance regression so let us make sure that new statistics are not published for its schemas.

1.12 Click on "Object Level Statistic Gathering Preferences"

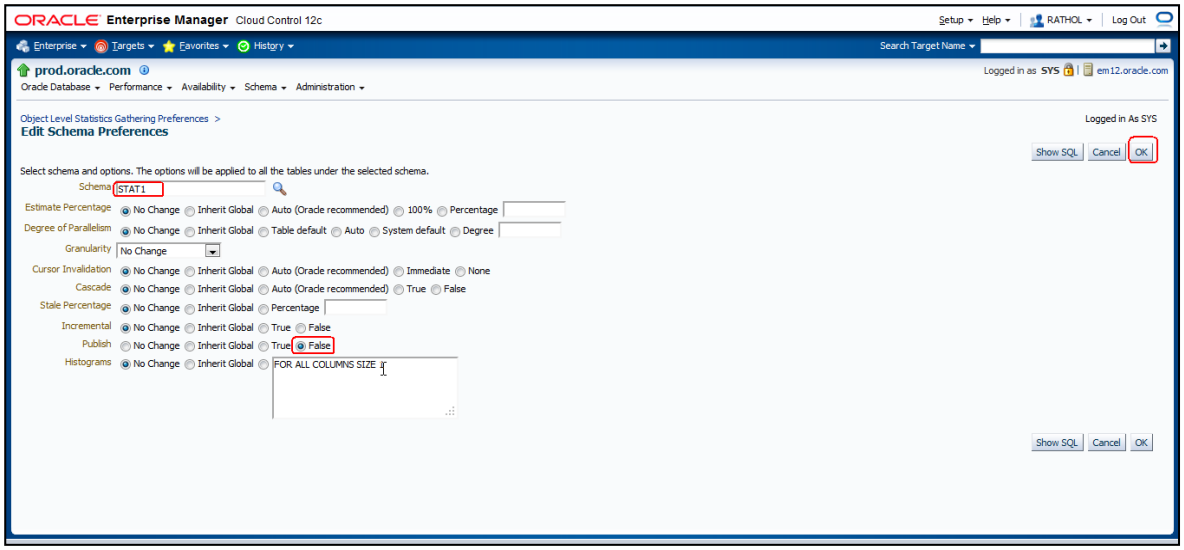


1.13 Click on "Edit Schema Preference"



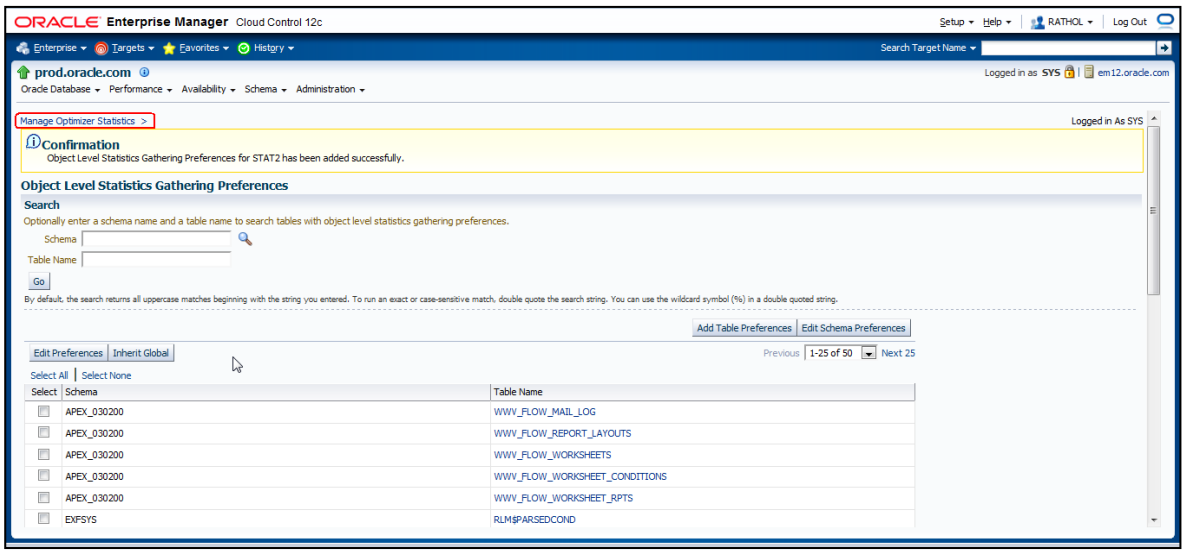
1.14 In the Schema field enter “STAT1”.

Click on “False” for Publish and click OK.

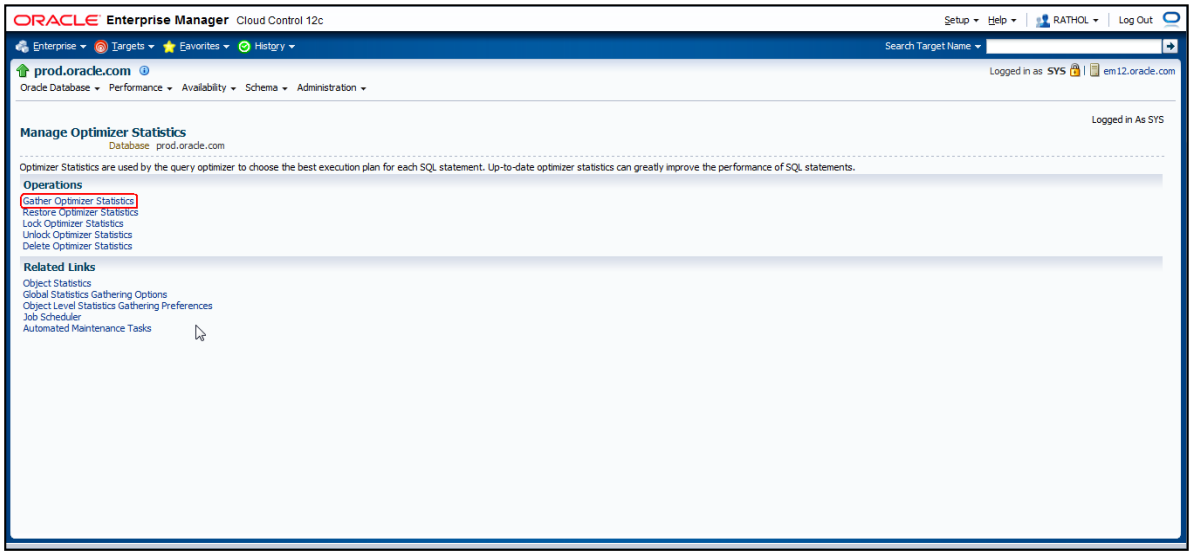


1.15 We have now changed the statistics gathering option for schema STAT1. Let us gather new statistics for this schema.

Click on the “Manage Optimizer Statistics” bread crumb

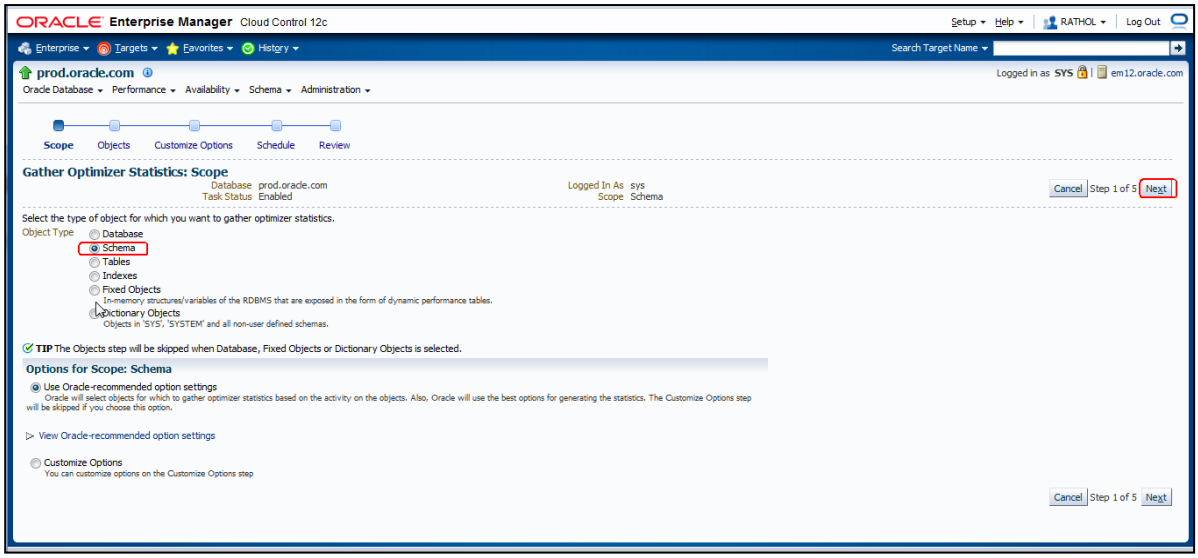


1.16 Click on "Gather Optimizer Statistics"

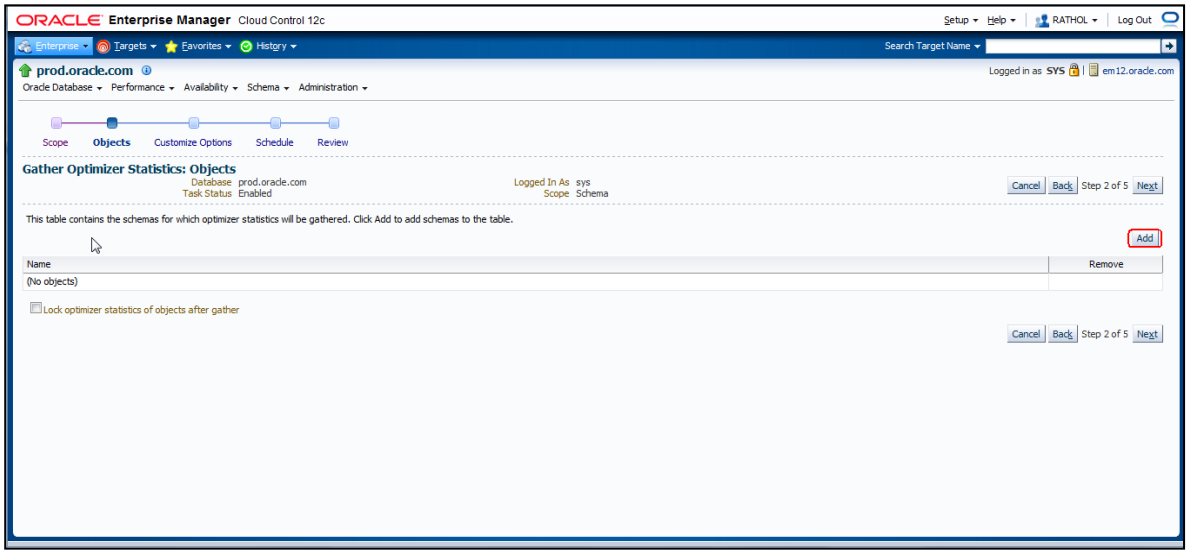


1.17 Let us gather statistics on schema level

Select Object Type "Schema". Click on "NEXT"



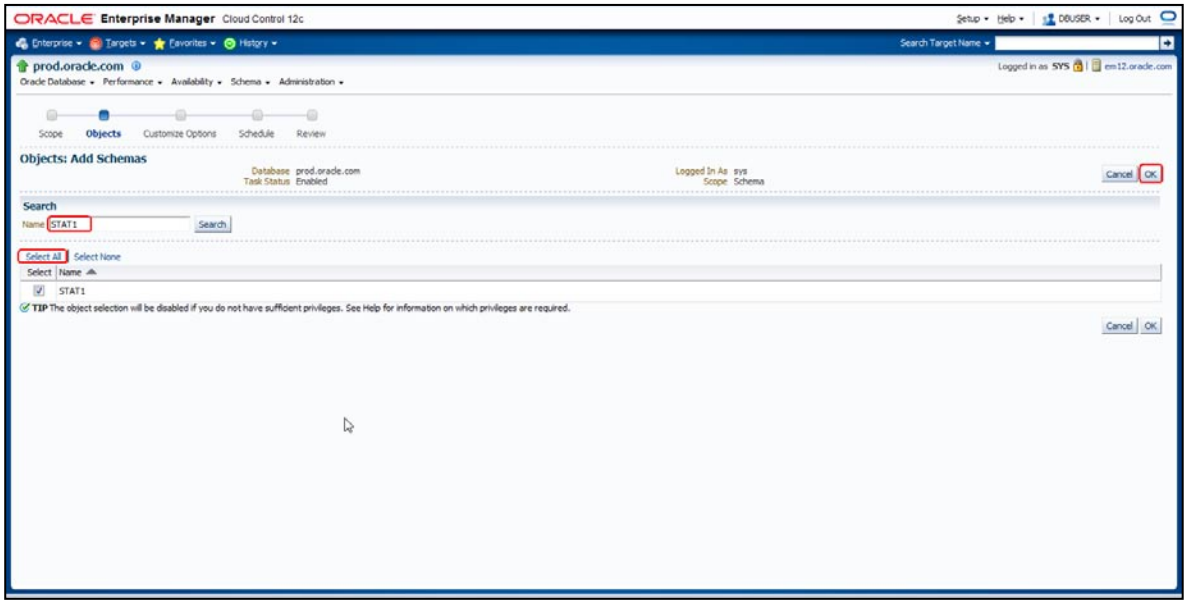
1.18 Click on “Add”



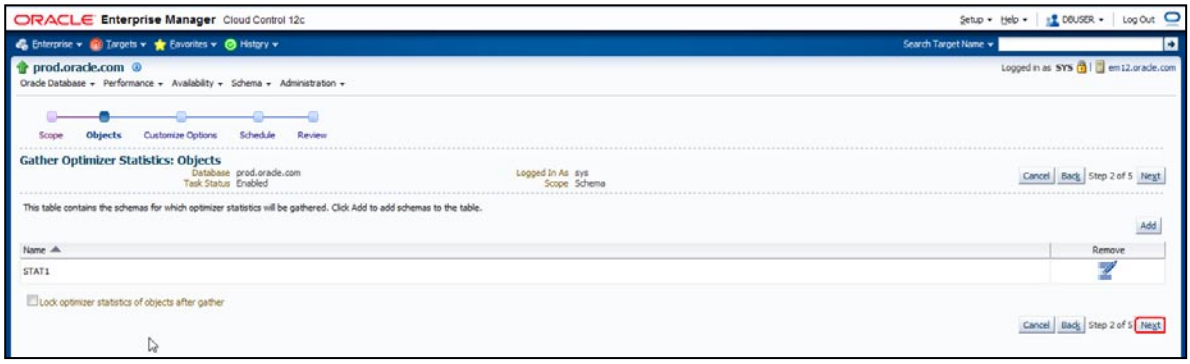
1.19 In name field enter “STAT1” and click “Search”

Click “Select All”.

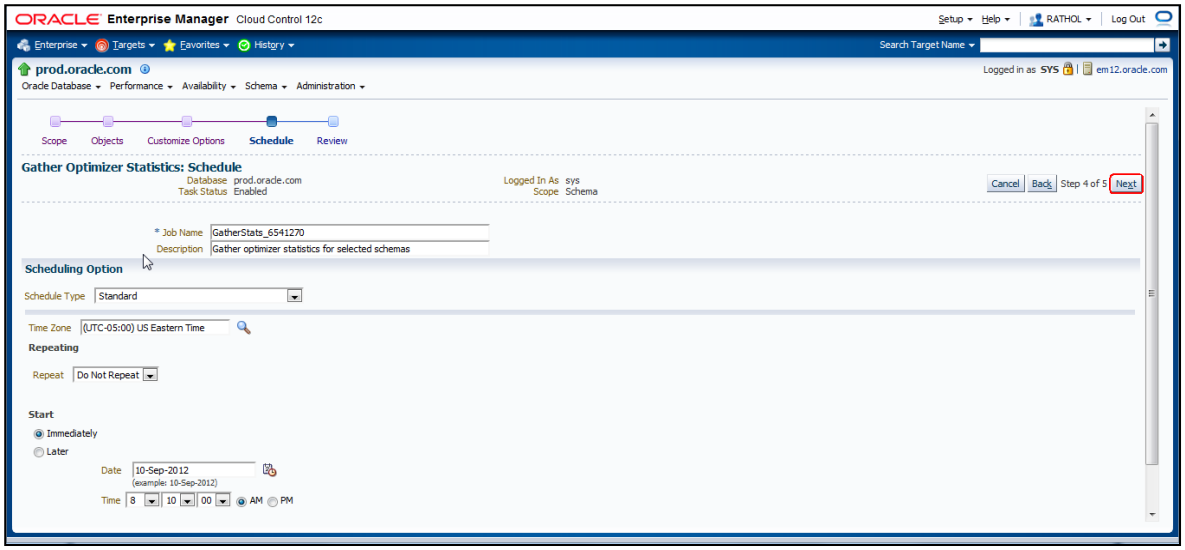
Click “OK”



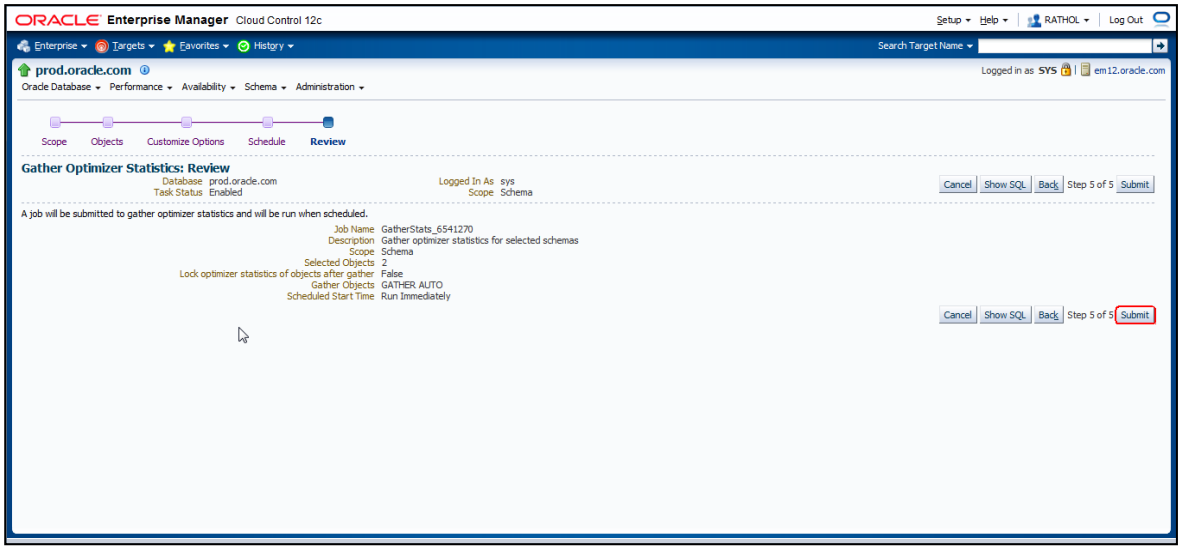
1.20 Click "Next"



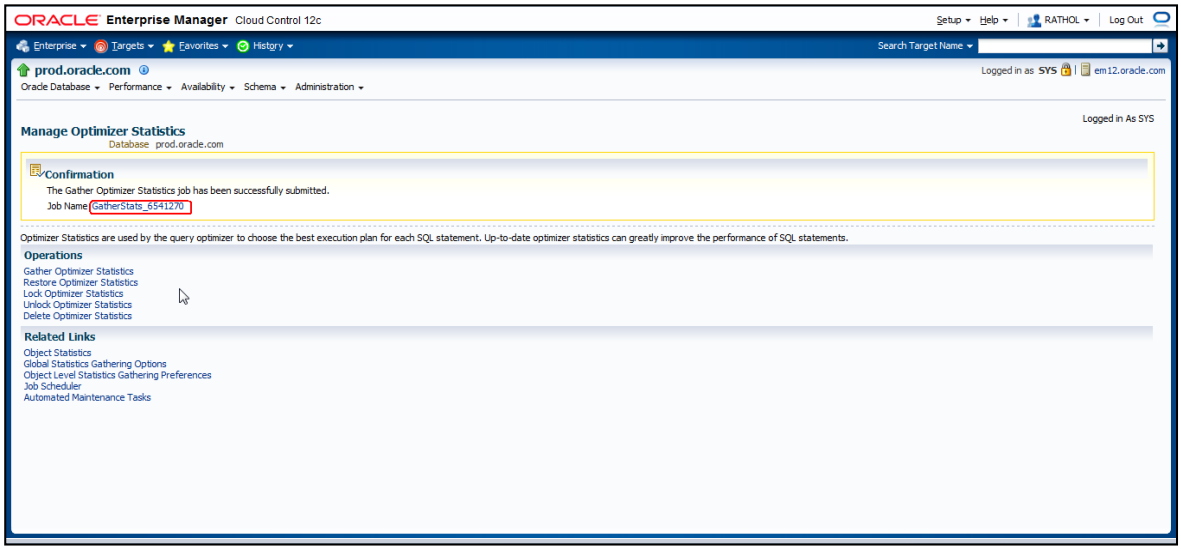
1.21 Click "Next"



1.22 Click "Submit"



1.23 You should now get a confirmation that the job has started.



A2. SPA Optimizer Statistics Refresh Validation

Estimated Time to Complete Use Case: *15 minutes*

Business Case

When gathering new statistics it is not uncommon that the new statistics cause the optimizer to choose a new query plan. In most cases the new plan will be more efficient but it can also be that sometimes it causes query regression.

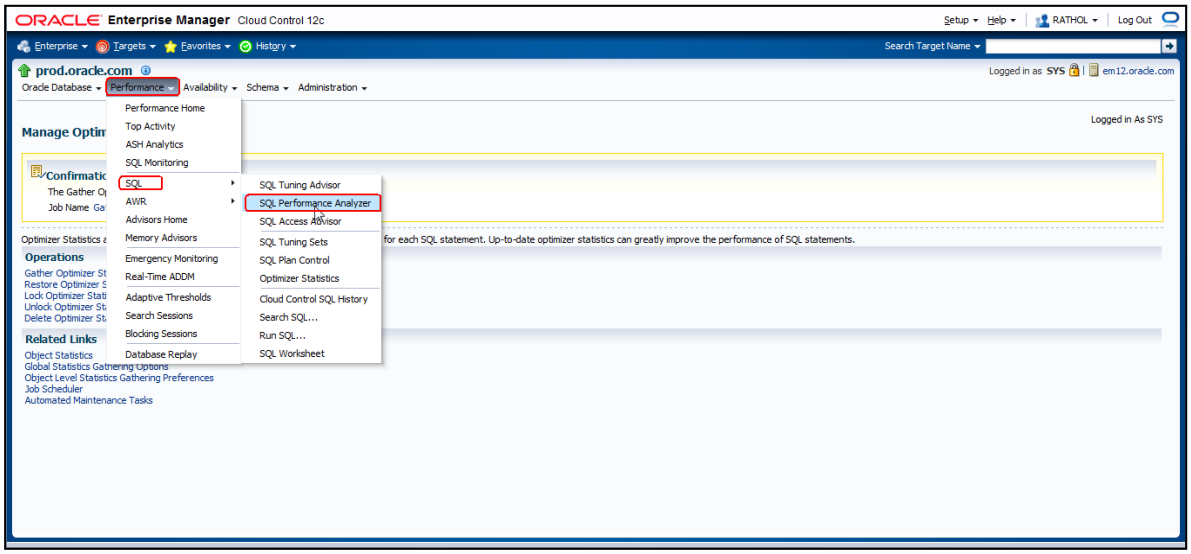
As a DBA it is important to proactively predict how new statistics will change the overall performance in the database. With SPA you have the ability to execute most of your SQL statement that occurs in your database. We have the possibility to gather production SQL statements into SQL Tuning Sets from either Cursor Cache or AWR history for a time period that we want to validate.

We have one pre created SQL Tuning Set which is representative for the peak workload of this application. So, let's see if the new statistics will change the performance for this application.

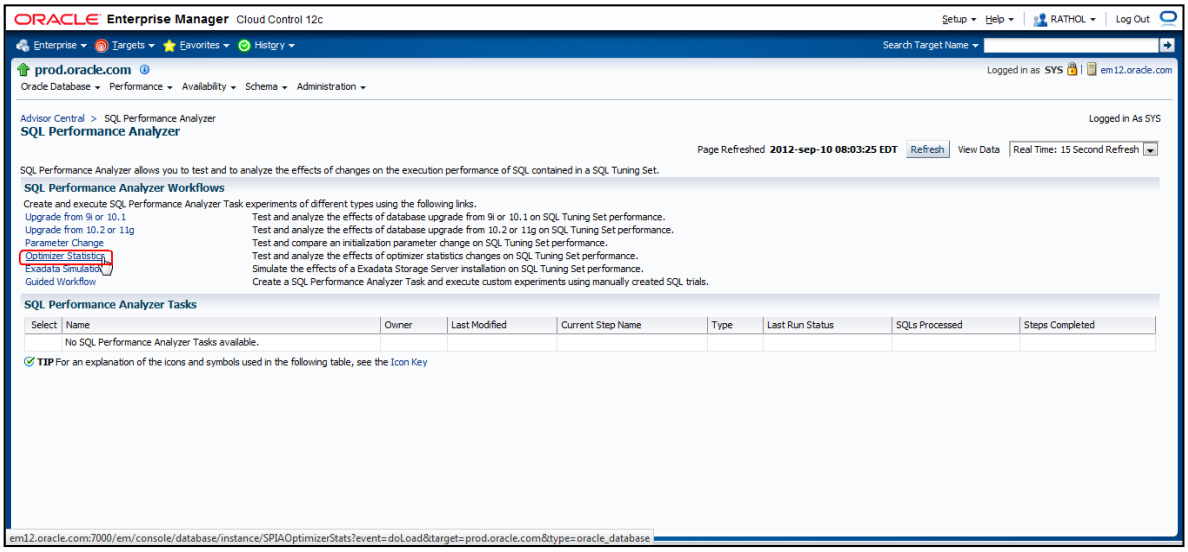
3. Execute SPA task using Optimizer statistics workflow

2.1 You should already be logged on to Enterprise Manager. If you are not, please follow the instructions detailed in earlier section of this workbook.

2.2 In prod database Navigate to Performance -> SQL -> SQL Performance Analyzer



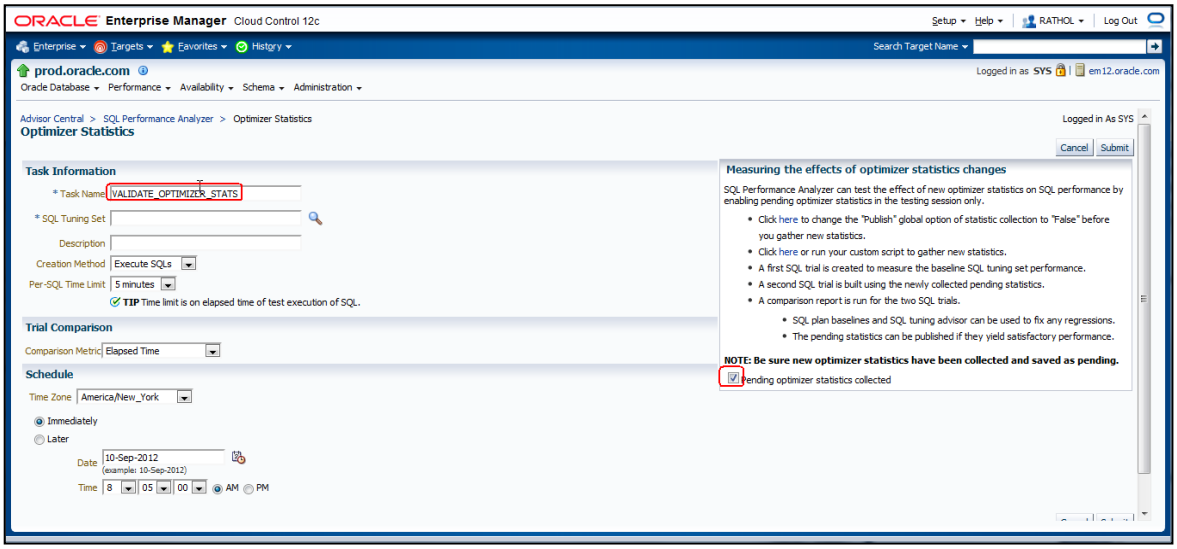
2.3 Click login "Optimizer Statistic" link.



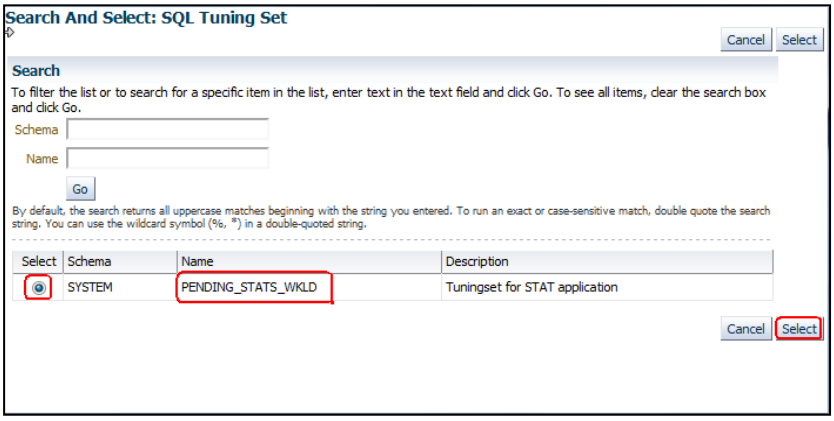
2.4 Enter:

Task Name : VALIDATE_OPTIMIZER_STATS_NN (where NN is your initials).

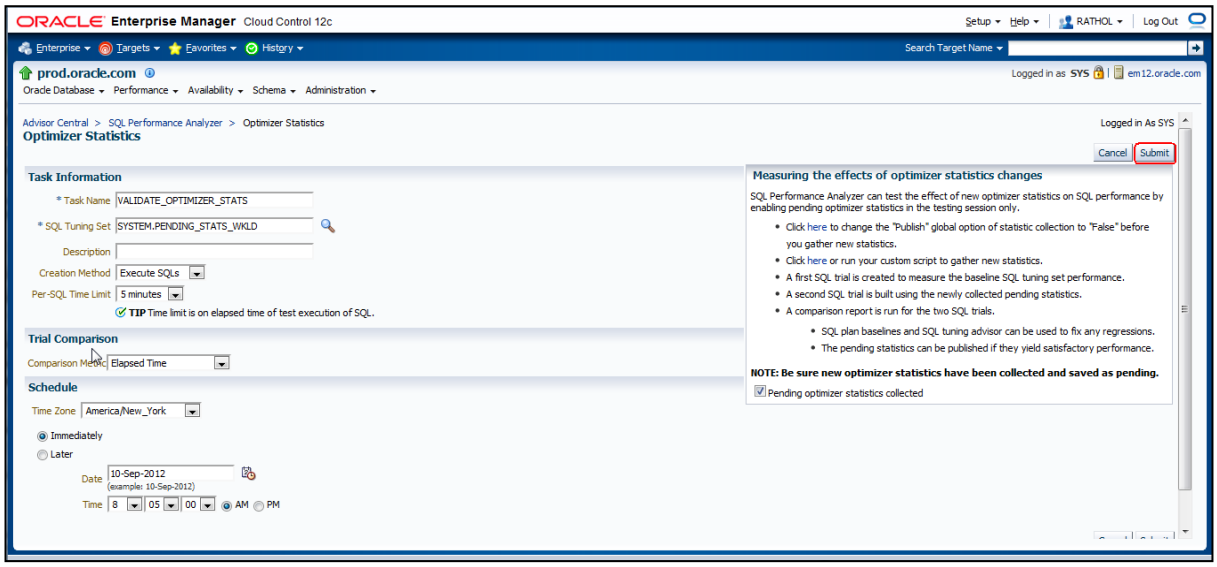
SQL Tuning Set : SYSTEM.PENDING_STATS_WKLD (use 🔍)



2.5 Mark the "PENDING_STATS_WKLD" Tuning Set and click select.



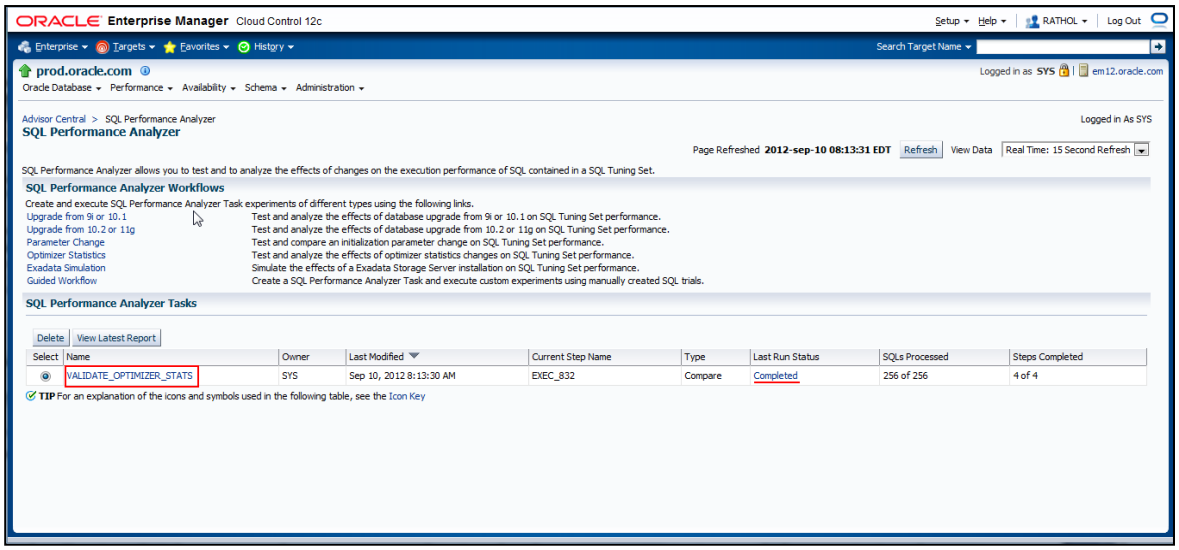
2.6 Mark the "Pending Optimizer Stats Collected" and click Submit



2.7 The SPA task is now in progress and it will take a minute or two to complete.

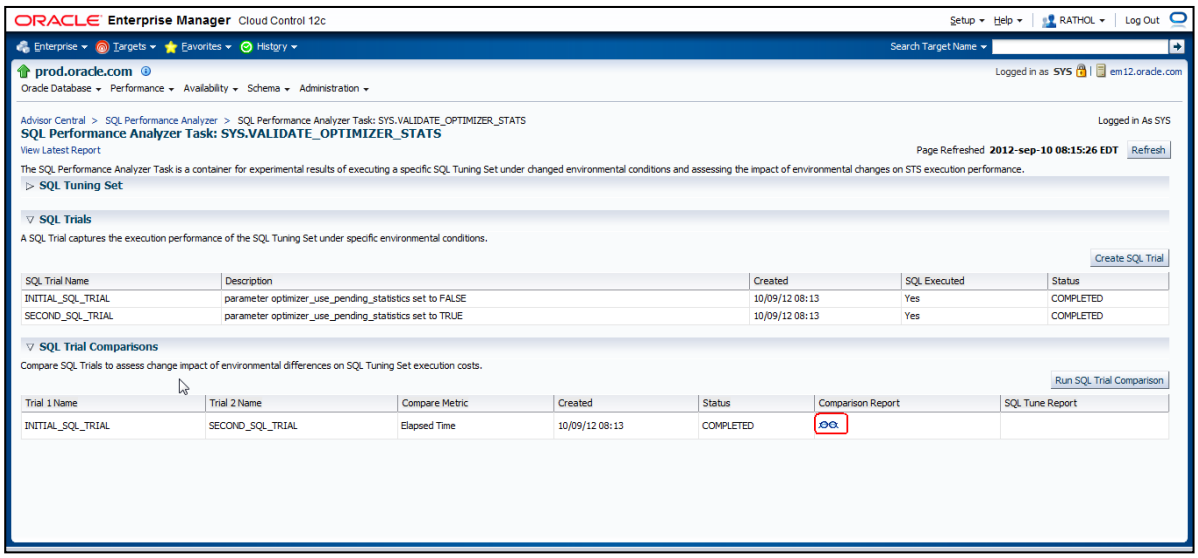
When Last Run Status have changed to Completed:

Click on your SPA task name.



2.8 Statement in the Tuning Set have now been executed using both current statistics and the statistics that we gathered in previous exercise

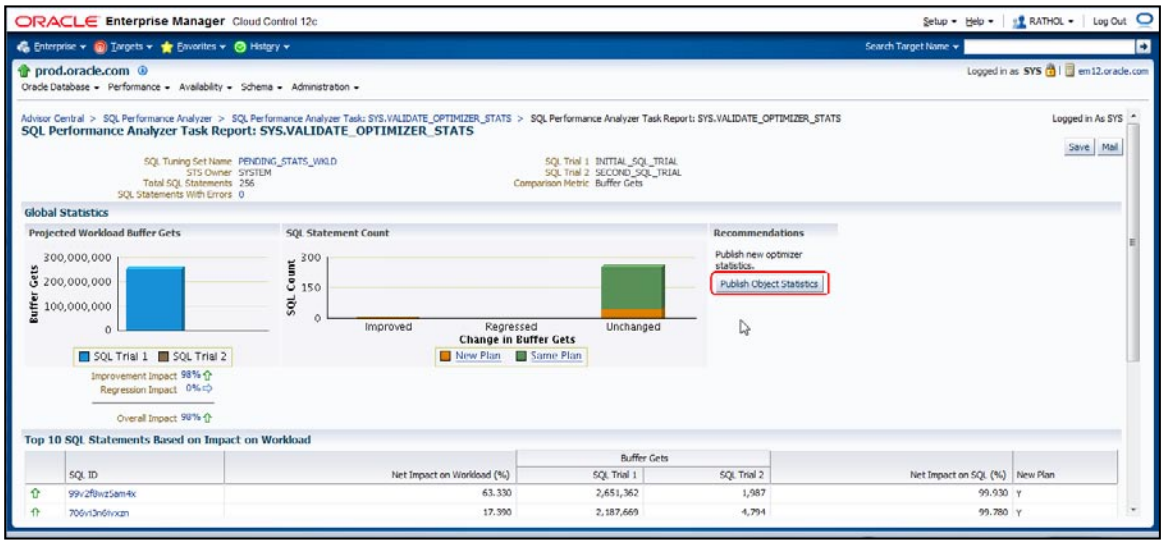
Click on the glasses for Comparison Report



2.9 As you can see the new statistics gave us a performance improvement that was significant. It could easily be said that we can safely implement the new statistics. You can also drill down on individual statements to see details on execution plans and execution statistics.

This comparison shows same good result so let us publish the new statistics.

Click on "Publish Object Statistics"



Now in the interest of time we'll skip the obvious step of publishing the stats, we will move on to the next section of the lab.

Please *only read through* the following steps: You Click on the Publish Object Statistics button and select the object that you want to publish and change Action (from drop down list) to Publish, repeat this for all objects of interest.

B. Secure testing with Real Application Testing

Lab Overview

Objective:

The objective of this document is to provide high-level guidelines on new features associated with test data management in Oracle Enterprise Manager Cloud Control 12c.

To perform real-world testing of Oracle databases, by capturing production workloads and replaying them on test systems enables you to perform real-world testing quickly and accurately. This allows enterprises to assess the impact of any planned system change before deploying it in production reliably. Additionally, enterprises run the risk of breaching sensitive information when copying production data into non-production environments for the purposes of application development, testing or data analysis.

Oracle Real Application Testing and Oracle Data Masking Pack provides end to end secure automation for provisioning test databases from production in compliance with regulations and to enable businesses to significantly reduce the risk of database application instability due to systems changes

B1. Generate Application Data Model for the Applications Deployed on the Target Databases

Estimated Time to Complete Use Case: **10 minutes**

Business Case

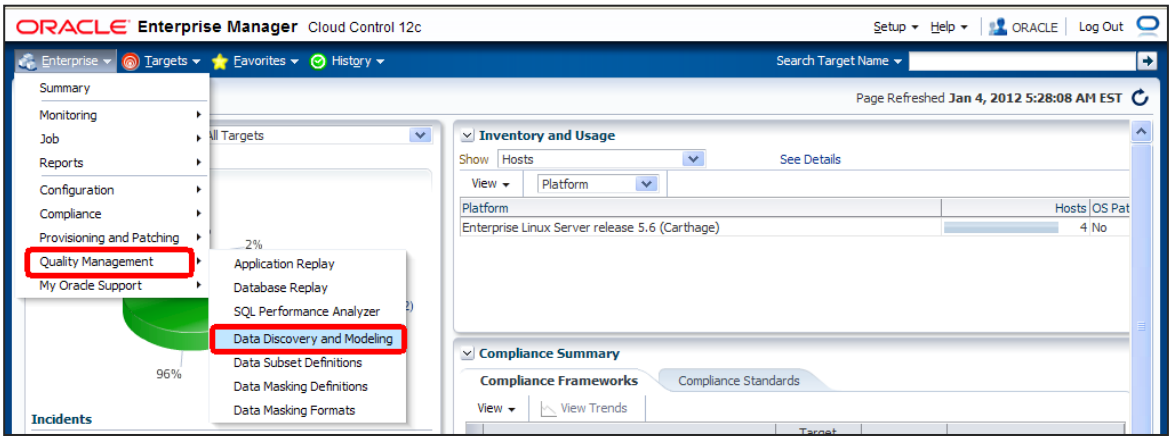
When a new application has been provided to the application users, it can be a daunting task to construct the application relationships that make up the application. Fortunately, the process of creating the application data model has been greatly simplified for application schema where the application relationships are enforced through database constraint. In this use case, you will construct the application relationships for the TPC-H workload schema. This application data model will be the basis for performing the rest of the test data management operations.

1. Generating the ADM

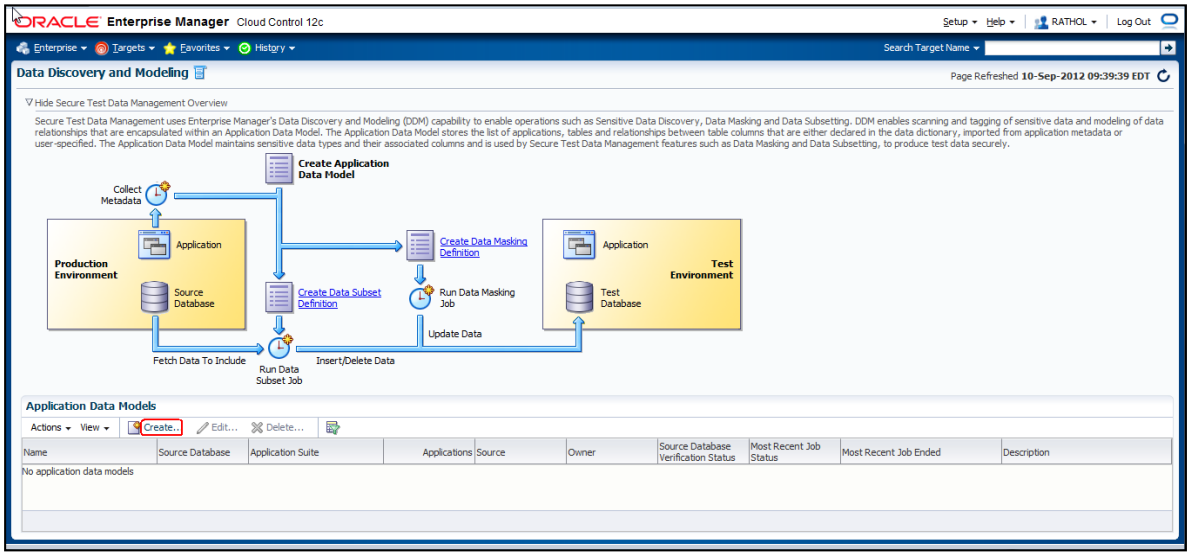
1.1 You should already be logged on to Enterprise Manager. If you are not, please follow the instructions detailed in earlier sections of this workbook.

1.2 Navigate to the Application Data Models screen.

From the Menu, Enterprise→ Quality Management →Data Discovery and Modeling



1.3 Click “Create” to create a new Application Data Model.



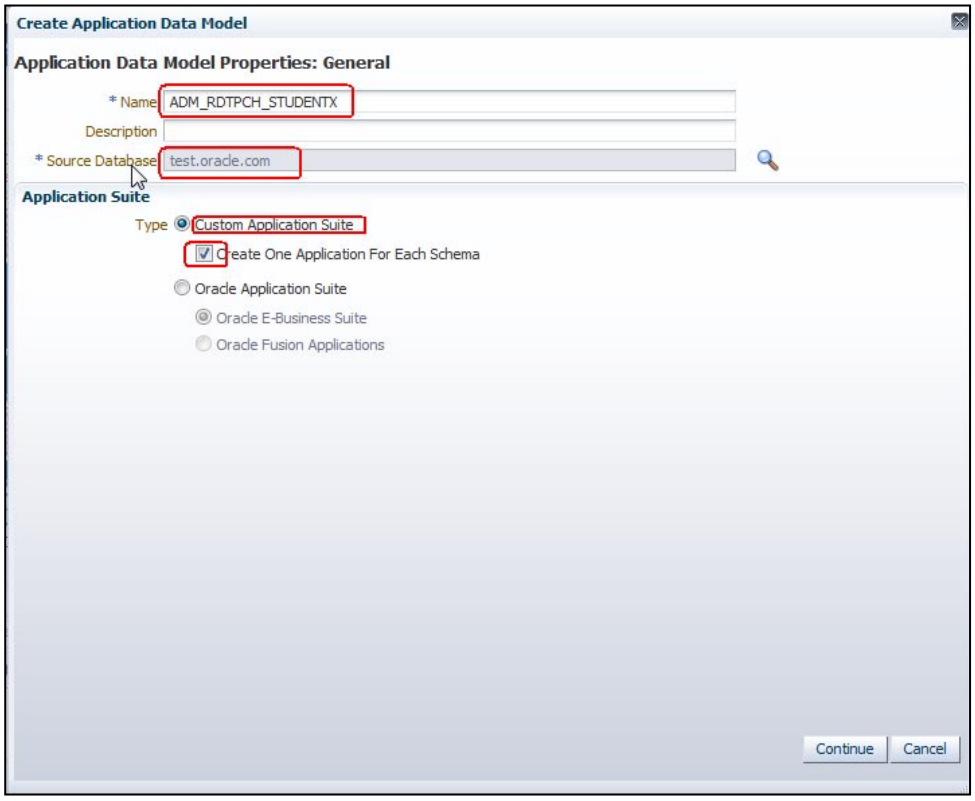
1.4 On the pop-up window, enter details about the new ADM:

Name : ADM_RDTPCH_XX

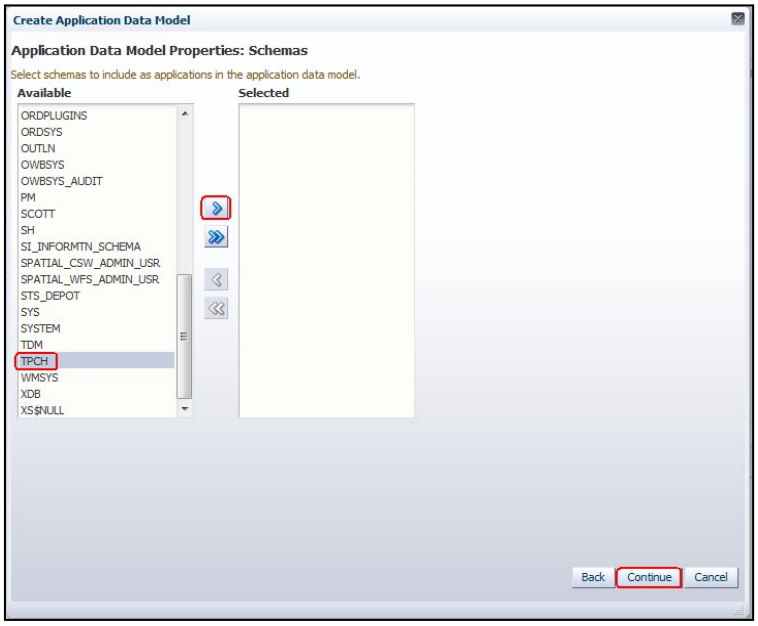
(Note: If an ADM with this name already exists on your environment, you can create ADM with new name, such as ADM_TPCH_<Your Initials>)

Source Database : test.oracle.com (use search 🔍 option)

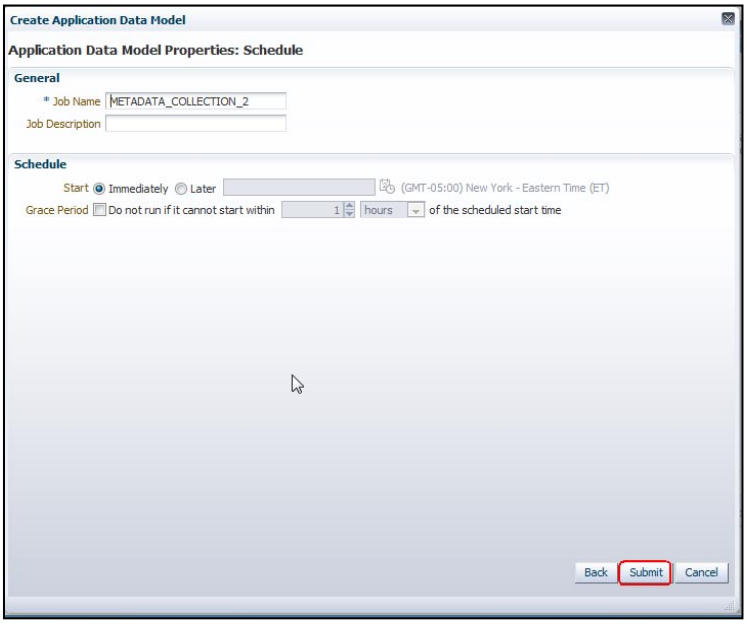
Click ‘Continue’



1.5 Select the 'TPCH' schema and click the button. Click Continue.

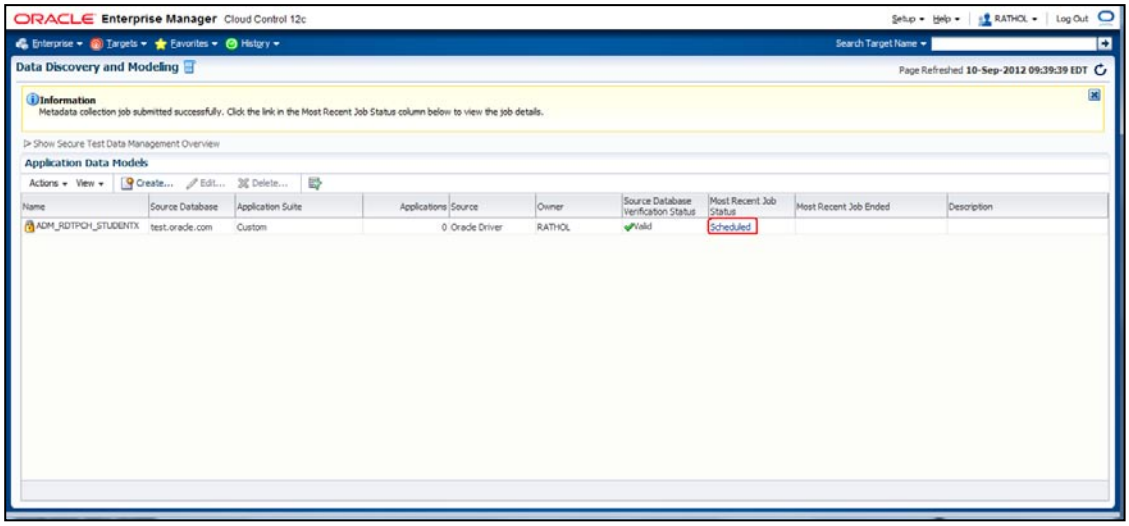


1.6 Click 'Submit' to submit the Job.


Create Application Data Model
Application Data Model Properties: Schedule
General
* Job Name
METADATA_COLLECTION_2
Job Description
Schedule
Start
Immediately
Later
(GMT-05:00) New York - Eastern Time (ET)
Grace Period
Do not run if it cannot start within
1
hours
of the scheduled start time
Back
Submit
Cancel

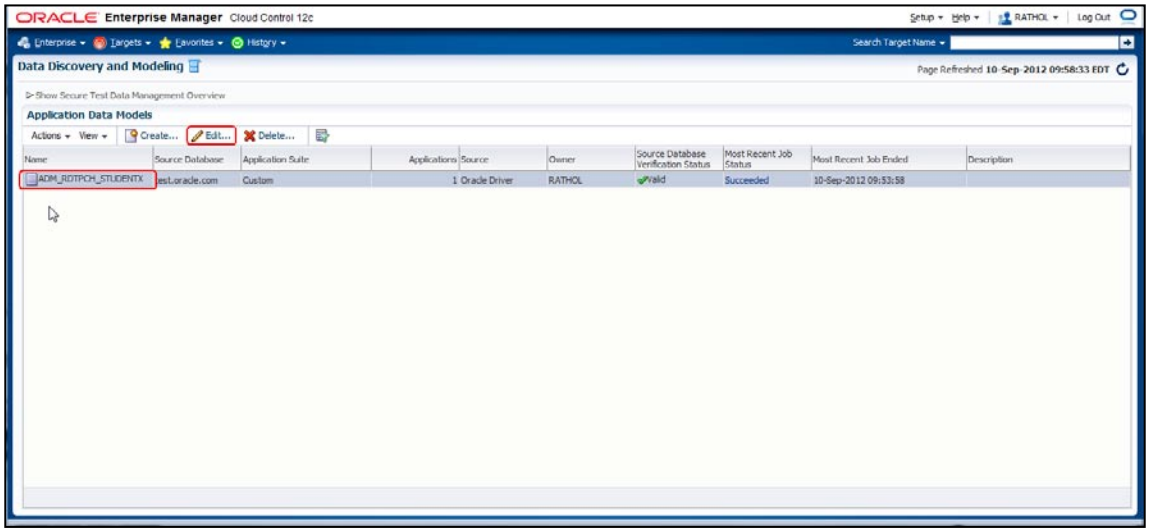
1.7 Monitor the job and ensure successful completion.

Click the refresh icon periodically and check the 'Most Recent Job Status' column.

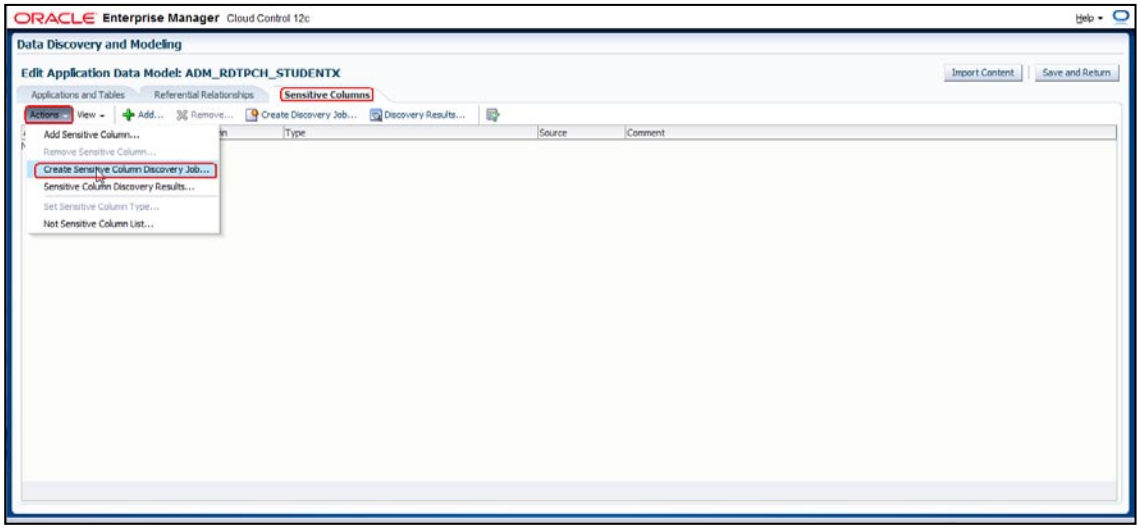


Job should complete within a minute. When completed, you'll see 'Succeeded' status.

1.8 Highlight the newly created ADM, click 'Edit'



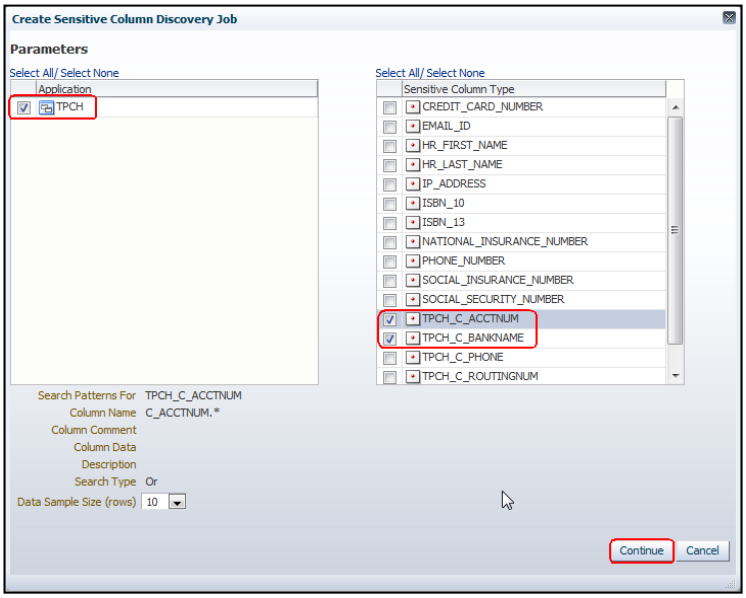
1.9 On the Sensitive Columns Tab. Select Action → Create Sensitive Column Discovery Job



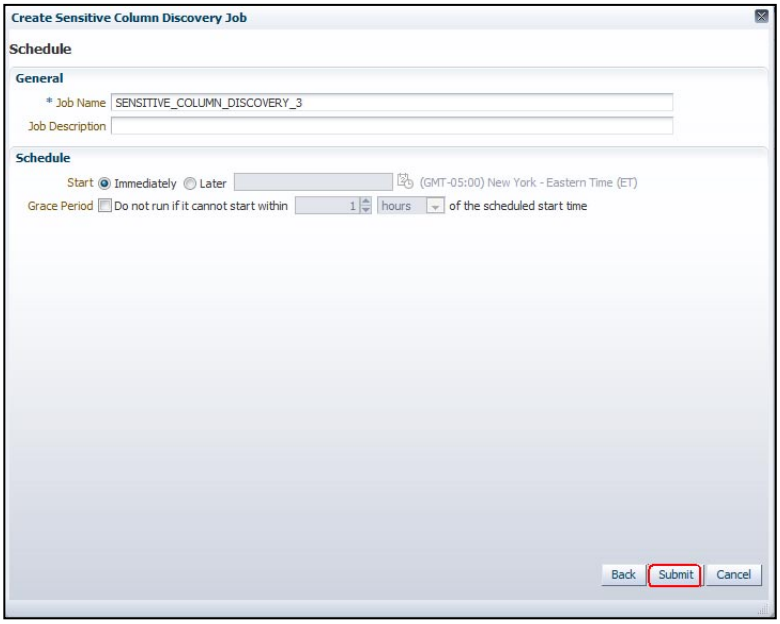
1.10 In Application, Select 'TPCH'.

In Sensitive Column Type, select Sensitive column types 'TPCH_C_ACCTNUM' and 'TPCH_C_BANKNAME'

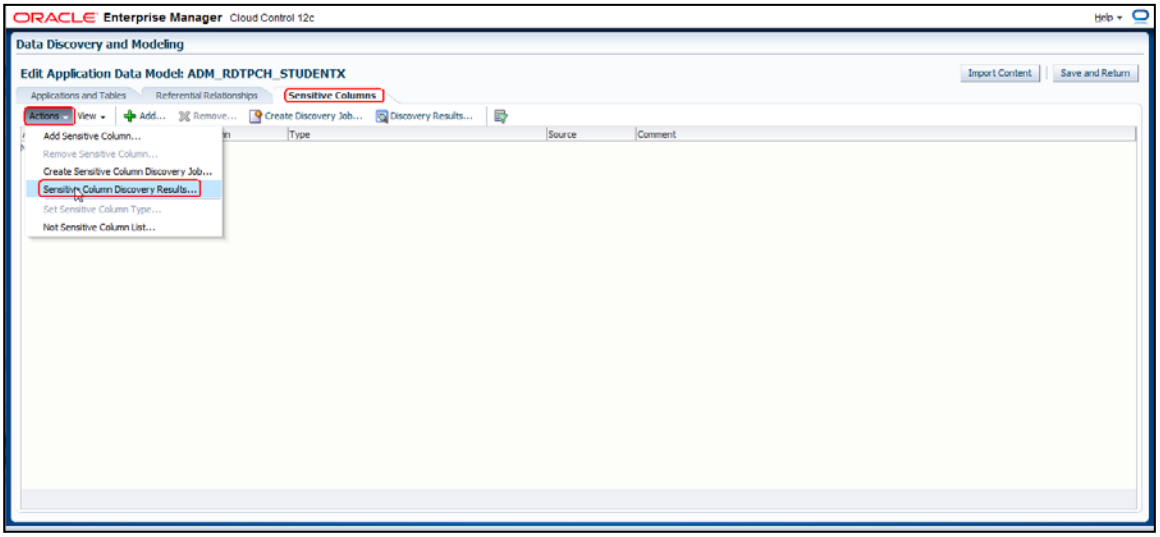
Click 'Continue'



1.11 Click 'Submit'



1.12 Click on 'Sensitive Column' Tab. Select action → 'Sensitive Column Discovery Results'

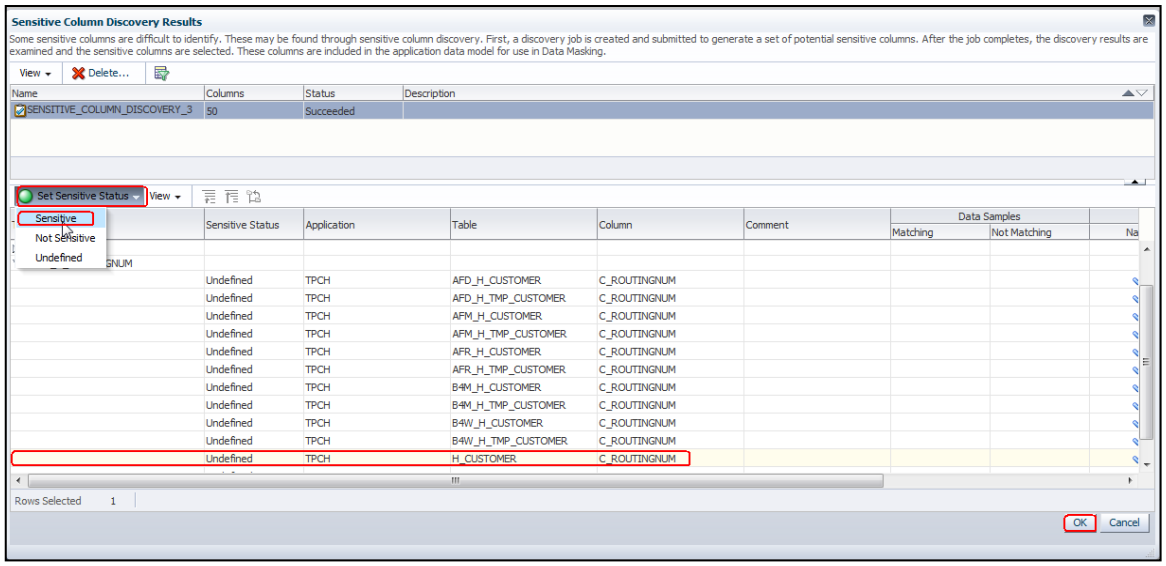


1.13 Expand Type for both TPCH_C_ACCTNUM and TPCH_C_BANKNAME, Identify table H_CUSTOMER.

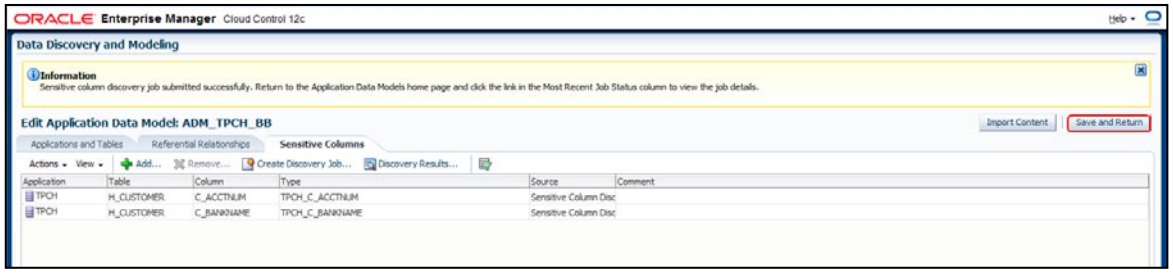
Click on the row to mark it.

Click on Set Sensitive Status and set it to 'Sensitive'

When ready click 'OK'



1.14 Click 'Save and Return'



B2. Define and Execute Masking on Application Data Model

Estimated Time to Complete Use Case: 20 minutes

Business Case

Having discovered the application relationships, the application administrator now needs to create a masked of this database so that the enterprise provide realistic-production data available to application developers or testing groups for accurate application testing while reduce their storage costs by not having to provision an entire production environment for each developer or project.

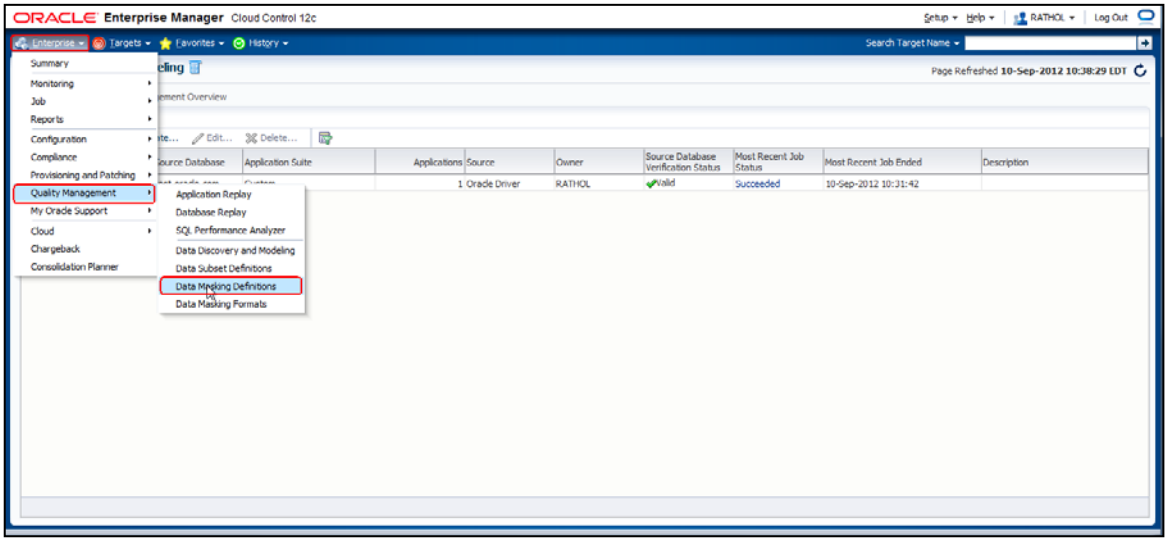
4. Execute Masking

4.1 You should already be logged on to Enterprise Manager. If you are not, please follow the instructions detailed in earlier section of this workbook.

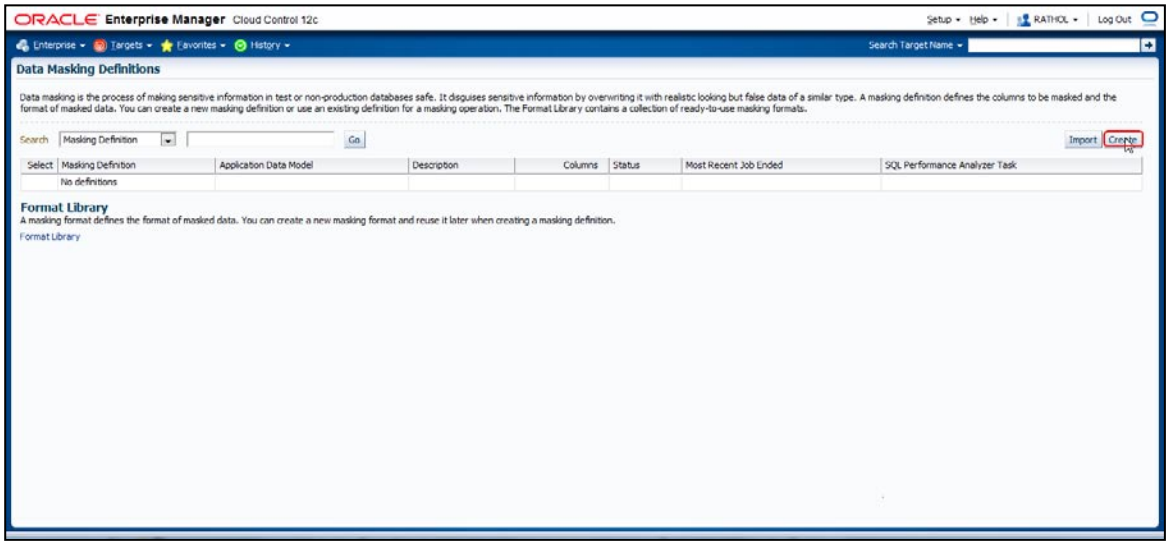
4.2 So, let's begin the Masking operation.

Switch to the original tab Navigate to Data Masking: From the Menu,

Enterprise → Quality Management → Data Masking Definitions



4.4 Create a masking definition for 'TPCH' schema. Click 'Create'



4.5 Complete the dialog box:

Name : TPCH-MASK_STUDENTX

(Note: If a Masking Definition with above name already exists in your environment. You can create masking definition with new name, such as TPCH-MASK_<Your Initials>)

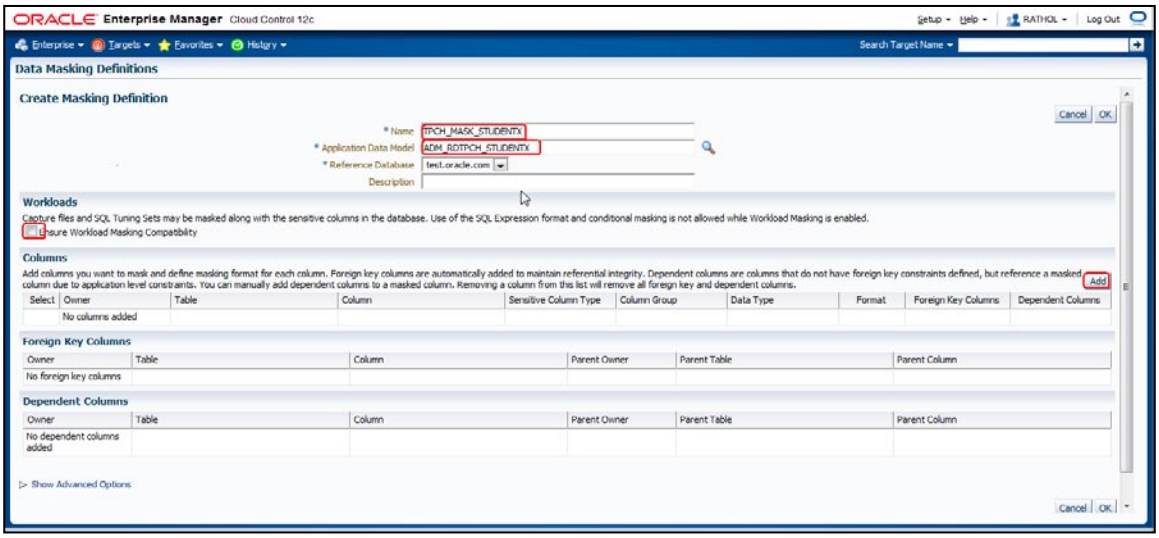
Application Data Model : ADM_RDTPCH_STUDENTX (use search option)

Note: If you created an ADM with a different name in Generate Application Data Model lab, you may use it here. You can also use "TPCH".

Reference Database : test.oracle.com (use search option)

Select 'Ensure Workload Masking Compability'

Add column you would like to mask by, click 'Add'



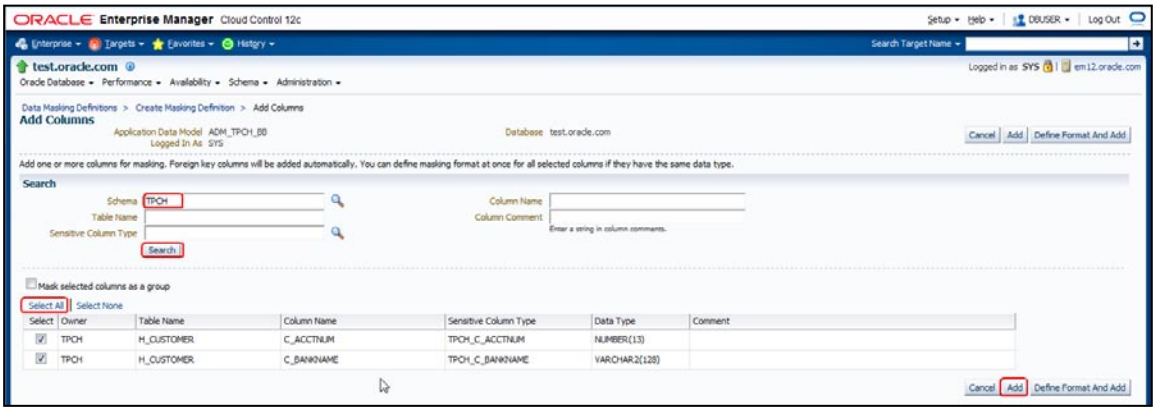
4.6 For credentials select

Preferred : SYSDBA Database

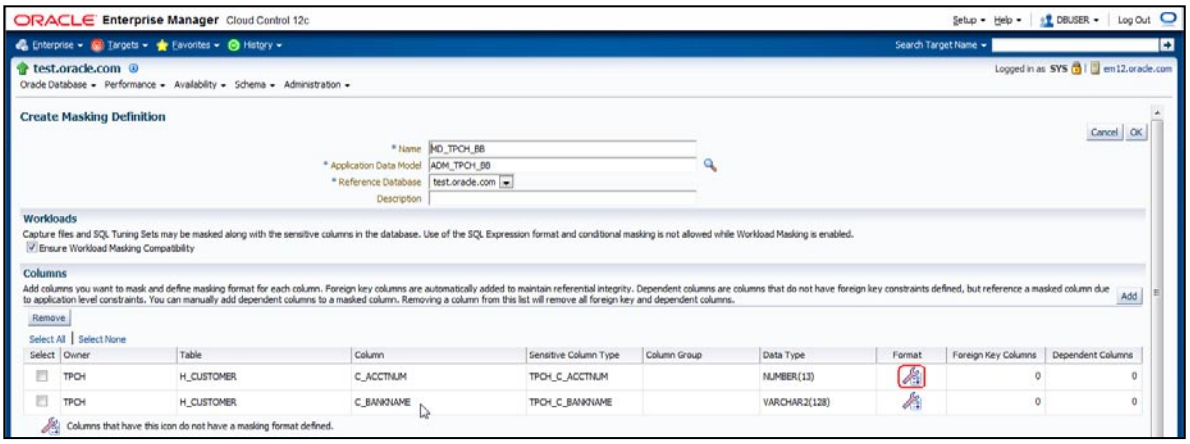
Click 'Login'

4.7 In Schema enter 'TPCH', click 'Search' wait for columns to be populated.

Click 'Select All' and click 'Add'.



4.8 Click the format icon for each added column.



4.9 For C_ACCTNUM.

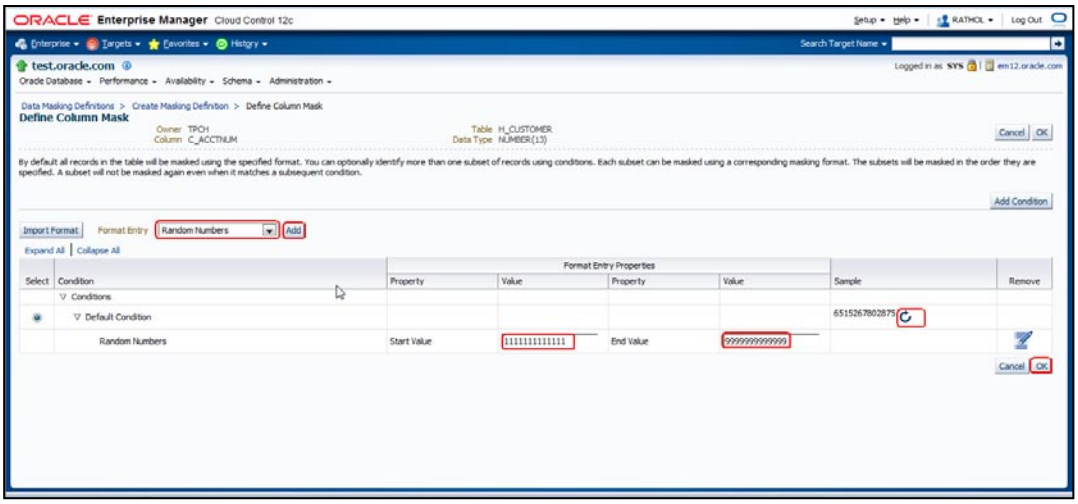
Select the 'Random Numbers' in the Format Entry drop down bar and click 'Add'.

Start Value : 1111111111111

End Value: 9999999999999

Click the refresh button to see an example

Click OK



4.10 For C_BANKNAME

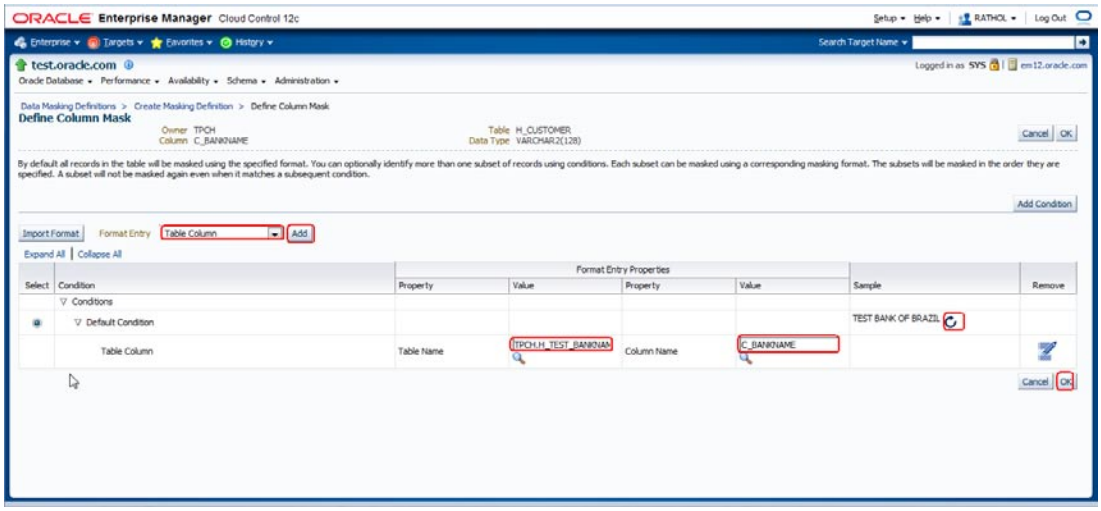
Select the 'Table Column' in the Format Entry drop down bar and click 'Add'.

Table Name : TPCH.H_TEST_BANKNAMES

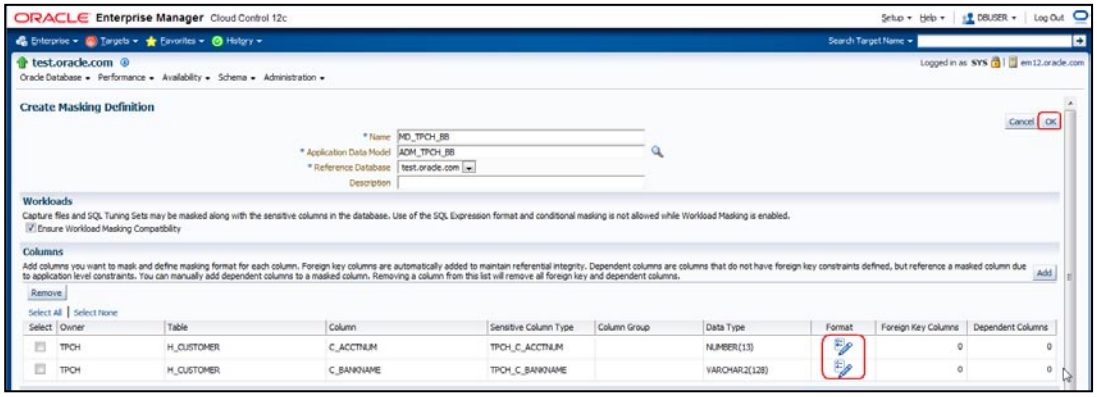
Column Name: C_BANKNAME

Click the refresh button to see an example

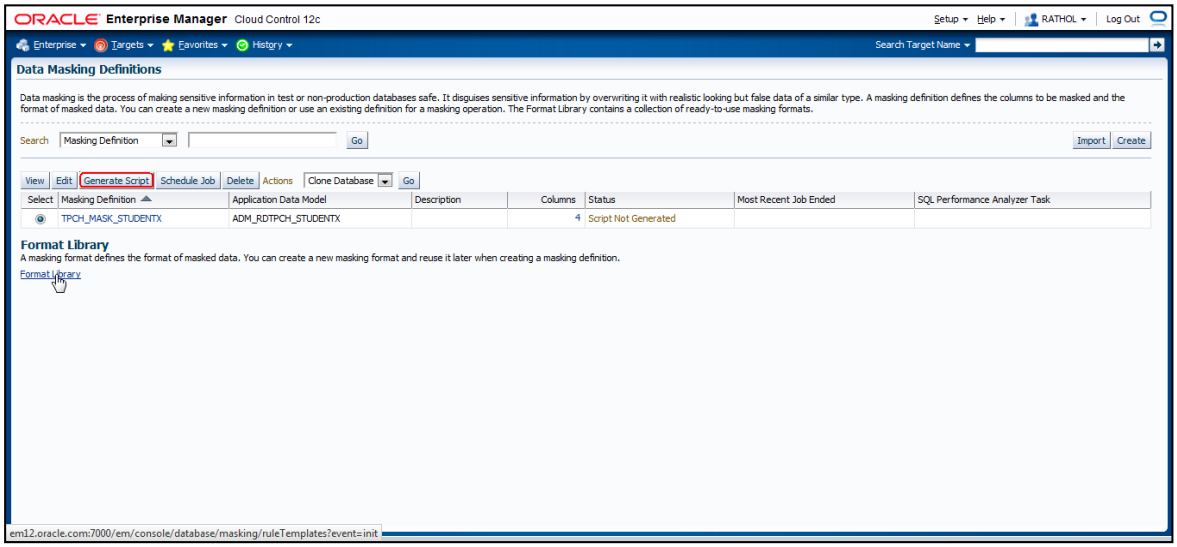
Click OK.



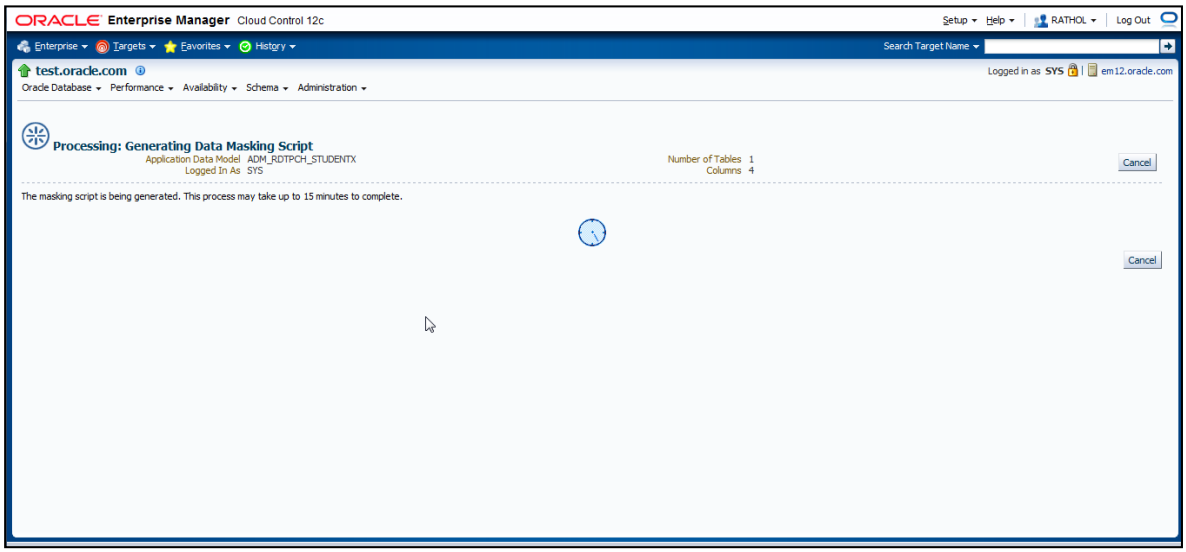
4.11 Now when both columns have been formatted save the masking Definition by clicking 'OK'.



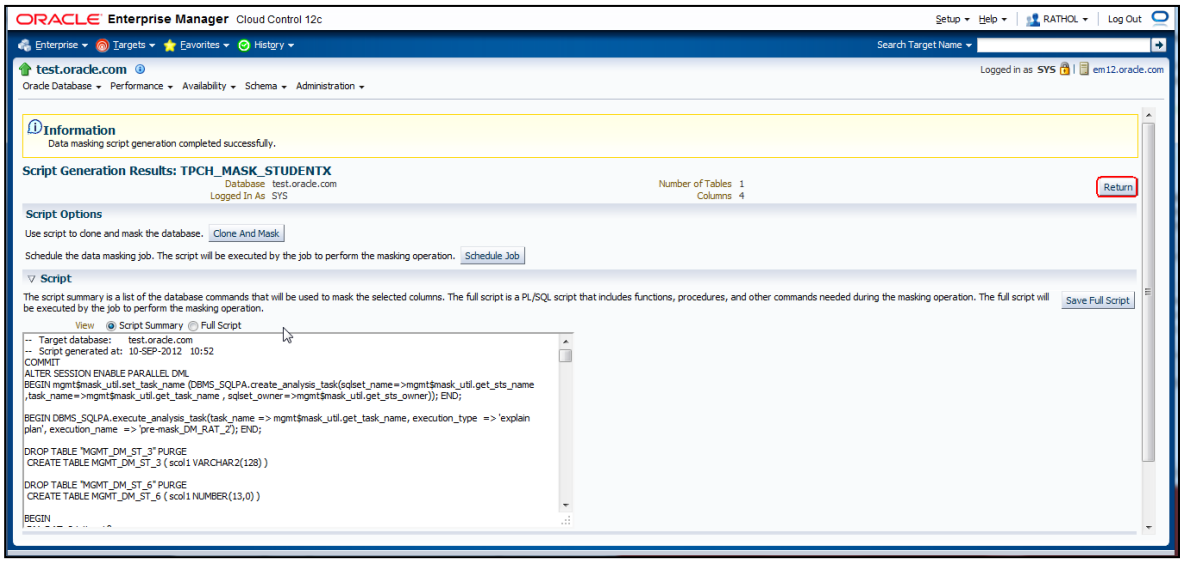
4.12 Now it is time to generate the masking script, click 'Generate Script' .



4.13 This is a small masking script so it will only take about one minute.



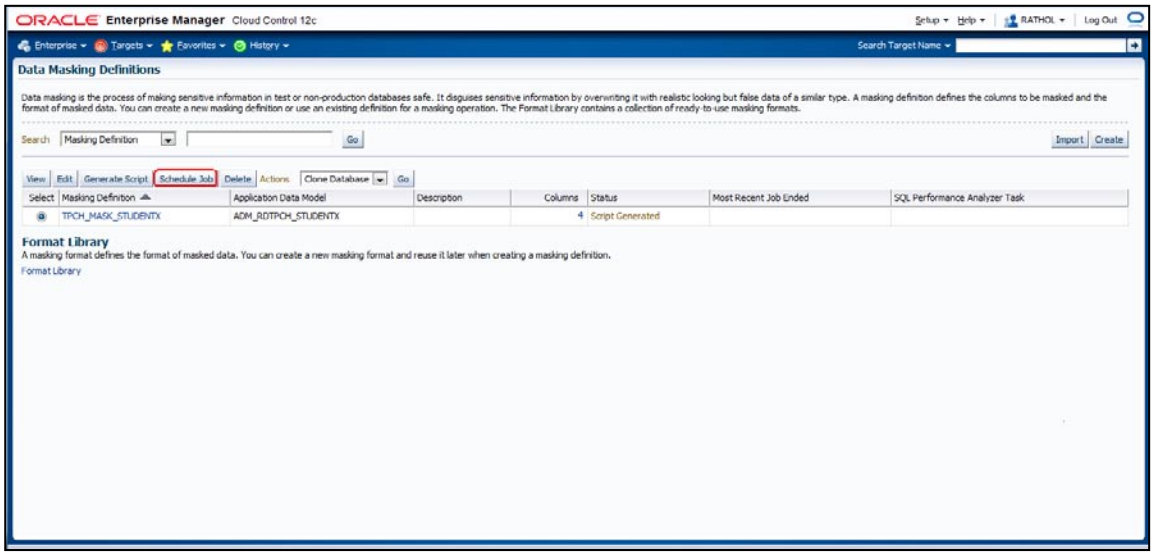
4.14 Once the script is generated, do a short review and then click 'Return'



4.15 The Masking of both workload and the database is a rather time consuming operation. We have therefore performed the masking but let's check the "Schedule Job" page.

Select the Masking definition for which you have just generated the script.

Click 'Schedule Job'



4.16 Credential Select

Preferred : SYSDBA Database

Click 'Login'

4.17 In the dialog, enter following values.

Section Encrypt Seed Section

If masking definition Encrypt or Decrypt have been chosen, an encryption seed is needed this will be supplied with:

'Seed' and 'Confirm seed' = This is the value that is used for the format Encrypt and Decrypt

Section Workload

Check 'Mask SQL Tuning Sets' and 'Capture Files'

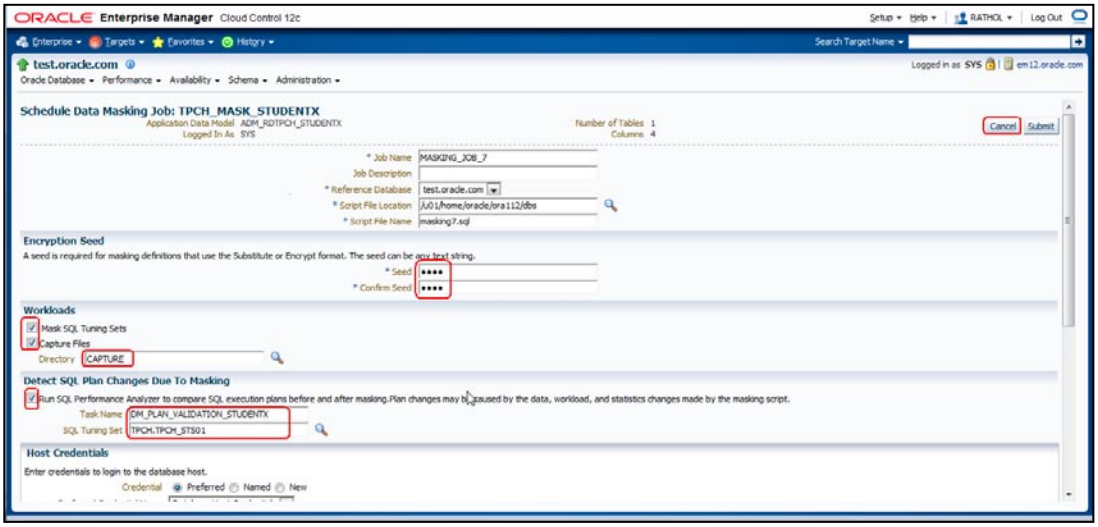
Select the Workload directory that corresponds to this database backup in this case 'CAPTURE'

Section Detect SQL Plan Changes Due to Masking

Check 'Run SQL Performance….'

Enter Task name 'DM_PLAN'

Now click 'Cancel'



B3. Run Masked Database replay

Estimated Time to Complete Use Case: 20 minutes

Business Case

For the purpose of this lab, assume that database has been masked and all sensitive data have been obfuscated by scheduling the job to completion. This was done due to time constraints of the lab. It is now time to send the database to the test team so they can conduct tests.

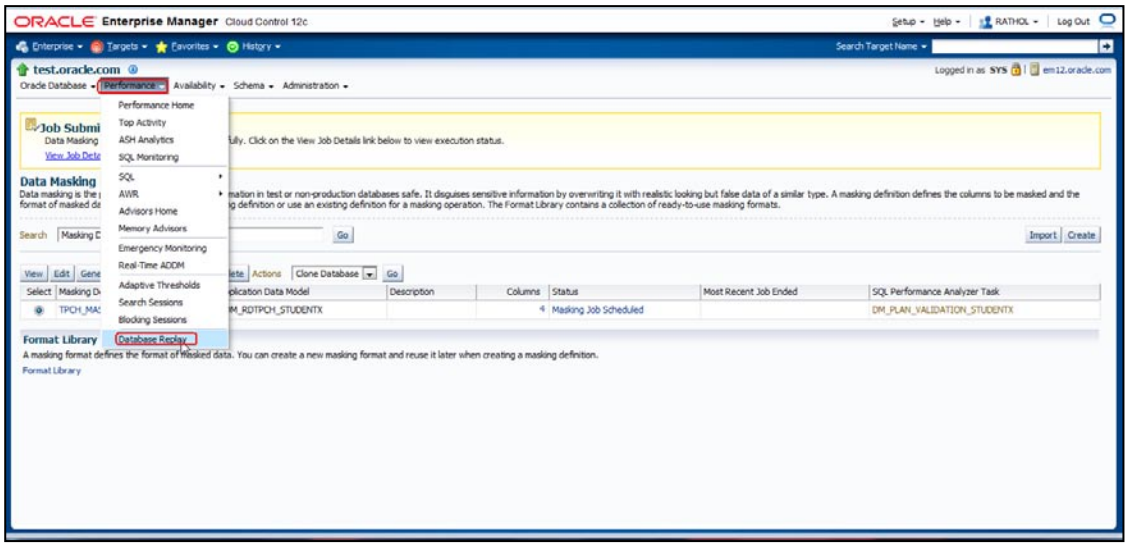
5. Run Database replay

5.1 You should already be logged on to Enterprise Manager. If you are not, please follow the instructions detailed in earlier section of this workbook.

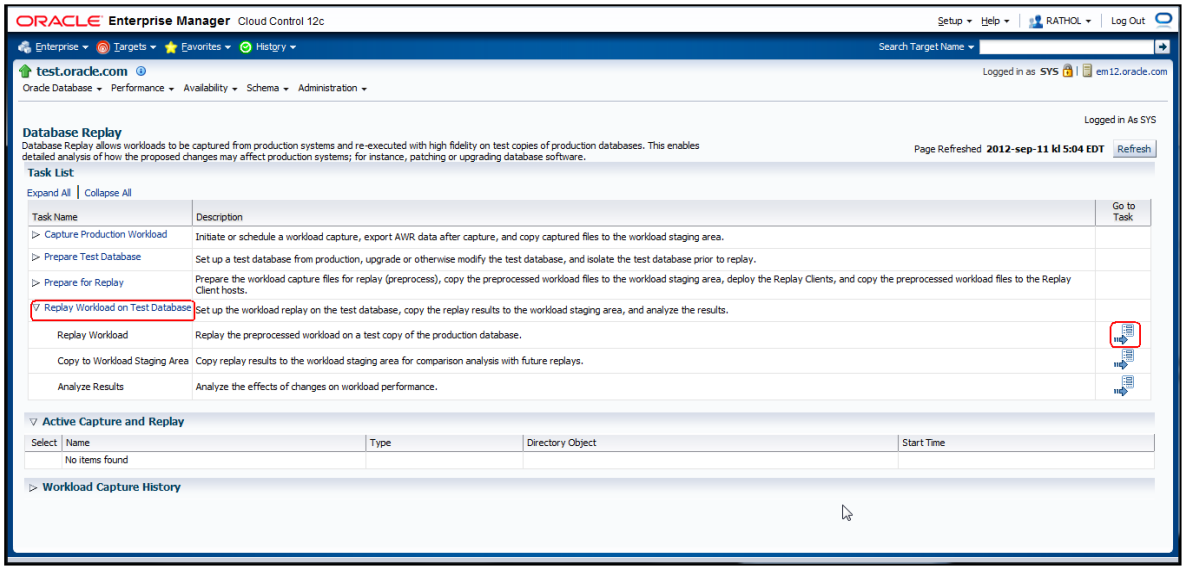
5.2 So, let's begin the Database replay operation

Switch to the original tab Navigate to Database Replay: From the Menu,

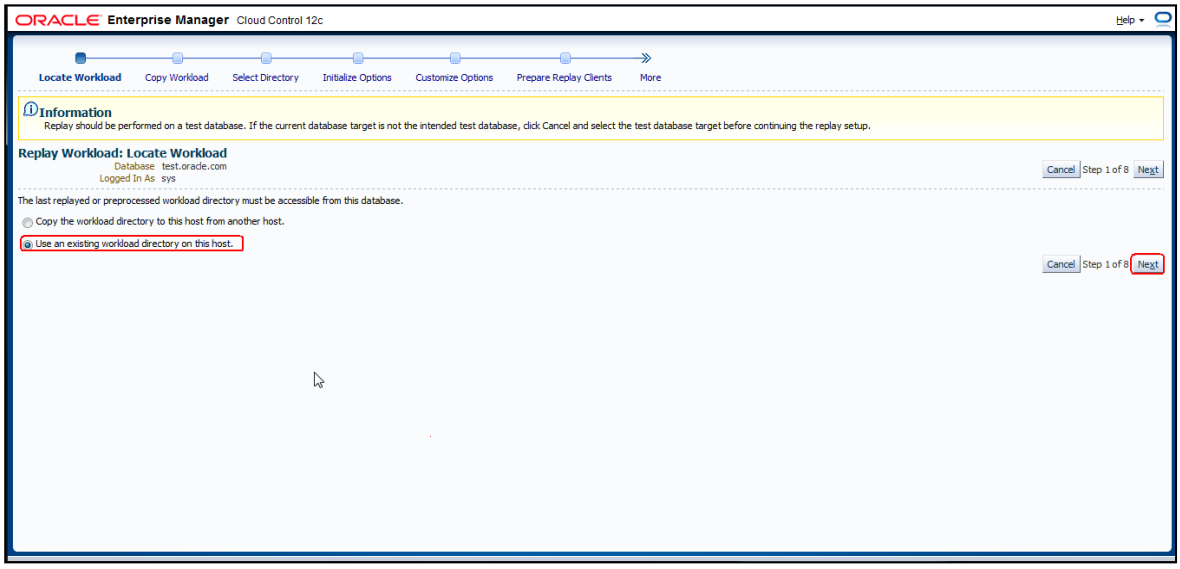
Performance → Database Replay



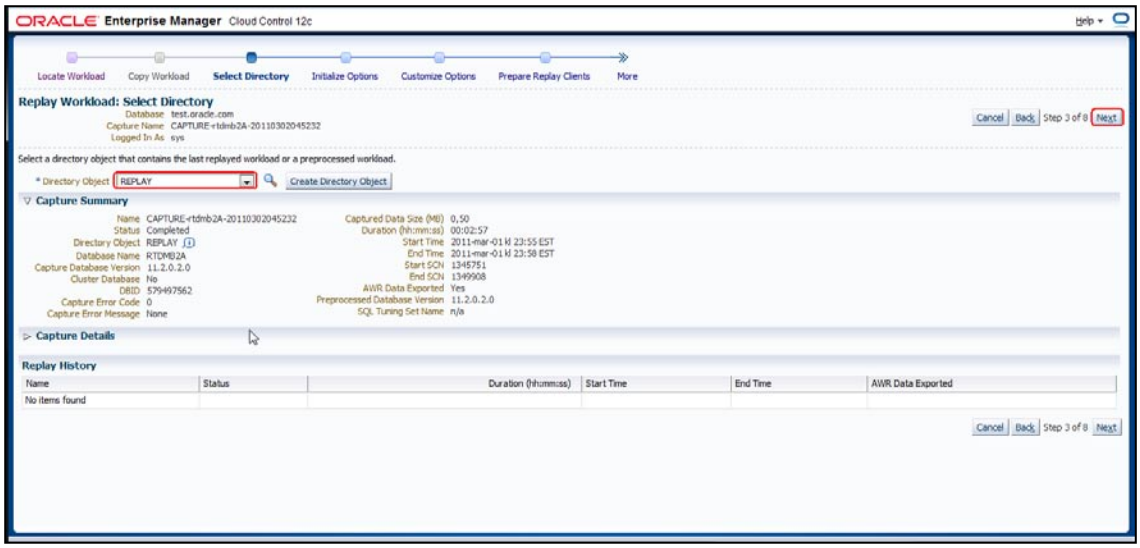
5.3 Expand 'Replay Workload on Test Database' and click on the 'Go to Task' icon for 'Replay Workload'



5.4 Select 'Use an existing workload directory on this host', click 'Next'

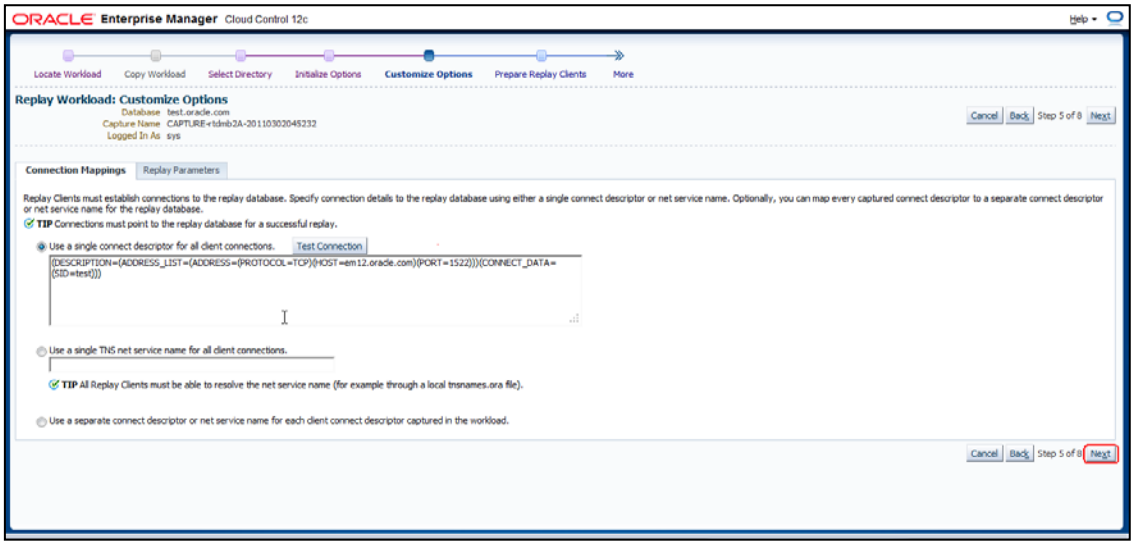


5.5 Set Directory Object to REPLAY. Wait until Capture Summary has been populated. Click 'Next'.



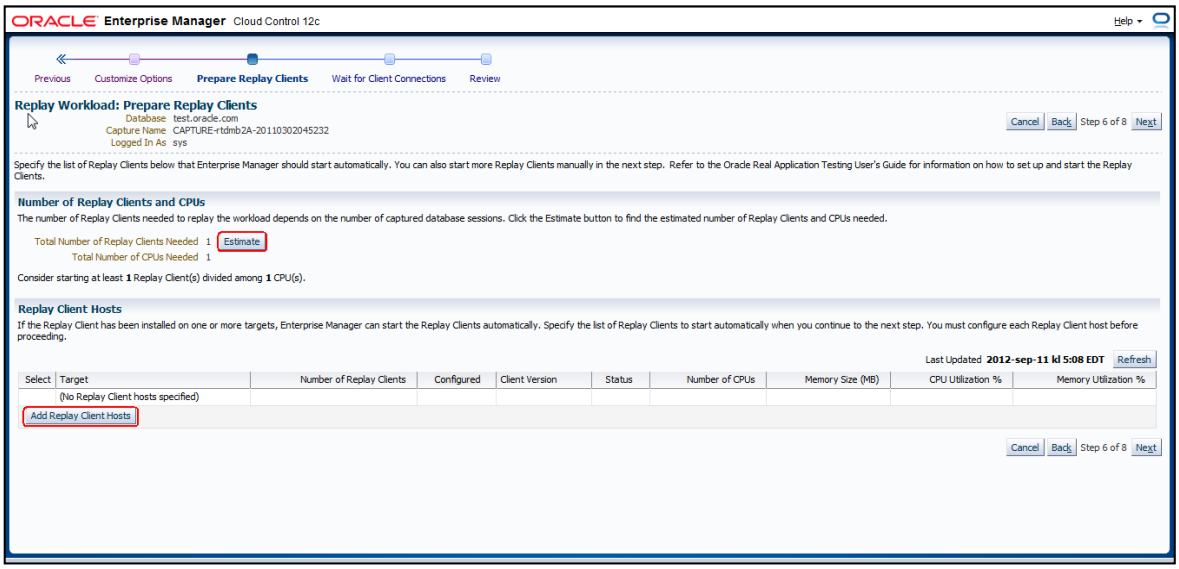
5.6 Use Default options on this page, Click 'Next'

5.7 Click 'Next'



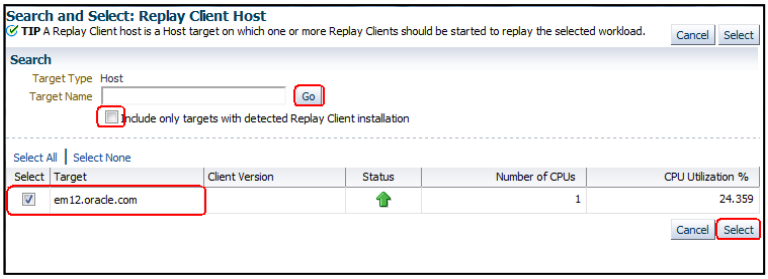
5.8 Click 'Estimate' to identify how many replay clients that are needed to run the workload. In this case it is only one, so let's add this replay client.

Click 'Add Replay Client Hosts'.



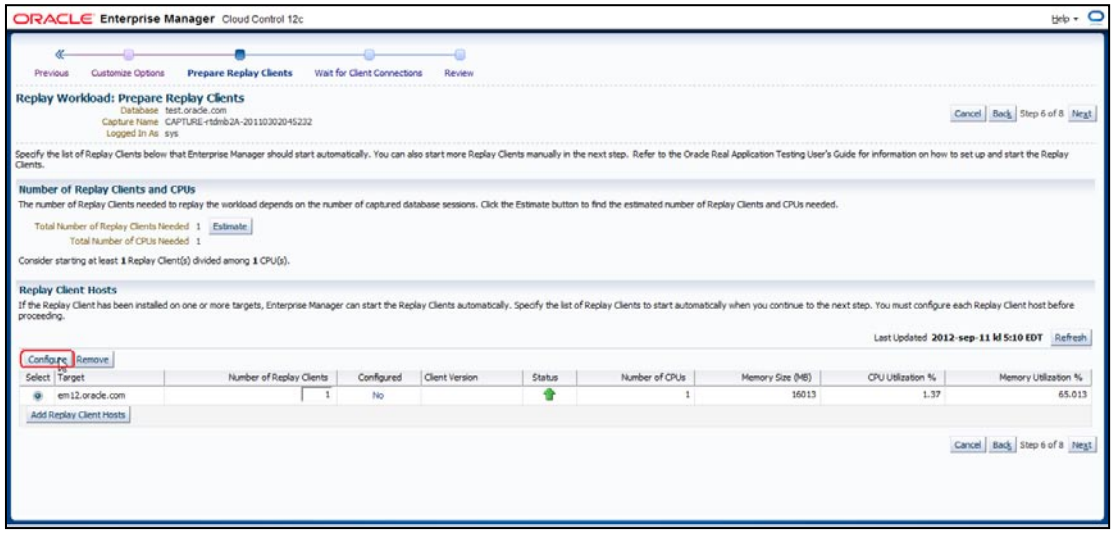
5.9 Deselect 'Include only ….', Enter Target Name: em12

Select target 'em12.oracle.com' and click 'Select'



5.10 We have now added the Replay Client Host, next let us configure it for the selected workload.

Click 'Configure'



5.11 On this page it is important that all parameters are correct otherwise the replay client won't start properly and we need to start all over on step 4.8. Host password should have been populated. Please copy values from this document for:

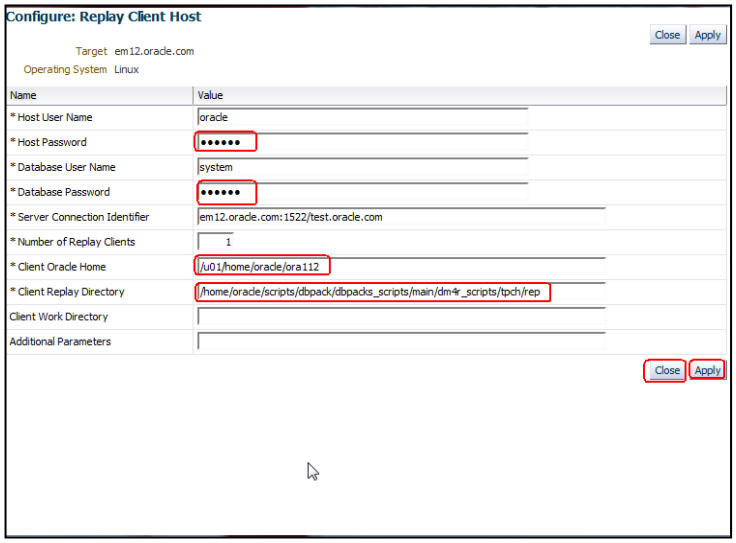
Host User Name: oracle Host Password: oracle12

Database User Name: system Database User Password: oracle12

Client Oracle Home: /u01/home/oracle/ora112

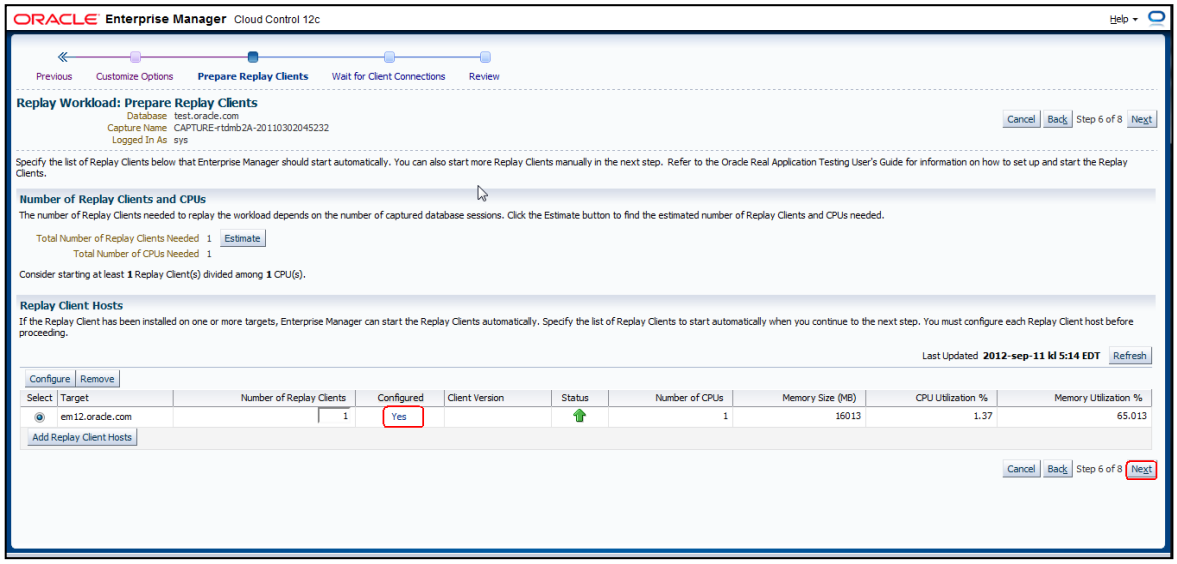
Client Replay Directory: /home/oracle/scripts/dbpack/dbpacks_scripts/main/dm4r_scripts/tpch/rep

Click 'Apply' and click 'Close'



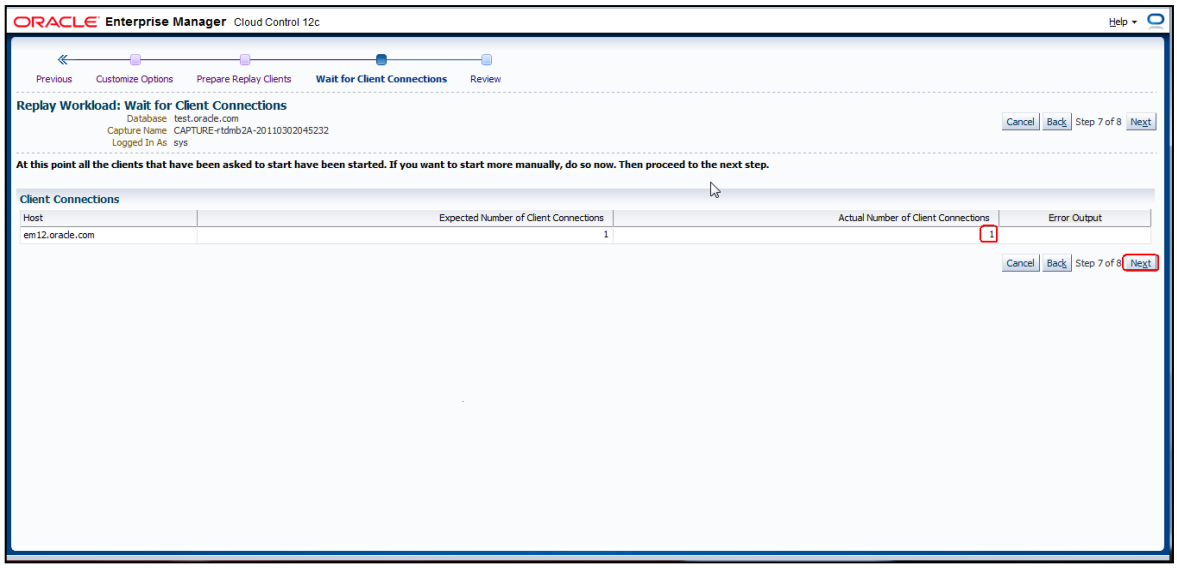
5.12 The Replay client is now configured which can be seen that 'Configured ' has changed to 'Yes'

Click 'Next'



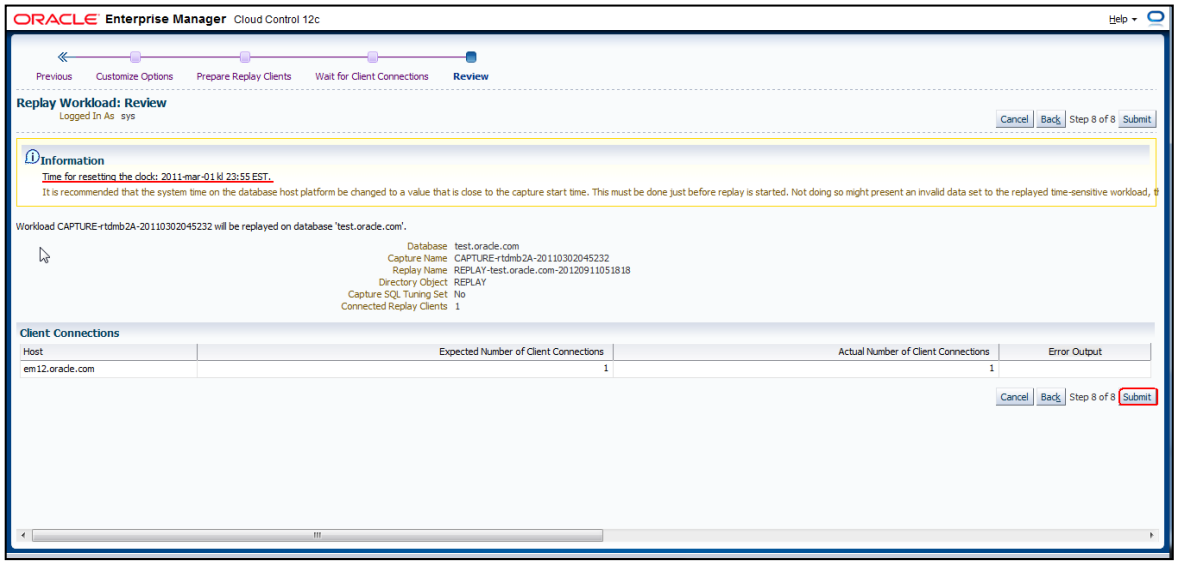
5.13 It will take a short time before the replay client have connected to the database, so let's wait until 'Actual Numbers of Client Connections' has changed to 1

Click 'Next'

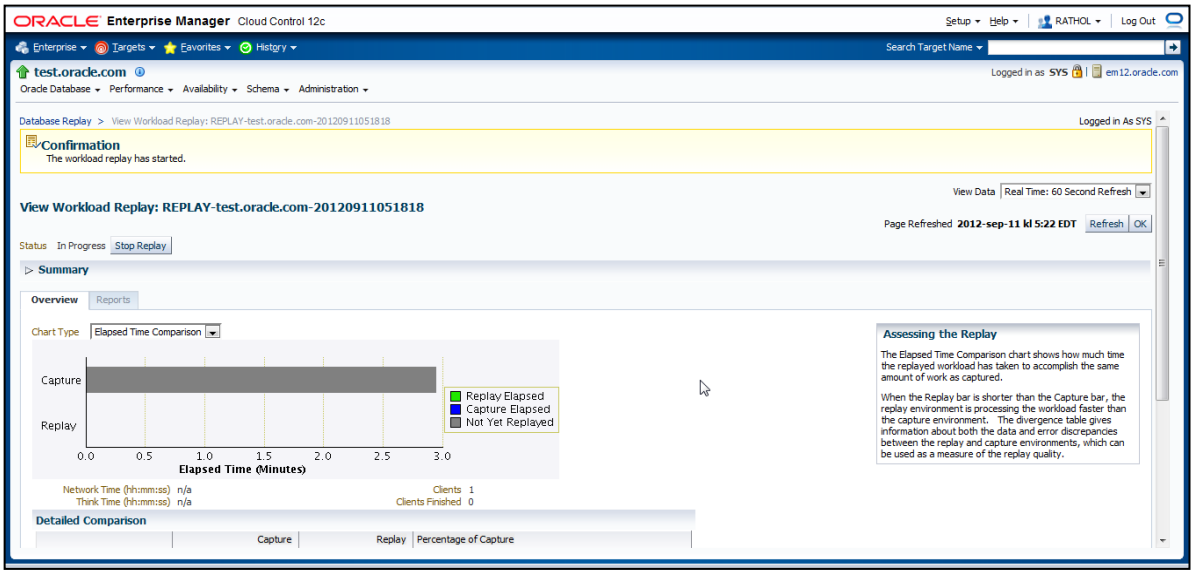


5.14 Many databases have applications that are sysdate dependent. If that is the case then it is time to change system time. You can see in the Information field the time that should be suitable for this replay. This application doesn't have any dependency so let's replay it.

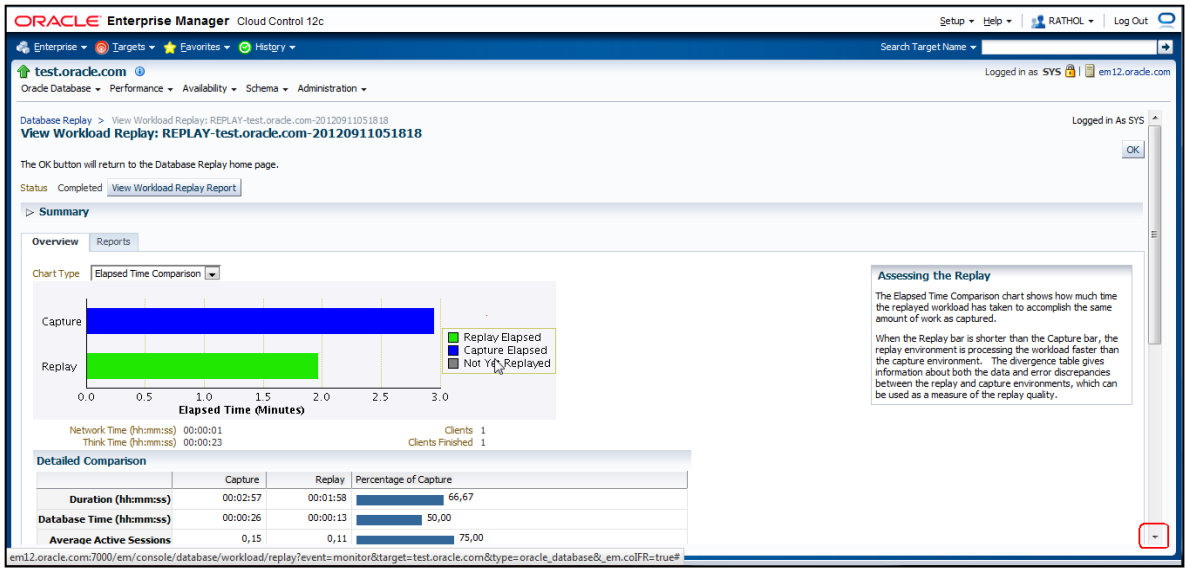
Click 'Submit'



5.15 The workload has now started. The page refresh will be done with 60 second interval. There is no use to update it on a higher frequency since this is the background data collection interval as well.

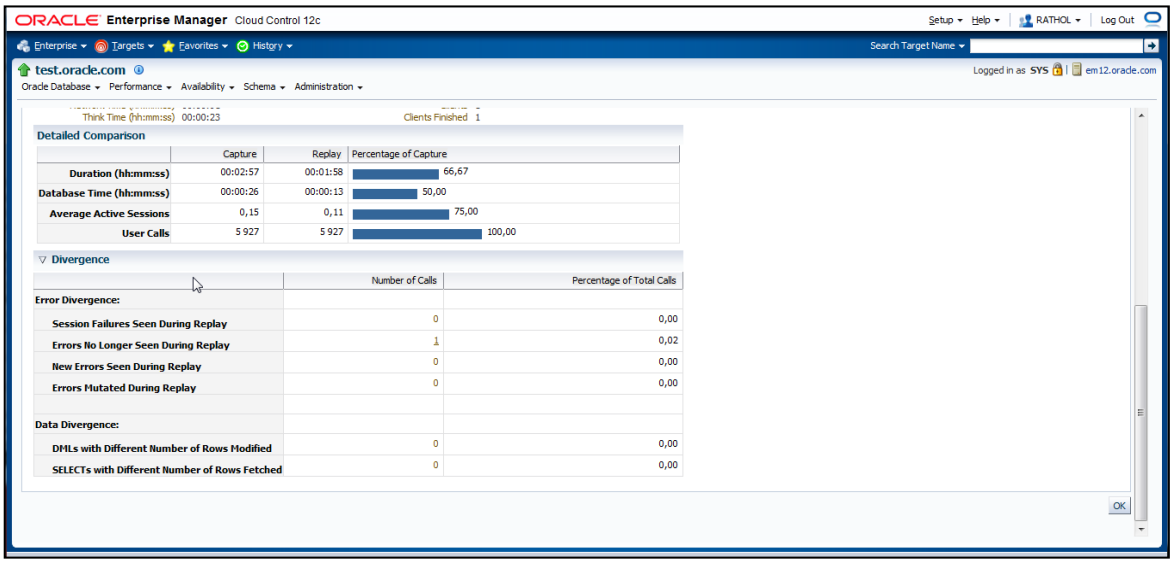


5.16 The replay will be completed in about two minutes. Please review the report that we captured from an earlier run in Step 5.20 below and come back to this step after replay completes. Scrolldown and validate the divergence section.



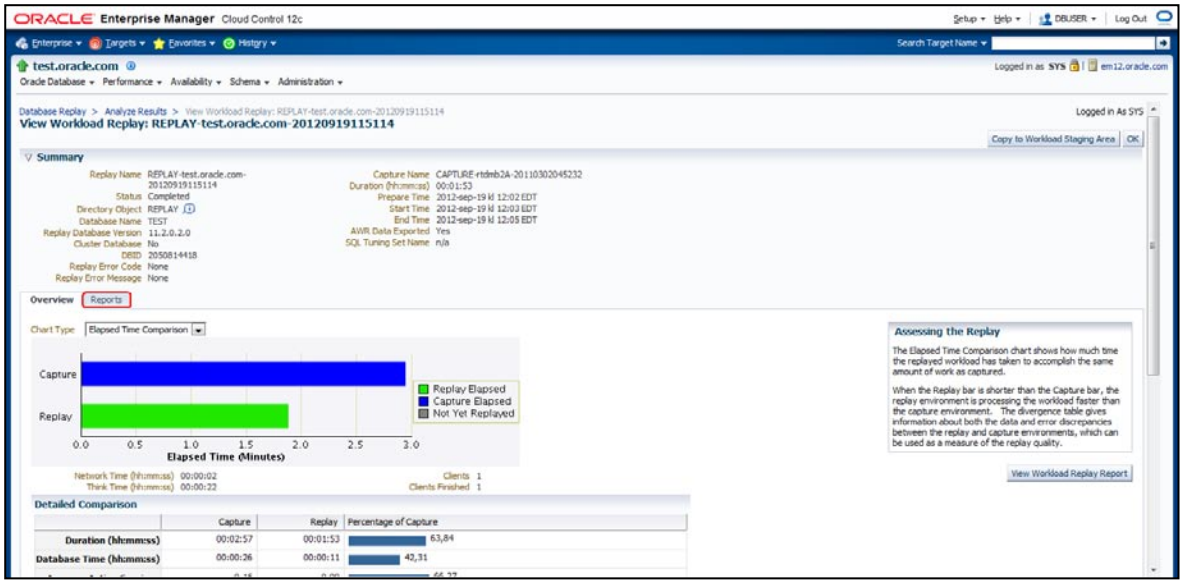
5.17 The divergence is minimal so this replay is successful.

Go back to the top of the screen



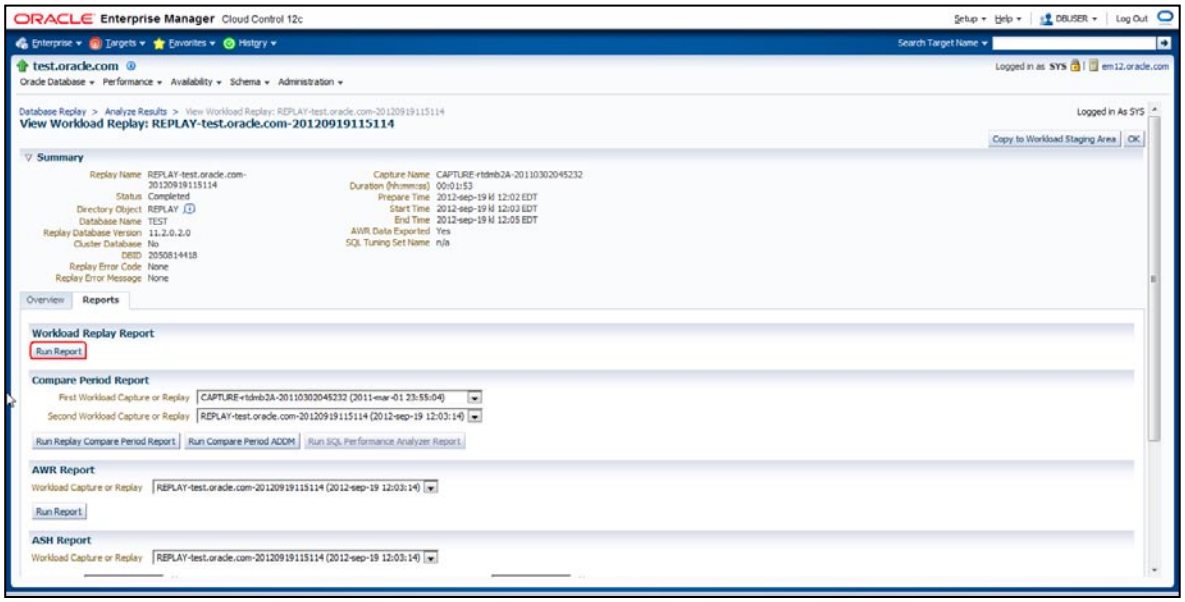
5.18 Let's take a look at some of the reports that we have available

Click on 'Reports' tab

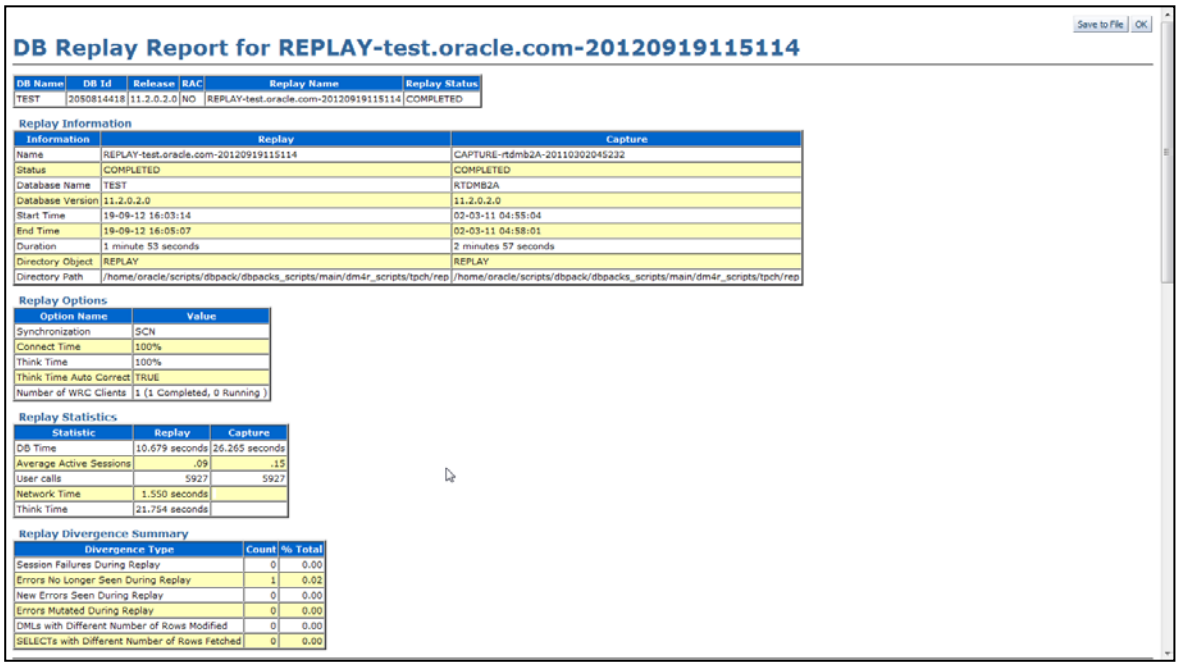


5.19 In Workload Replay Report section

Click 'Run Report'



5.20 Please review the Replay Report that will be output after the replay completes. While you're waiting for the Replay to complete you can review this..



DB Replay Report for REPLAY-test.oracle.com-20120919115114

DB Name	DB Id	Release	RAC	Replay Name	Replay Status
TEST	2050814418	11.2.0.2.0	NO	REPLAY-test.oracle.com-20120919115114	COMPLETED

Replay Information

Information	Replay	Capture
Name	REPLAY-test.oracle.com-20120919115114	CAPTURE-rtdmb2A-20110302045232
Status	COMPLETED	COMPLETED
Database Name	TEST	RTDMB2A
Database Version	11.2.0.2.0	11.2.0.2.0
Start Time	19-09-12 16:03:14	02-03-11 04:55:04
End Time	19-09-12 16:05:07	02-03-11 04:58:01
Duration	1 minute 53 seconds	2 minutes 57 seconds
Directory Object	REPLAY	REPLAY
Directory Path	/home/oracle/scripts/dbpack/dbpacks_scripts/main/dm4r_scripts/tpch/rep	/home/oracle/scripts/dbpack/dbpacks_scripts/main/dm4r_scripts/tpch/rep

Replay Options

Option Name	Value
Synchronization	SCN
Connect Time	100%
Think Time	100%
Think Time Auto Correct	TRUE
Number of WRC Clients	1 (1 Completed, 0 Running)

Replay Statistics

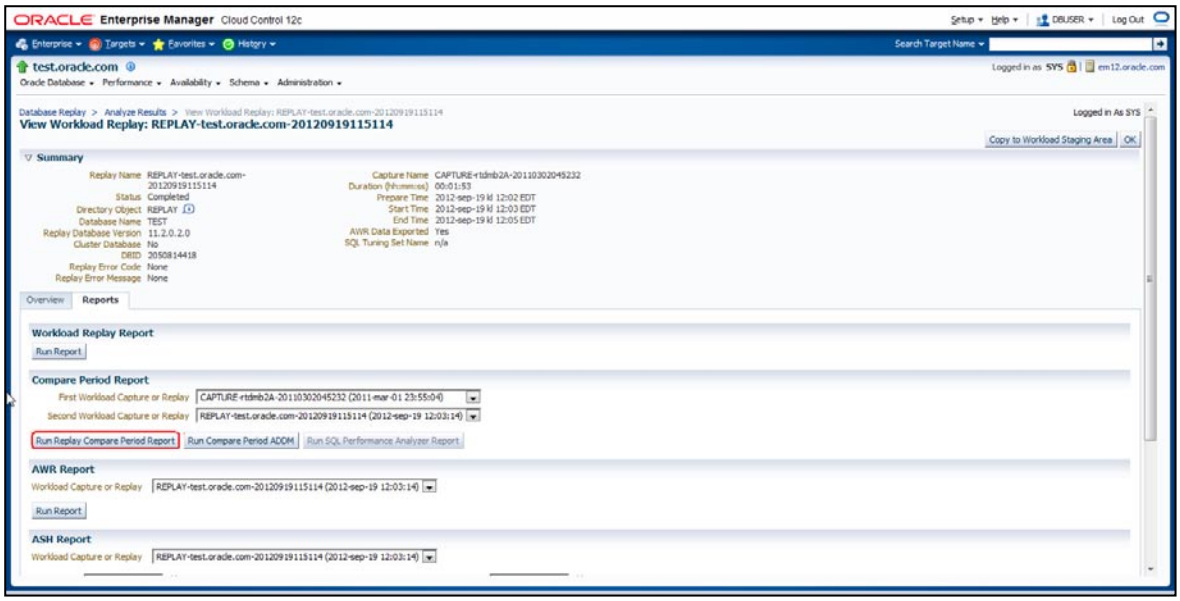
Statistic	Replay	Capture
DB Time	10.679 seconds	26.265 seconds
Average Active Sessions	.09	.15
User calls	5927	5927
Network Time	1.550 seconds	
Think Time	21.754 seconds	

Replay Divergence Summary

Divergence Type	Count	% Total
Session Failures During Replay	0	0.00
Errors No Longer Seen During Replay	1	0.02
New Errors Seen During Replay	0	0.00
Errors Mutated During Replay	0	0.00
DMLs with Different Number of Rows Modified	0	0.00
SELECTs with Different Number of Rows Fetched	0	0.00

5.21 Go back to the main screen

Another important report is the Compare period report. This report needs AWR Data to be imported from the capture. This is a rather time consuming operation so we have provided a Compare Period report in Appendix A, please take a look at the report.



This concludes the Secure Testing section.

Appendix 1. Compare Period Report

This report gives you the possibility to compare the overall replay performance with either the capture or another replay.

In this example we have compared two replays on different platforms.

When comparing statistics from capture vs. Replay or Replay vs. Replay.

First thing to look at is the divergence, if the divergence is small or similar then we can continue with the analyze.

We can see that divergence during this replay is 0%. This is exceptional good and not very common, less than 5% should be considered as a good replay.

This is a platform comparison so next step is to validate the performance. This is done by comparing Database Time (Database time is the total time spent inside the database for all calls to the database. This includes CPU time, Wait time and I/O time)

This report shows that the Linux configuration performed better, it was almost 30% faster and that this performance improvement is mostly I/O related since I/O wait time have been reduced by 66%.

Elapsed: 00:00:00.30 Elapsed: 00:00:00.05 Elapsed: 00:00:01.41

Compare Period Report: Replay vs. Replay

Collapse all sections

This report compares the performance of two workload replays of the same original captured system. Throughout the report "Capture" refers to the original captured system, while "1st Replay" and "2nd Replay" refer to the replayed workload.

(-) General Information

This section describes the experimental setup. Check it carefully to verify that the intended experiment was performed.

(-) Data Sources

	1st Replay	2nd Replay	Capture
Capture/Replay name	win_replay	wrr-20091009-172011	windows
Capture/Replay ID	52	49	45
Data Directory Name	capture2	capture2	capture2
Directory Path	/home/oracle/capture2	/home/oracle/capture2	/home/oracle/capture2

(-) Information About Databases

	1st Replay	2nd Replay	Capture
Database Name	ORCL	ORCL2	ORCL
Original Database ID	1227368024	680635737	1227368024
Version	11.1.0.7.0	11.1.0.7.0	11.1.0.7.0
Platform	Microsoft Windows IA (32-bit)	Linux IA (32-bit)	Microsoft Windows IA (32-bit)
Is It RAC?	NO	NO	NO
Number of Instances	1	1	1

(-) Information About AWR and Time Periods

	1st Replay	2nd Replay	Capture
Start Time	2009-10-11 21:24:48	2009-10-09 17:20:40	2009-10-07 16:05:13
End Time	2009-10-11 22:33:59	2009-10-09 18:25:23	2009-10-07 17:13:20
Duration	1.15 hours	1.08 hours	1.14 hours
AWR Database ID	1527643436	1665419362	529231513
AWR Start Snapshot ID	43	5	18
AWR End Snapshot ID	45	7	20

No Changes to Important Parameters

No Changes to Optimizer-Relevant Parameters

(-) Changes to Memory Configuration Parameters

	1st Replay	2nd Replay
memory_target	820 M	512 M

(-) Instances of the 1st Replay Database

instance number	instance name	host name	number of CPU cores	number of CPU sockets	physical memory	instance type
1	orcl	ORACLE-E7C6FMP7	1	1	2 G	RDBMS

(-) Instances of the 2nd Replay Database

instance number	instance name	host name	number of CPU cores	number of CPU sockets	physical memory	instance type
1	orcl2	localhost	1	1	1.98 G	RDBMS

(-) Replay Divergence

This section describes the divergence in the two replays compared to the captured system and compared to each other. Please look at the full divergence report if this report shows significant divergence. The possible divergence levels are: (NONE) no divergence detected at all (LOW) minimal divergence detected but the performance comparison is most likely still valid (MEDIUM) some non-trivial divergence is detected and the performance comparison is suspect (HIGH) severe divergence detected and the performance comparison is unlikely to be informative.

	Divergence Level	Percent of Calls That Diverged
Divergence of 2nd Replay compared to 1st Replay	NONE	0%
1st Replay Divergence (compared to Capture)	NONE	0%
2nd Replay Divergence (compared to Capture)	NONE	0%

(-) Main Performance Statistics

This section does a high-level performance comparison of the two periods. Start by looking for a change in Database Time. If there is no significant change in Database Time, you can assume performance as a whole is similar. You can look for a change in the Database Time pieces that follow (CPU, User I/O, and Cluster) to see how the different ingredients of Database Time changed from one period to the next, either to explain a change in Database Time or to see if some pieces regressed and others improved.

	Change in DB time	1st Replay total time	2nd Replay total time	1st Replay % of DB time	2nd Replay % of DB time
Database Time	-29.63%	14927.46 seconds	10504.19 seconds	100	100
CPU Time	-7%	3824.23 seconds	3556.47 seconds	25.62	33.86
User I/O Wait Time	-66.1%	30.93 seconds	10.48 seconds	.21	.1

(-) Top SQL by Change in DB Time

This section compares the performance change of individual SQL statements from one period to the next. SQL statements are identified by their force matching signature to account for literal usage. They are ordered by the total change in DB Time, as the most relevant changes are those that impact total throughput the most. Any SQL tuning you do should begin with the statement that regressed by the most DB Time.

Force Matching Signature	example SQL_ID	Change in DB Time	Change in Average Response Time	1st Replay DB time	2nd Replay DB time	example sql text
15902161590565153284	6g38j29k4051q	-1751.07 seconds	-23.59%	7422.49 seconds	5671.43 seconds	(+) select t1.orig as orig, t1.dest as first_stop, [...]
6149797722892106905	aw5xbnagwmnkx	-788.49 seconds	-26.56%	2969 seconds	2180.51 seconds	(+) insert into REQUESTS(rid, cid, status, orig, dest, [...]
2328722149208612348	cz8775bf9m57t	-663.73 seconds	-22.83%	2907.14 seconds	2243.41 seconds	(+) select t1.orig as orig, min(t1.dest) keep(de [...]

(-) Hardware Usage Comparison

(-) CPU Usage

This section describes general CPU usage on the systems and helps assess if they were CPU bound. The number of CPUs is summed over all instances. CPU usage is averaged over instances. Note that "Oracle Run-queue Load" is for Oracle processes only and usually underestimates the run-queue part.

system	CPU Sockets/Cores/Threads	Hosts' CPU Usage	Oracle Sessions on CPU	Oracle Run-queue Load
1st Replay	1/1/1	94.05%	.93 active sessions	.25 active sessions
2nd Replay	1/1/1	92.87%	.92 active sessions	1.78 active sessions

(-) I/O to Data and Temp Files

This section shows some basic I/O statistics about data and temp files. First look at the single block read time. An I/O bound system will show a high value (much more than 10 miliseconds). The total read/write rates should provide some guidance to determine if high single-block latencies are caused by an excess of requests from the database or poor I/O throughput in general.

	1st Replay	2nd Replay
average time of single block read (miliseconds)	41.79	2.72
total number of single block reads	1671	1888
total physical read	.268 G	.345 G
total physical write	.296 G	.127 G
read rate	.066M per sec	.091M per sec
write rate	.073M per sec	.033M per sec

(-) ADDM Comparison

This section provides a comparison of ADDM analyses of the two time periods ordered by the absolute difference in impact. By comparing ADDM results for the two periods, you can see problems that existed in one but not the other, as well as a change in individual finding impacts. If your change is intended to improve database throughput, you should see that improvement reflected in the ADDM findings and impacts.

		impact (sec)	average active sessions	percent active sessions
"Scheduler" Wait Class	1st Replay	7606	1.83	50.92
	2nd Replay	N/A	N/A	N/A
Unusual "Network" Wait Event	1st Replay	549	.13	3.68
	2nd Replay	N/A	N/A	N/A
Commits and Rollbacks	1st Replay	402	.1	2.69
	2nd Replay	N/A	N/A	N/A

End of Report. Elapsed: 00:00:00.04

C1. Generate Application Data Model for the Applications Deployed on the Target Databases

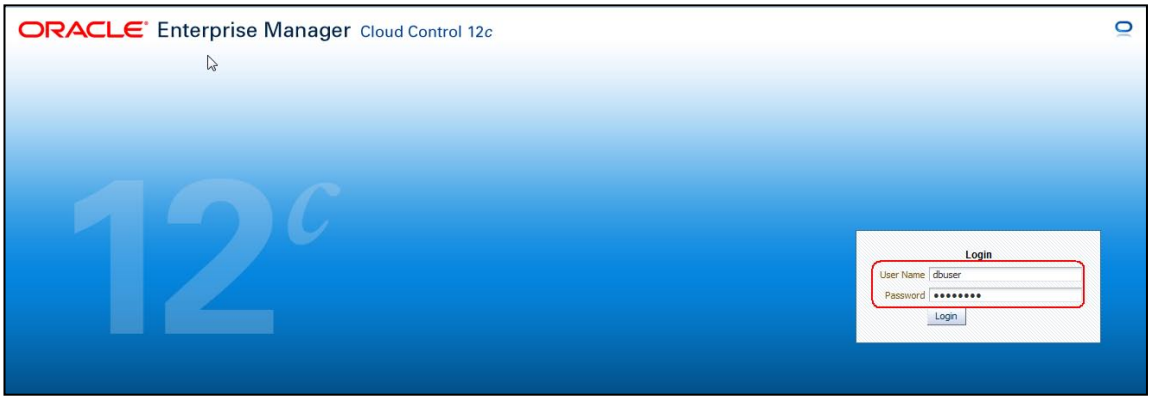
Estimated Time to Complete Use Case: **10 minutes**

Business Case

When a new application has been provided to the application users, it can be a daunting task to construct the application relationships that make up the application. Fortunately, the process of creating the application data model has been greatly simplified for application schema where the application relationships are enforced through database constraint. In this use case, you will construct the application relationships for the HR workload schema. This application data model will be the basis for performing the rest of the Data Masking operations.

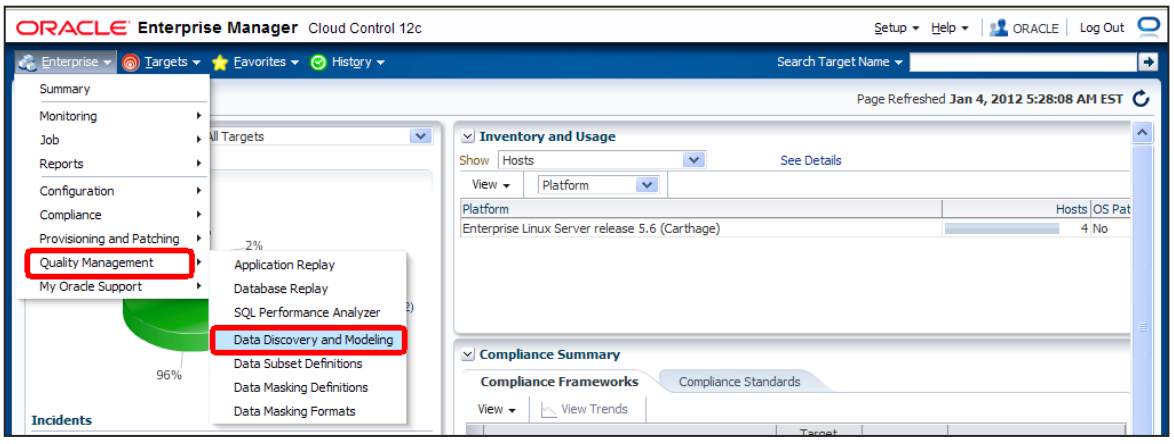
2. Generating the ADM

2.1 Logon using username and password dbuser / oracle12



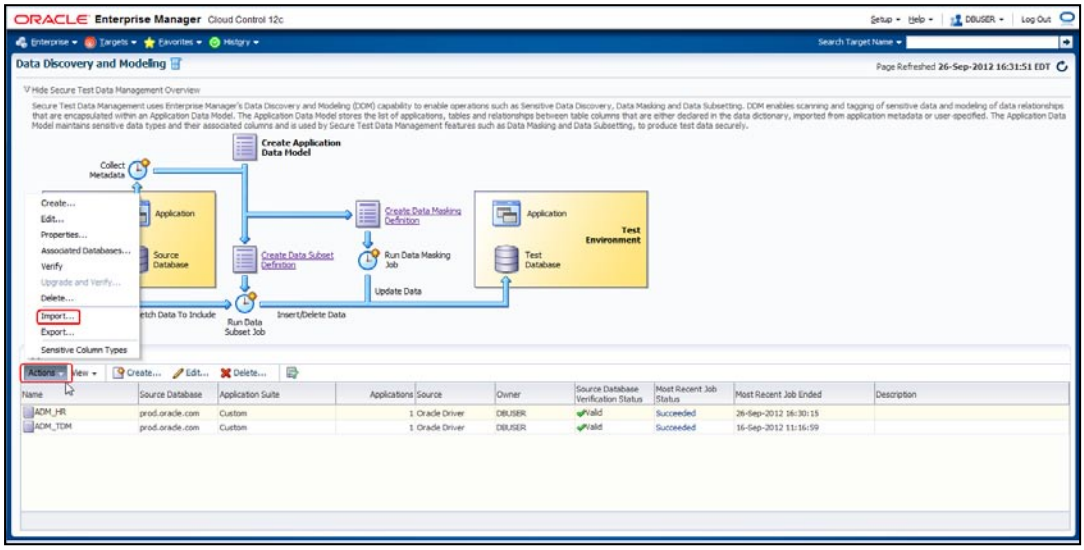
2.2 Navigate to the Application Data Models screen.

From the Menu, Enterprise→ Quality Management →Data Discovery and Modeling



2.3 We are going to start with a pre-created Application Data Model in xml format locally stored on computer.

Click 'Action' -> 'Import…'



2.4 Complete The Dialog Box

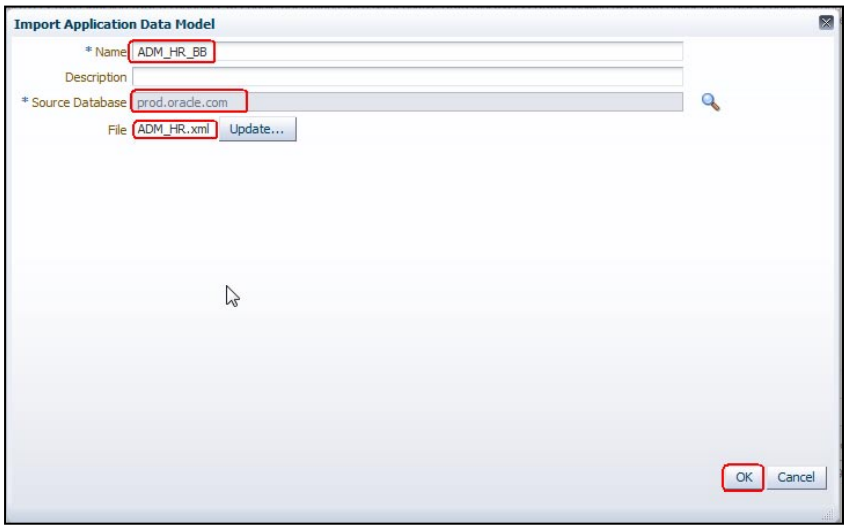
Name : ADM_HR_XX

(Note: Create Application Data Model with new name, such as ADM_HR_<XX> where XX are yor initials)

Source Database : prod.oracle.com (use search option)

File : ADM_HR.xml*

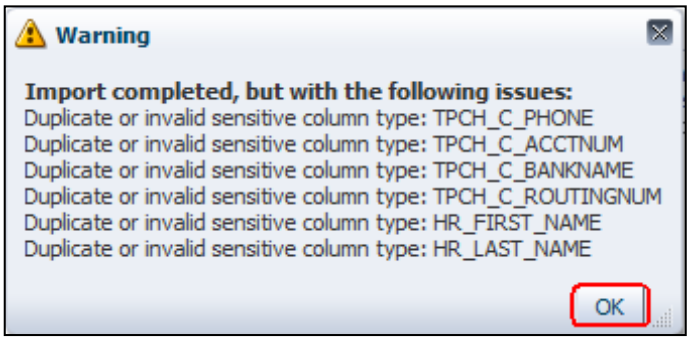
Click Continue.



**To get ADM_HR.xml file, download the following zip file from OTN and unzip–*
http://www.oracle.com/technetwork/oem/app-quality-mgmt/adm-hr-1914944.zip
In case you can't access above URL, ask your lab instructor to provide this file.

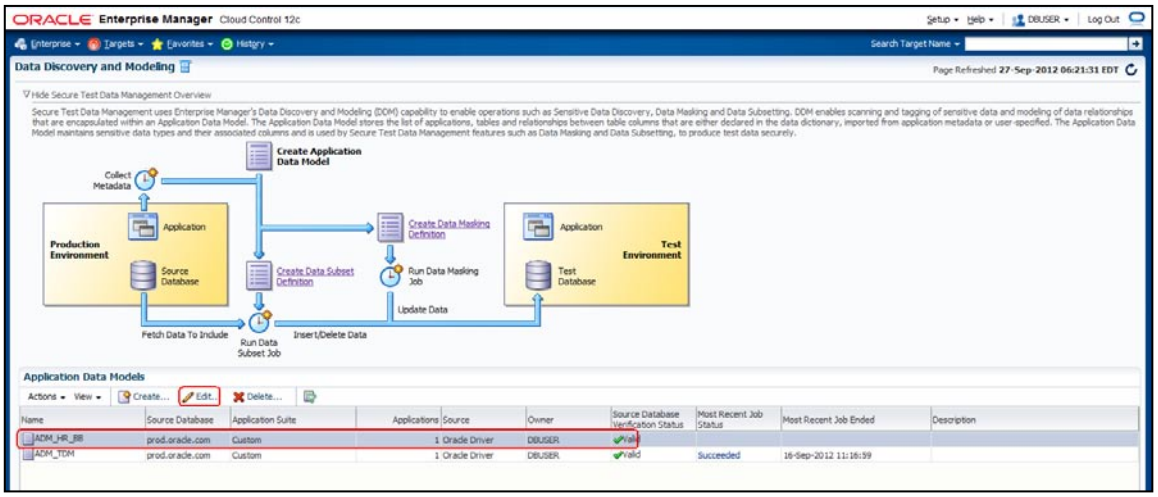
2.5 The ADM includes information regarding all defined Sensitive column types. These are already present in the repository thus the warning below.

Click 'OK'



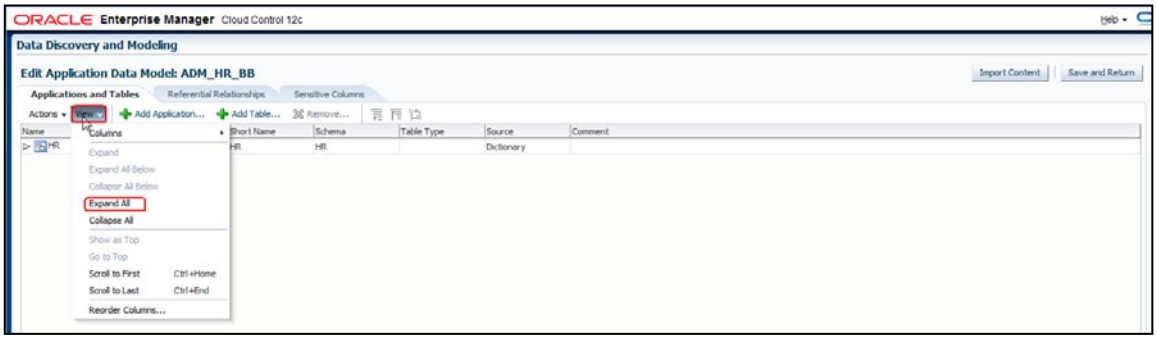
2.6 We are now going to modify the ADM and add a new column that has been decided to be sensitive.

Highlight the newly imported ADM and click 'Edit'

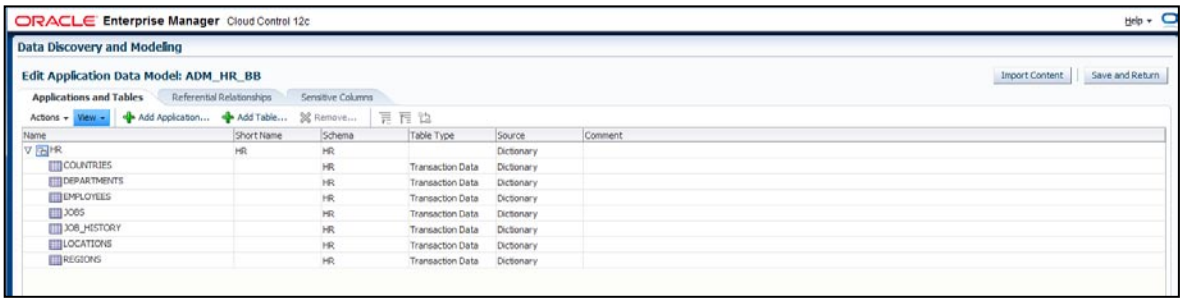


2.7 This Application Data Model has one Application/schema. The application was auto discovered so let's see the content for this application

Click 'View' -> 'Expand All'

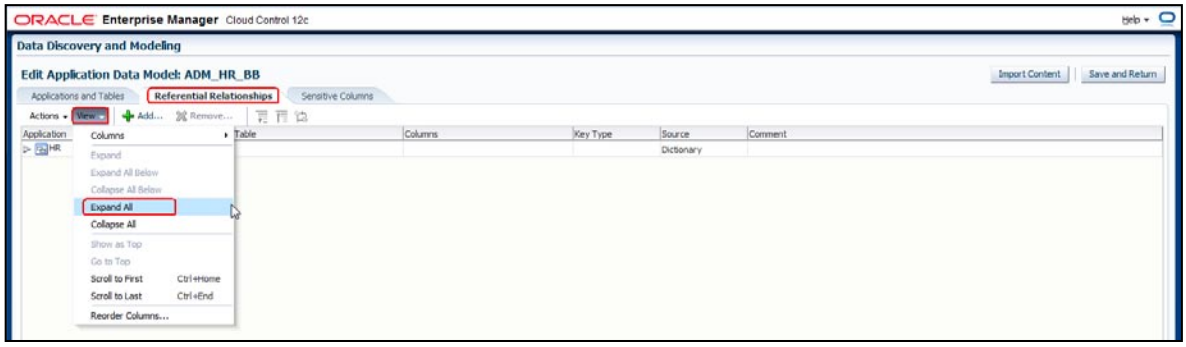


2.8 In ‘Applications and Tables’ we can see all schemas and tables.

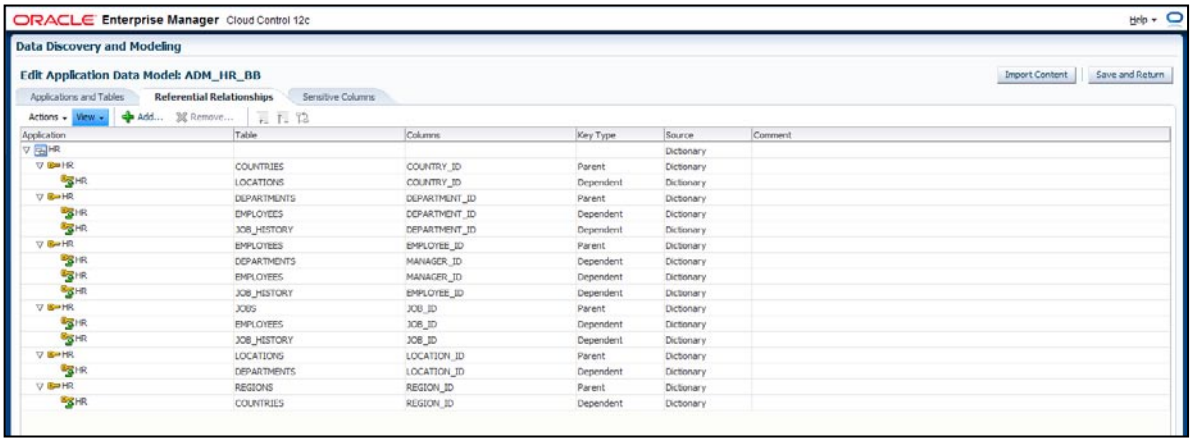


2.9 Go to ‘Referential Relationships’

Click ‘View’ -> ‘Expand All’

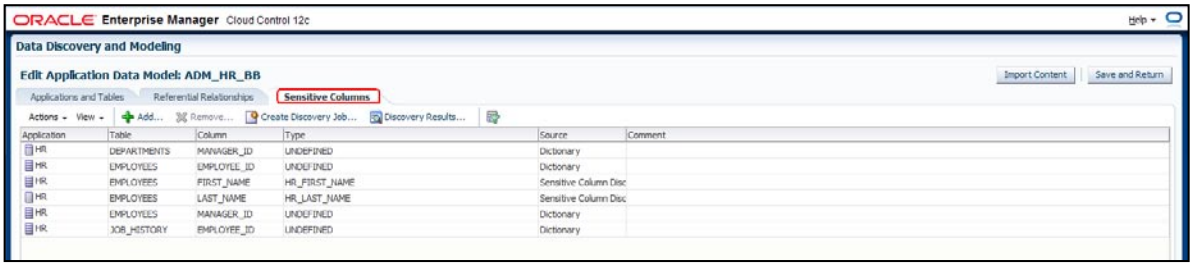


2.10 The discovery process has identified all referential constraints that are implemented for this application. If there are references that are implemented without enforcing it with foreign key constraints then it is possible to add it here as well.


ORACLE Enterprise Manager Cloud Control 12c
Help
Data Discovery and Modeling
Edit Application Data Model: ADM_HR_BB
Import Content
Save and Return
Applications and Tables
Referential Relationships
Sensitive Columns
Actions
View
Add...
Remove...
Application
Table
Columns
Key Type
Source
Comment
HR
Dictionary
COUNTRIES
COUNTRY_ID
Parent
LOCATIONS
Dependent
DEPARTMENTS
DEPARTMENT_ID
EMPLOYEES
JOB_HISTORY
EMPLOYEE_ID
MANAGER_ID
JOBS
JOB_ID
LOCATION_ID
REGIONS
REGION_ID

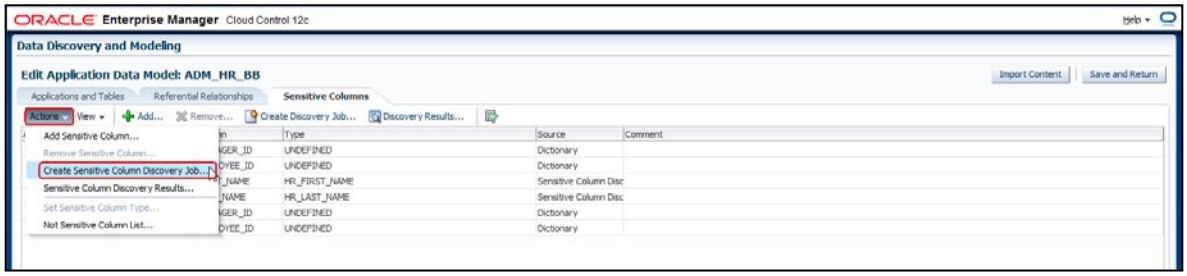
2.11 Go to 'Sensitive Columns'

In this section we have all columns that are defined as sensitive



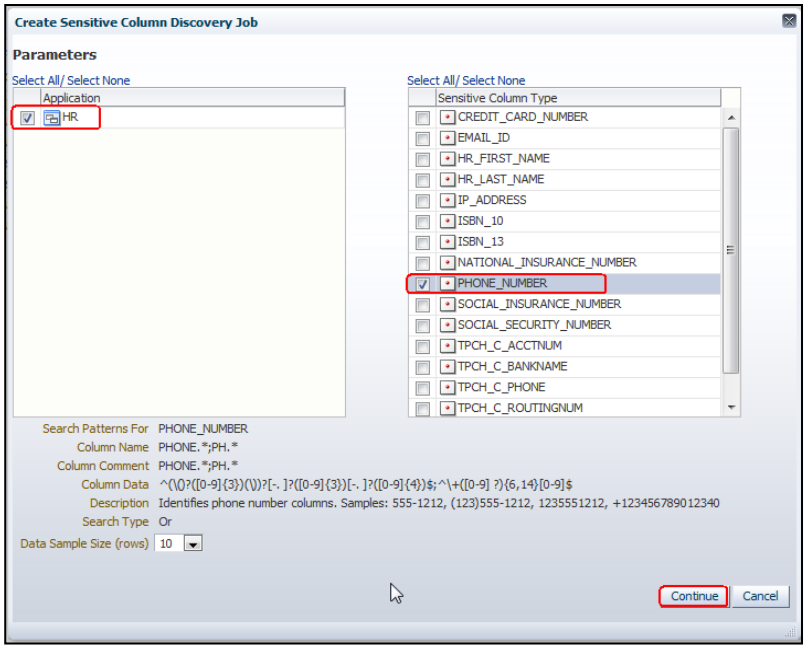
2.12 We are now going to add a new sensitive column and we will use the discovery feature to identify concurrencies of this column. The column can be identified either by column name, column comment or column content.

Click 'Action' -> 'Create sensitive Discovery Job…'

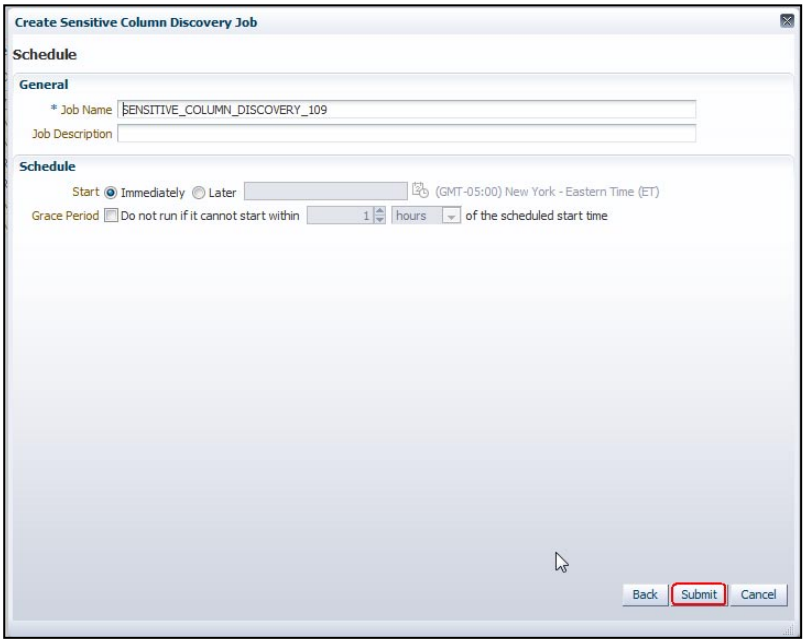


2.13 For Application select 'HR' and for 'Sensitive Column Type' select 'PHONE_NUMBER'

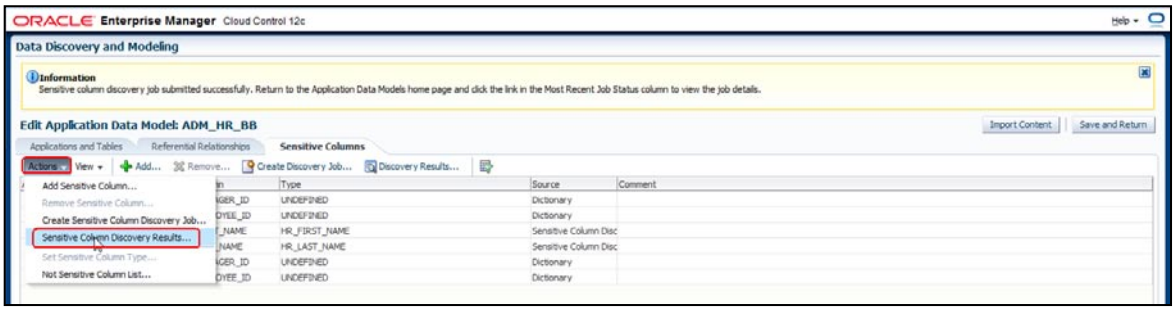
Click 'Continue'



2.14 Click 'Submit'

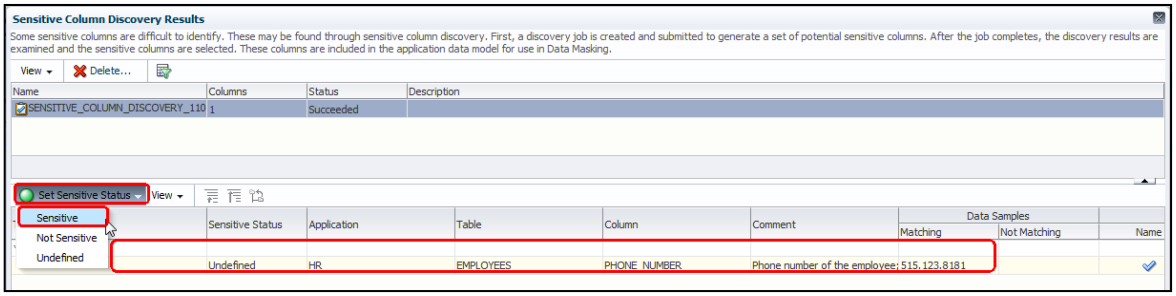


2.15 Click 'Action' -> 'Sensitive Column Discovery Results..'

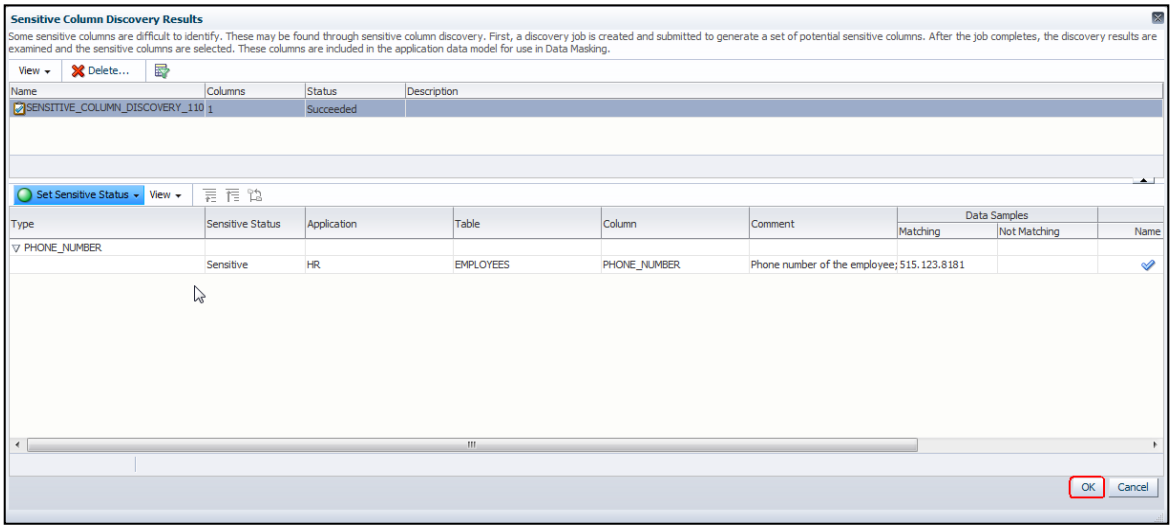


2.16 Expand 'PHONE_NUMBER', mark PHONE_NUMBER for EMPLOYEES

Click 'Set Sensitive Status' and set it to 'Sensitive'

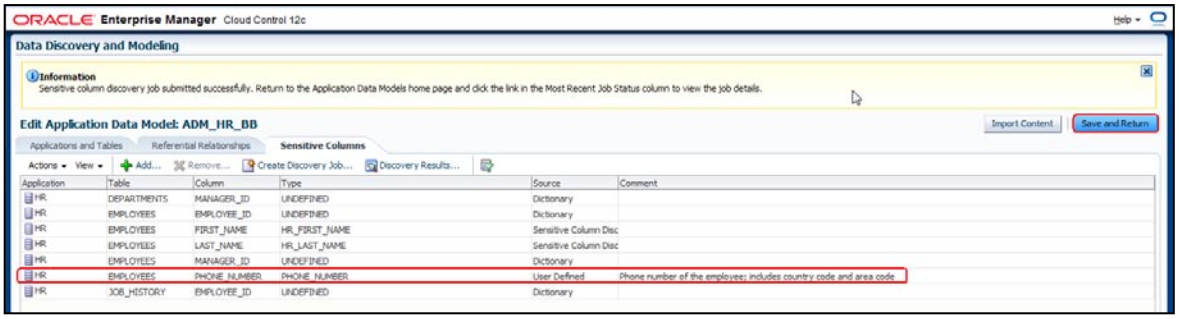


2.17 Click 'OK'



2.18 We have now added a new sensitive column to the ADM. Let's save it.

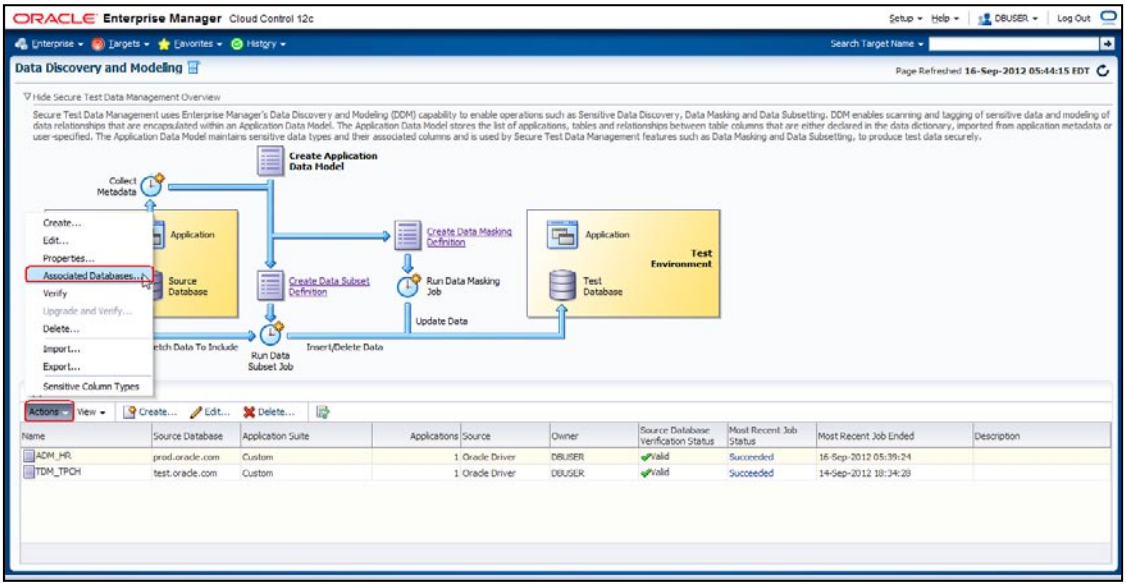
Click 'Save and Return'



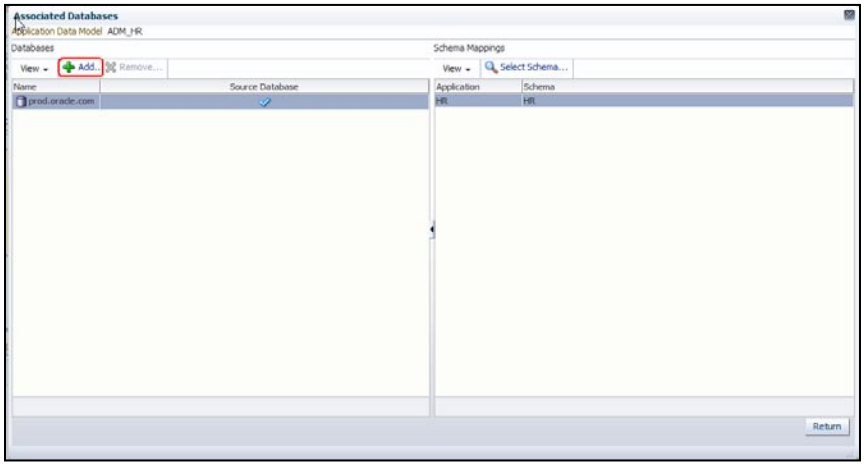
2.19 We have built the ADM for prod database but we should perform the masking on test so we have to make the ADM aware that the application is present in our test database as well.

Select the newly created Application Data Model

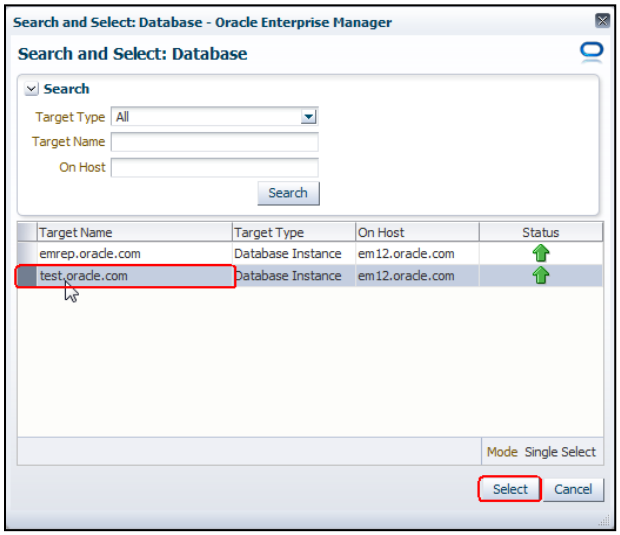
Click ‘Action’ -> ‘Associated databases’



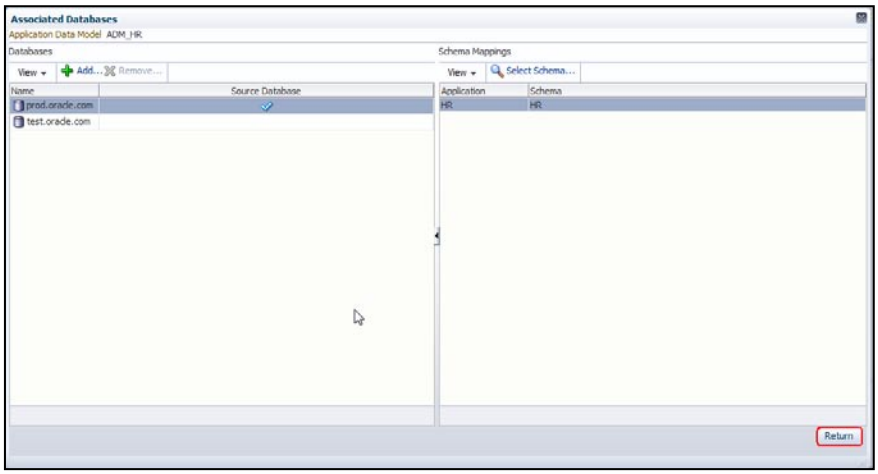
2.20 Click ‘Add’



2.21 Highlight ‘test .oracle.com’ and click ‘Select’



2.22 Click ‘Return’



C2. Create Data Masking Definition

Estimated Time to Complete Use Case: **20 minutes**

Business Case

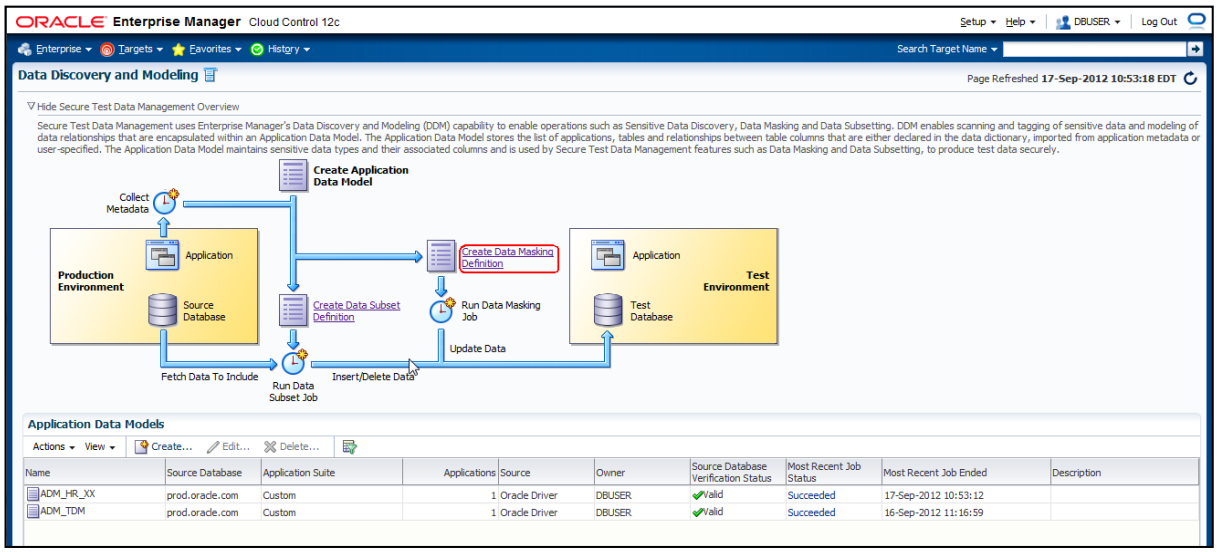
When a new application has been provided to the application users, it can be a daunting task to construct the application relationships that make up the application. Fortunately, the process of creating the application data model has been greatly simplified for application schema where the application relationships are enforced through database constraint. In this use case, you will construct the application relationships for the HR workload schema. This application data model will be the basis for performing the rest of the Data Masking operations.

3. Create the Masking Definition and mask the database

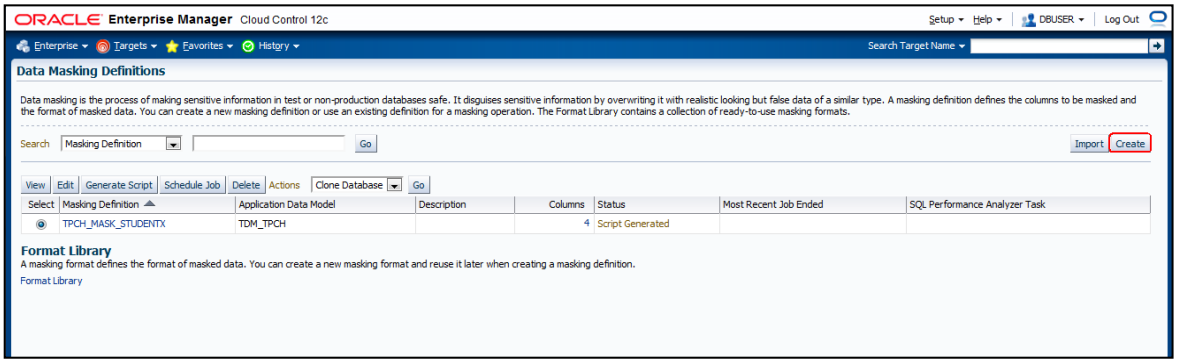
3.1 You should already be logged on to Enterprise Manager. If you are not, please follow the instructions detailed in earlier sections of this workbook.

3.2 From the 'Data Discovery and Modeling' page click 'Data Masking Definition'

Or from the Menu, Enterprise→ Quality Management → Data Masking Definition



3.3 Click 'Create'



3.4 Complete the dialog box:

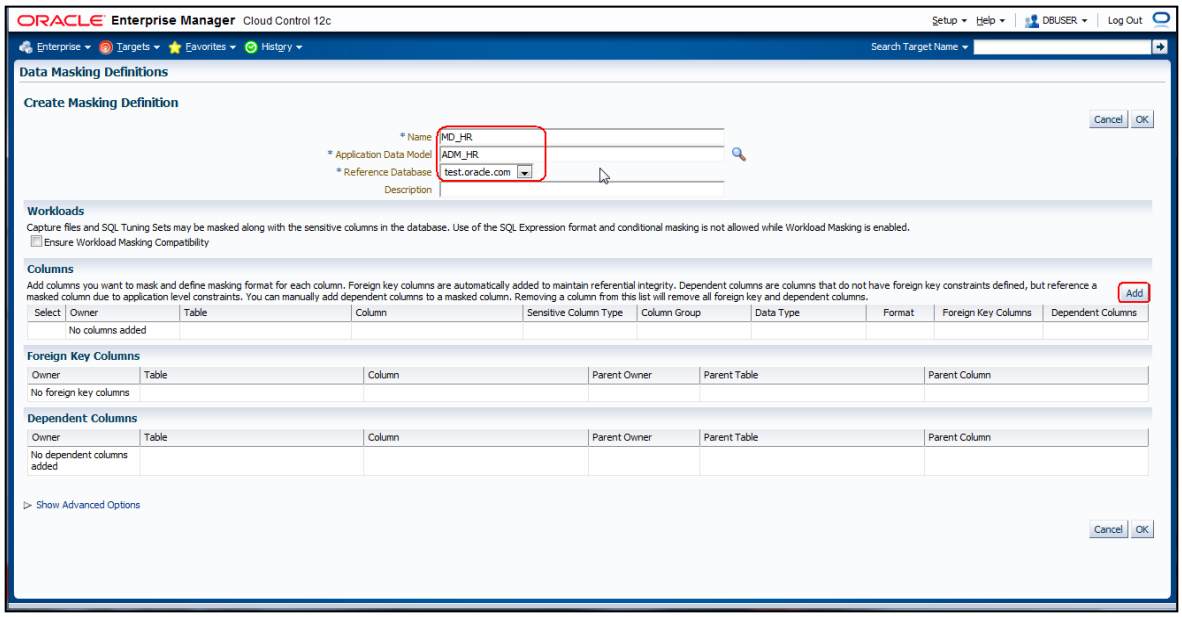
Name : MD_HR_XX (where XX are your initials)

Application Data Model : ADM_HR_XX (Use the ADM created in previous section, use search option)

Reference Database : test.oracle.com

Click 'Add'.

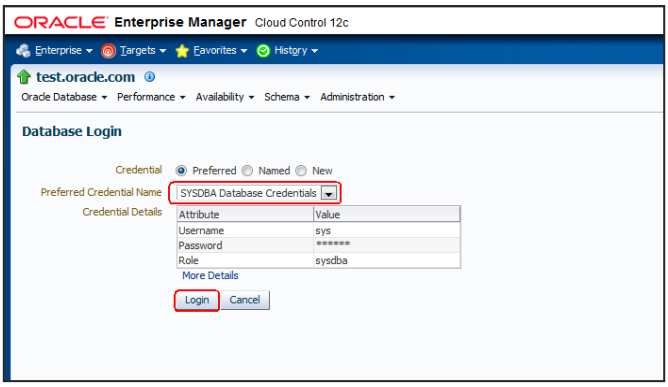
We will now add columns that needs to be masked



3.5 For Credentials select

Preferred : SYSDBA Database

Click 'Login'

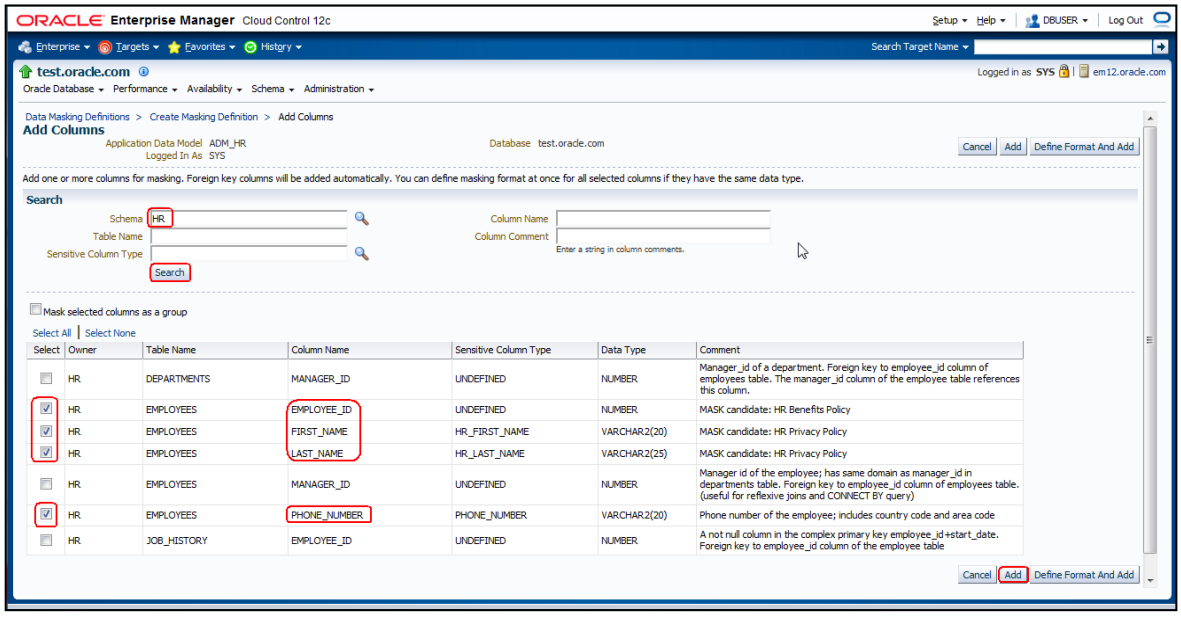


3.6 For Schema : HR

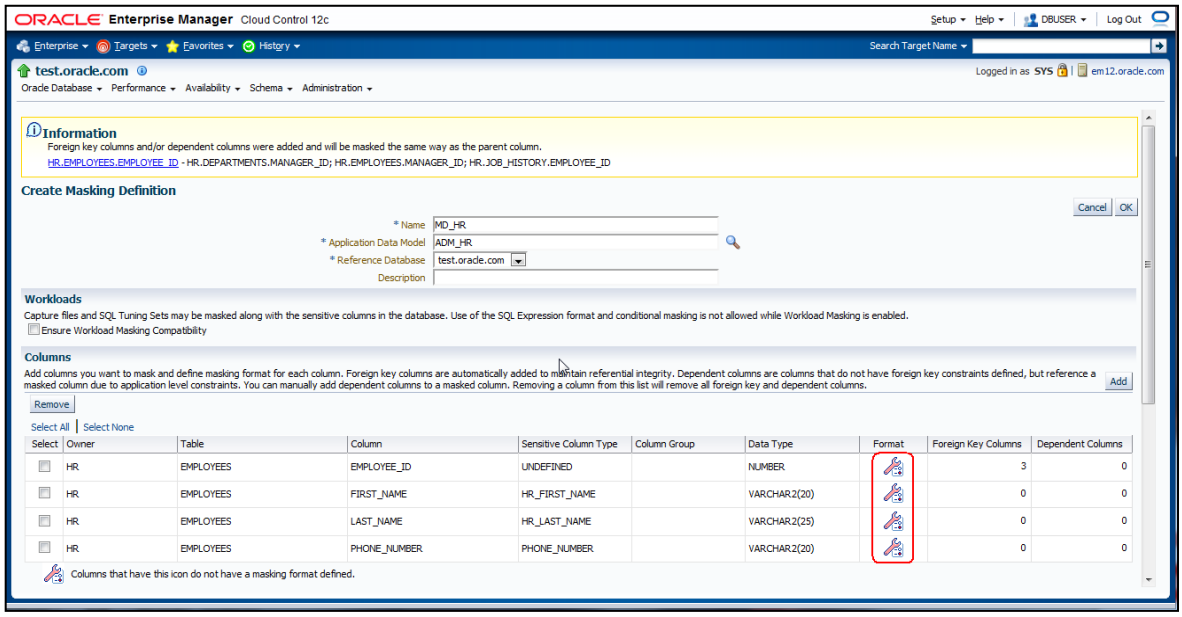
Click 'Search'

Select EMPLOYEE_ID, FIRST_NAME, LAST_NAME and PHONE_NUMBER for table EMPLOYEE

Click 'Add'



3.7 Click  to define masking format for each row

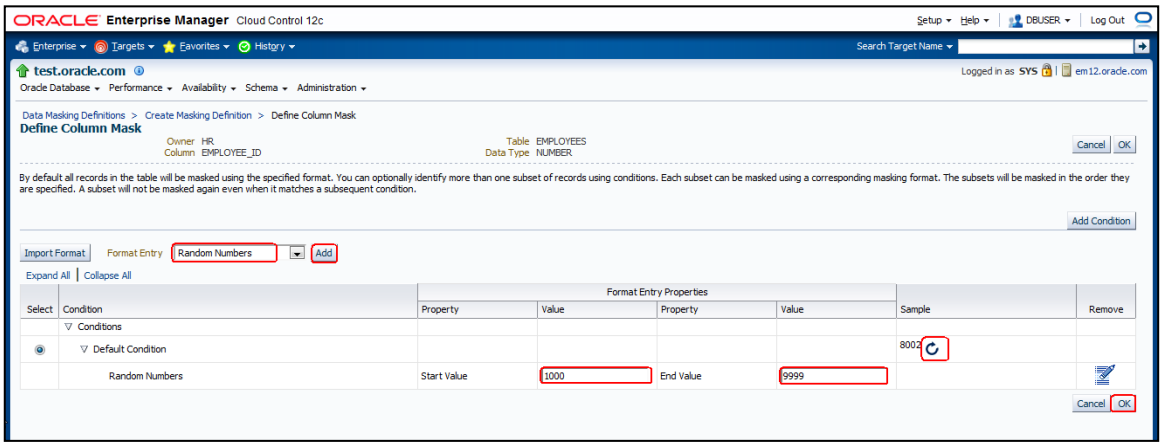


3.8 In this system we have no employee_id that is larger than 999 so we are going to use random numbers For EMPLOYEE_ID starting with 1000 and ends with 9999

Select Random Numbers in 'Format Entry, click 'Add'

Start Value : 1000 End Value : 9999

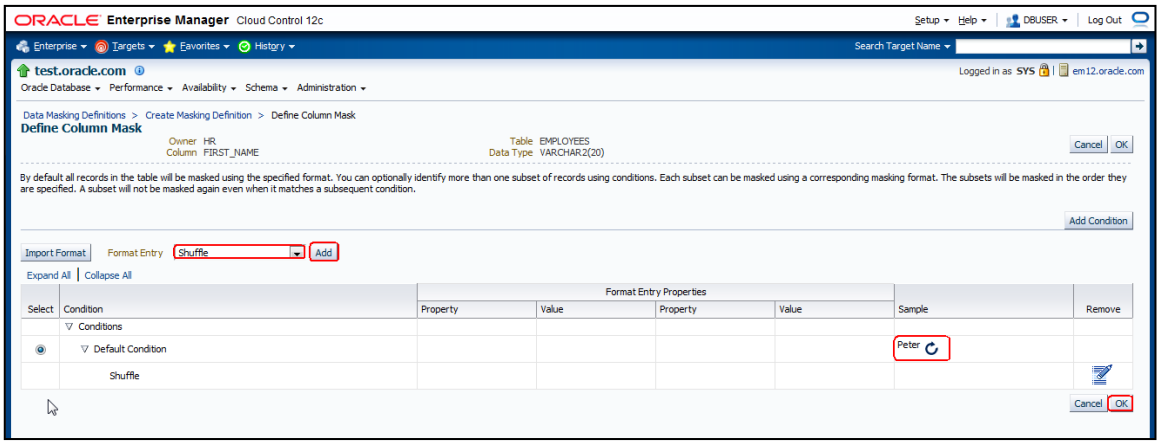
Click  to see a sample value. Click 'OK'



3.9 We will reuse real first names but we will shuffle them around.

Select Shuffle in 'Format Entry, click 'Add'

Click ↻ to see a sample value. Click 'OK'

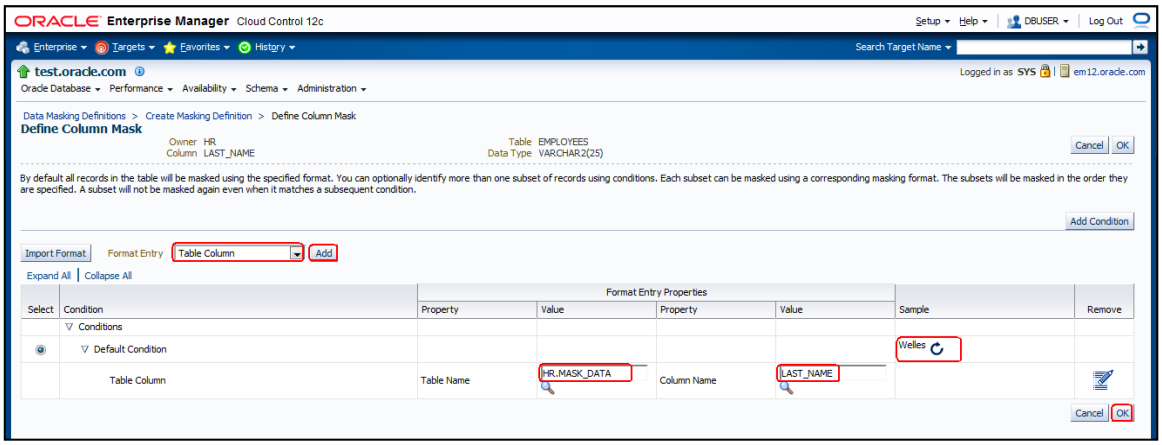


3.10 Last names will be collected from a separate table where we have entered allowed sir names.

Select Table Column in 'Format Entry, click 'Add'

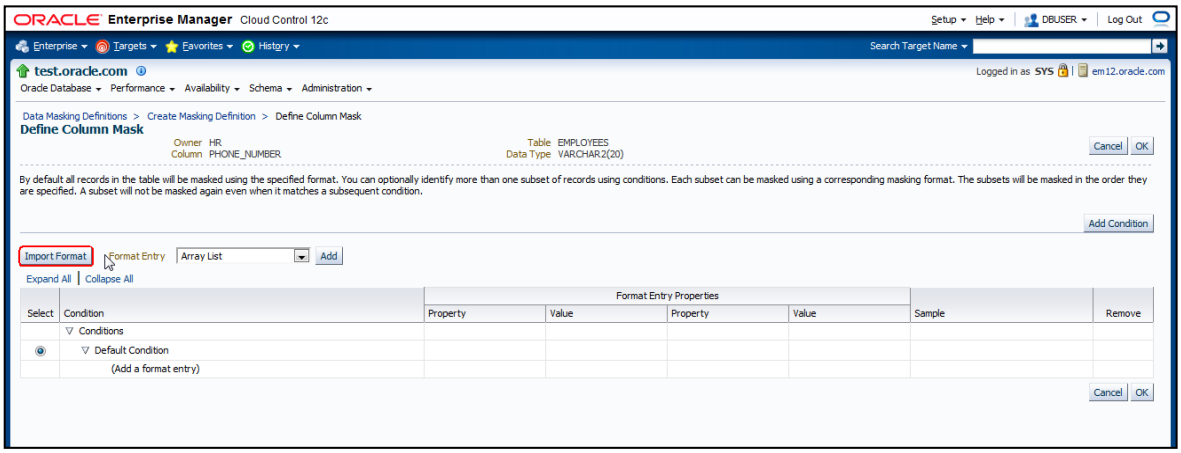
Table Name : HR.MASK_DATA Column Name : LAST_NAME

Click ↻ to see a sample value. Click 'OK'



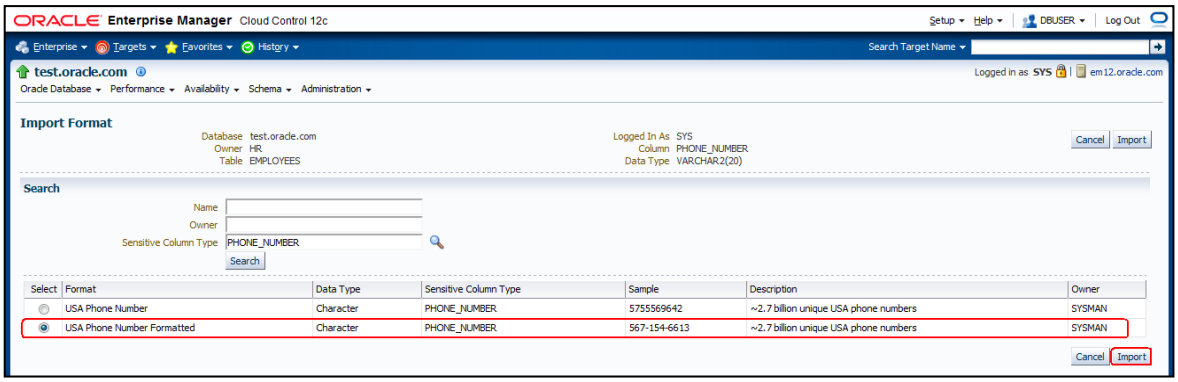
3.11 There are predefined formats for columns like Phone number and credit card numbers which we can import into the definition.

Click 'Import Format'

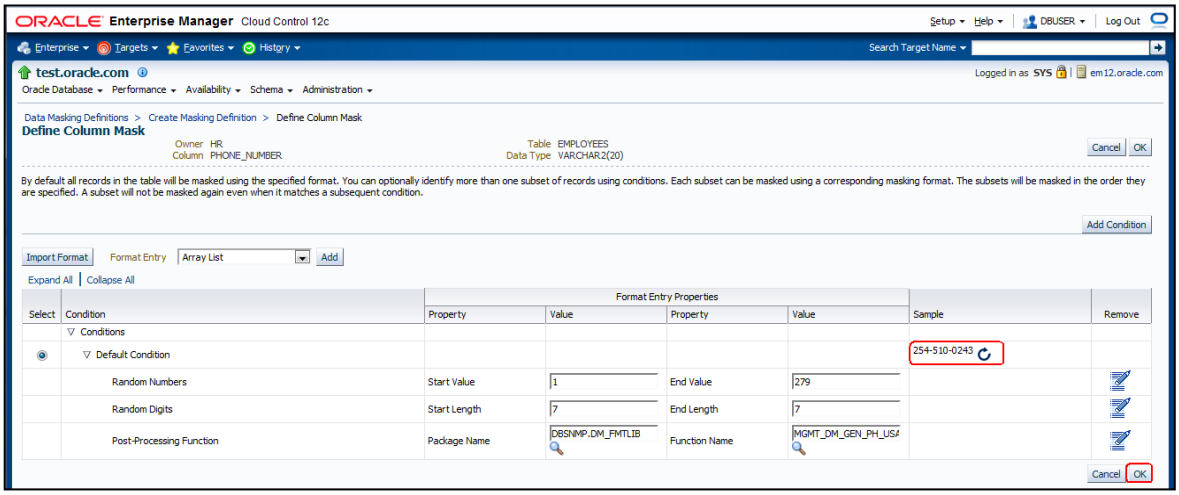


3.12 Select 'USA Phone Number Formatted'

Click 'Import'

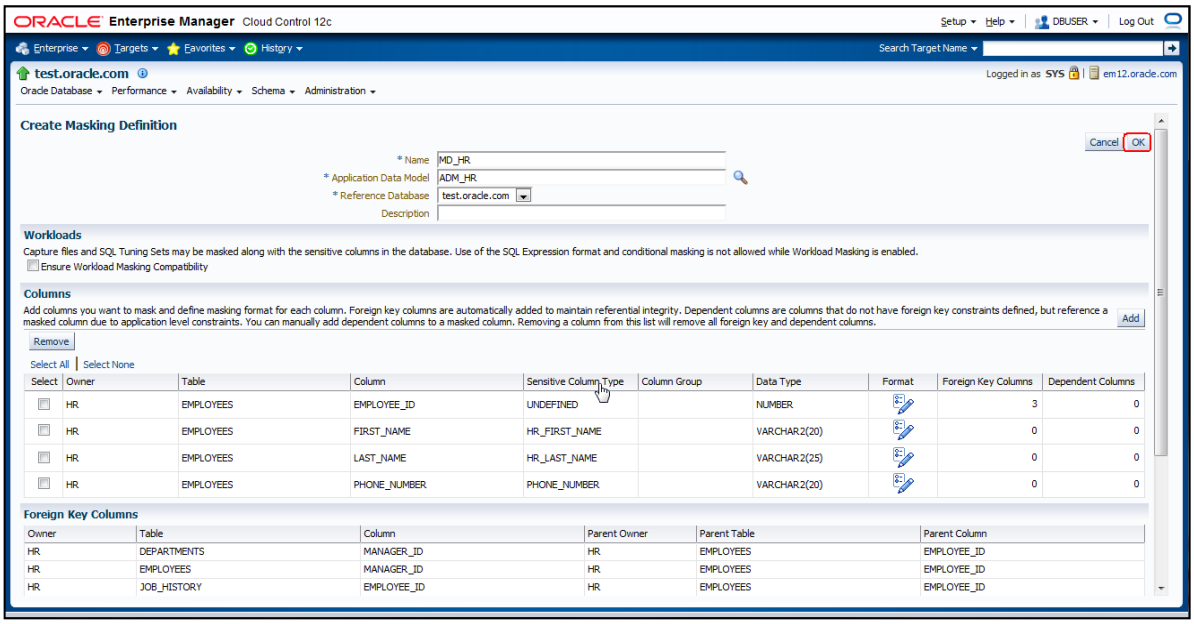


3.13 Click ↻ to see a sample value. Click 'OK'.



3.14 All columns are now formatted. Lets save the Masking Definition

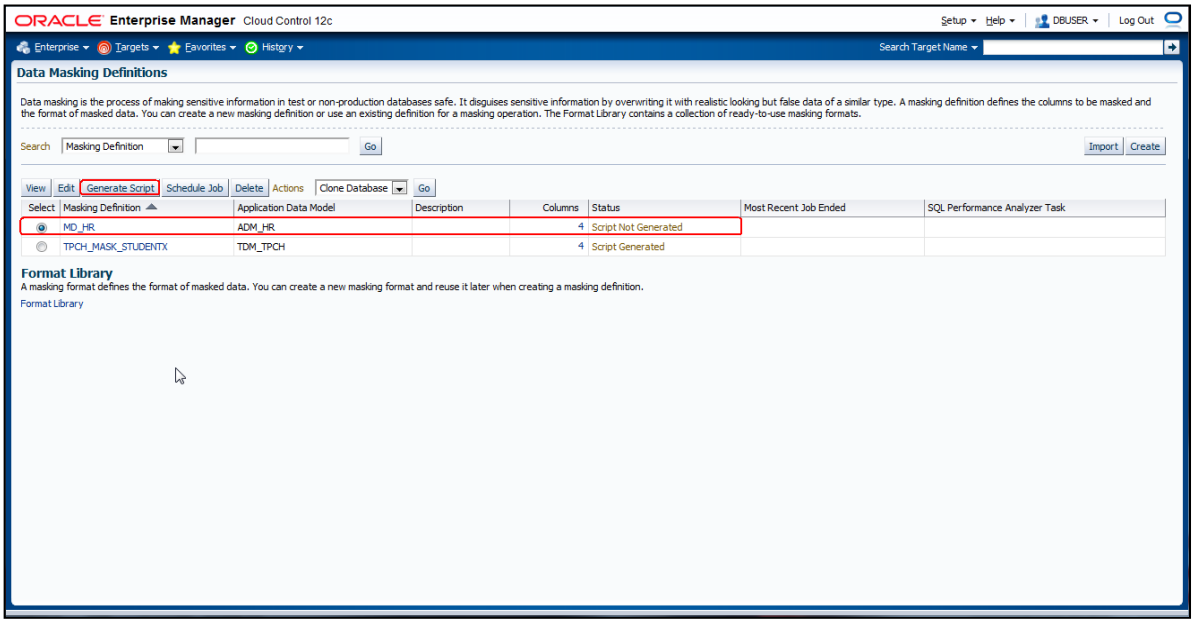
Click 'OK'



3.15 It is now time to generate the SQL and PL/SQL that will perform the masking.

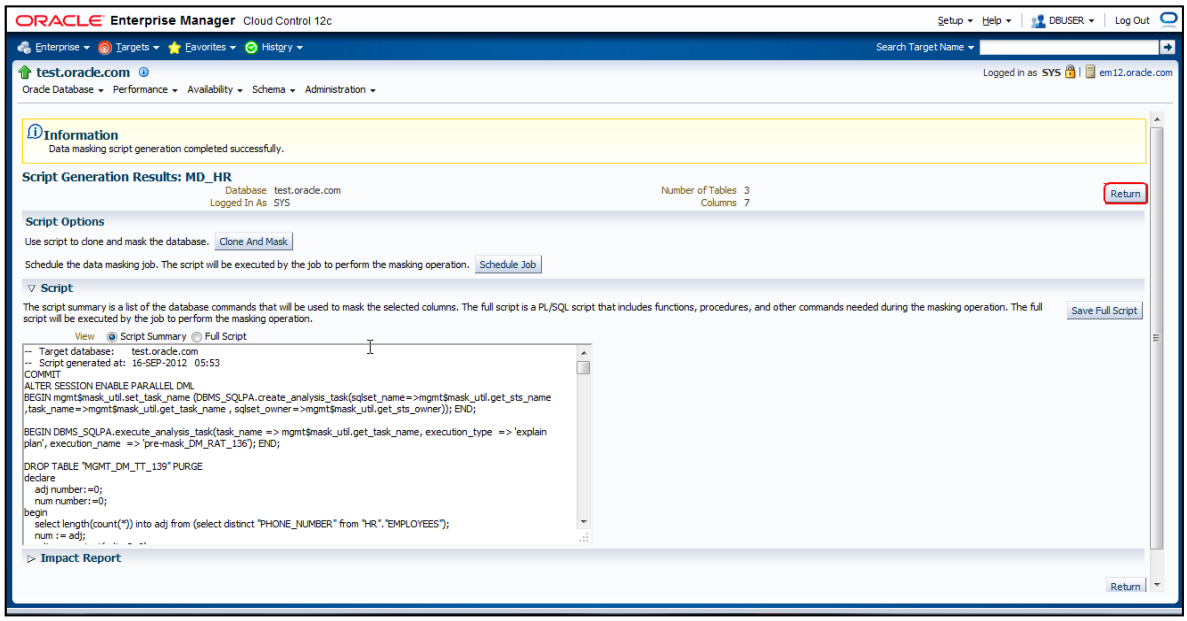
Select the newly created Masking Definition.

Click 'Generate Script'


ORACLE Enterprise Manager Cloud Control 12c
Setup
Help
DBUSER
Log Out
Enterprise
Targets
Favorites
History
Search Target Name
Data Masking Definitions
Data masking is the process of making sensitive information in test or non-production databases safe. It disguises sensitive information by overwriting it with realistic looking but false data of a similar type. A masking definition defines the columns to be masked and the format of masked data. You can create a new masking definition or use an existing definition for a masking operation. The Format Library contains a collection of ready-to-use masking formats.
Search
Masking Definition
Go
Import
Create
View
Edit
Generate Script
Schedule Job
Delete
Actions
Clone Database
Go
Select
Masking Definition
Application Data Model
Description
Columns
Status
Most Recent Job Ended
SQL Performance Analyzer Task
MD_HR
ADM_HR
4
Script Not Generated
TPCH_MASK_STUDENTX
TDM_TPCH
4
Script Generated
Format Library
A masking format defines the format of masked data. You can create a new masking format and reuse it later when creating a masking definition.
Format Library

3.16 This action will take about 1 minute. Now you have the opportunity to brows and look at the masking script that has been generated.

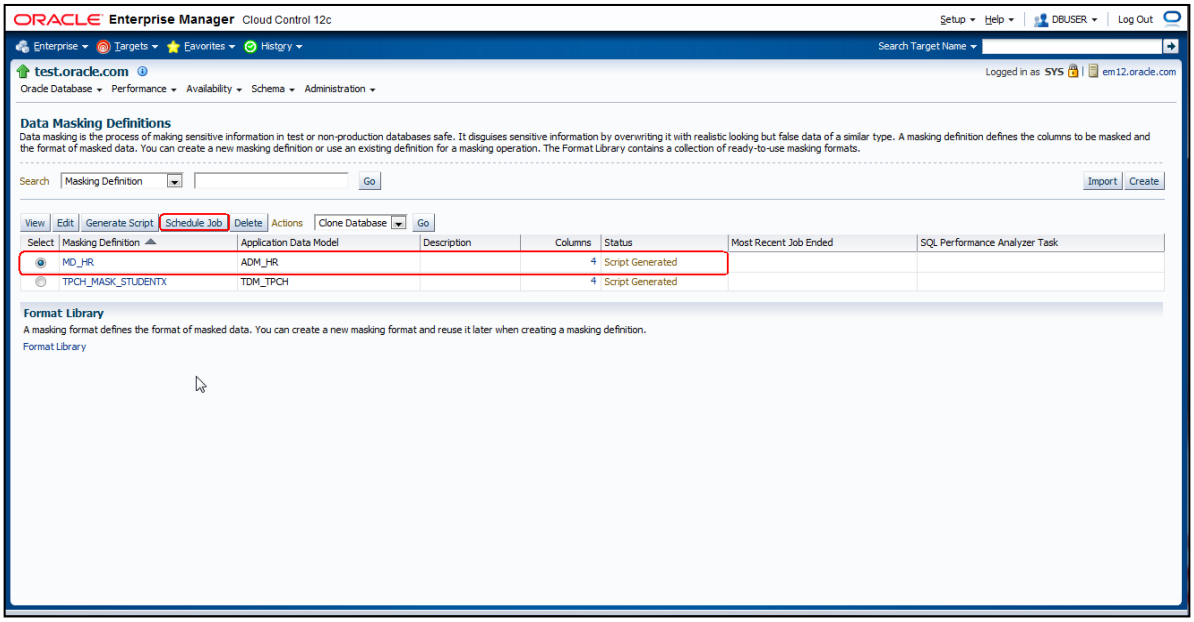
When you are ready, click 'Return'



3.17 It is now time to perform the masking on our test database.

Select the newly created Masking Definition.

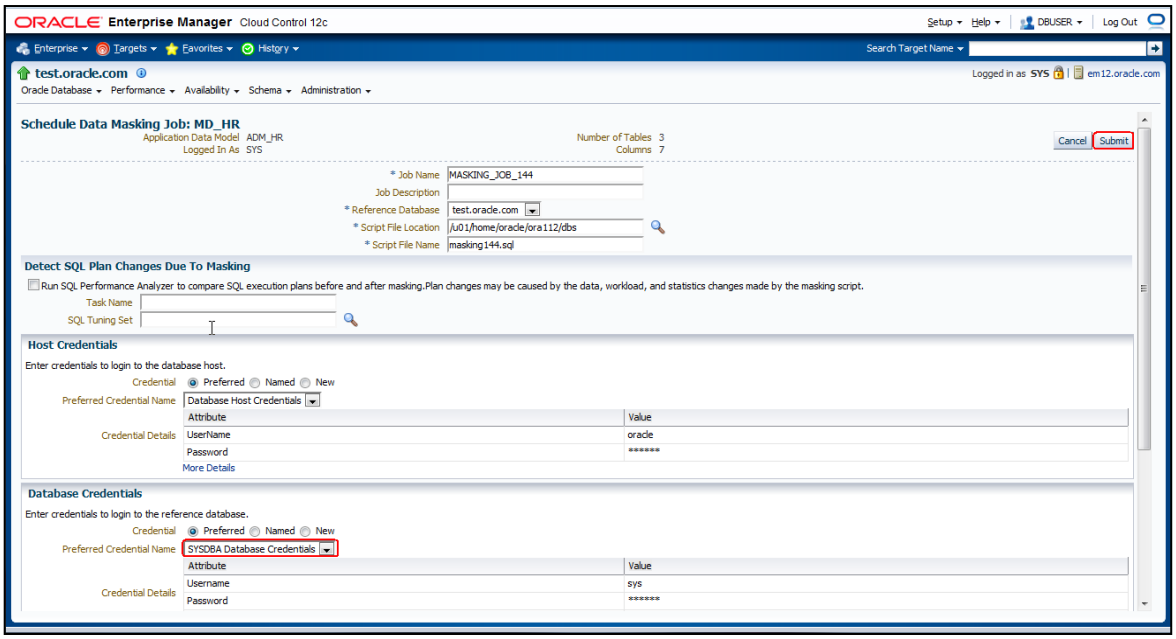
Click 'Schedule Job'



3.18 For Database Credentials select:

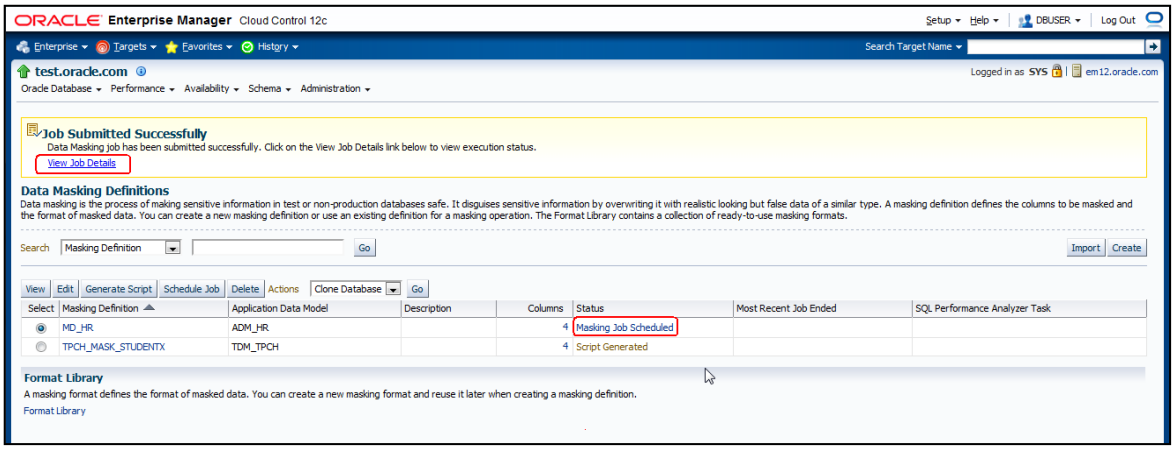
Preferred : SYSDBA Database

Click 'Submit'

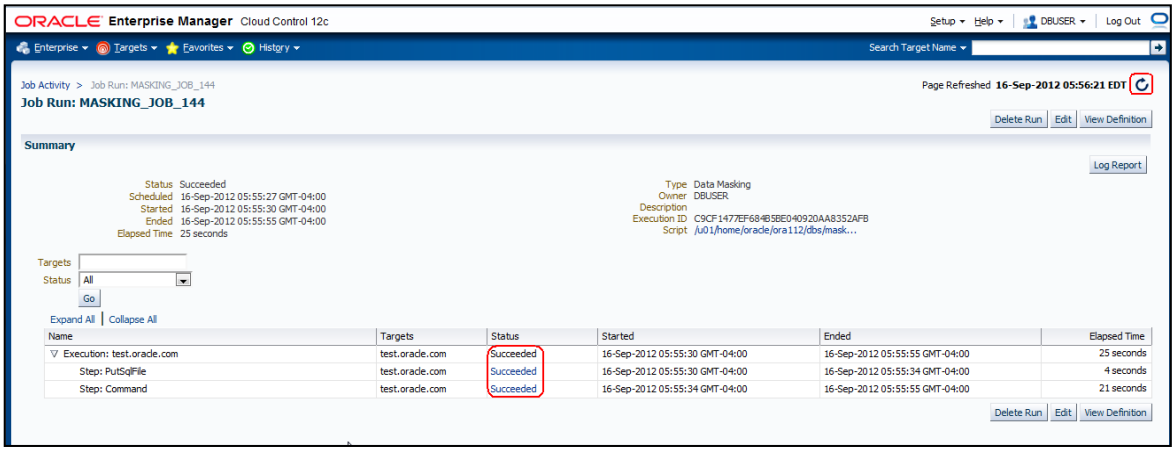


3.19 The Job is now scheduled and will run for a minute or two.

To monitor the job, right click on the 'View Job Details' and open it in a new tab.

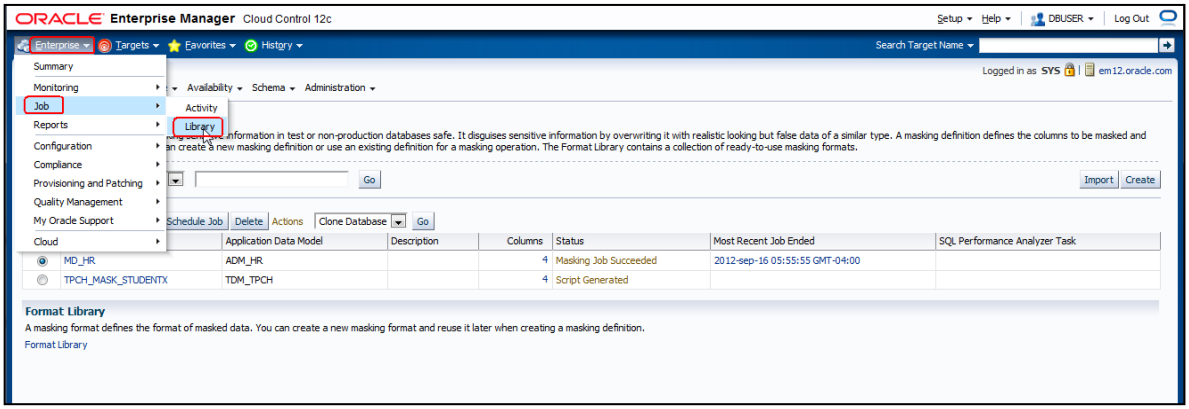


3.20 When all three steps have succeeded close the tab

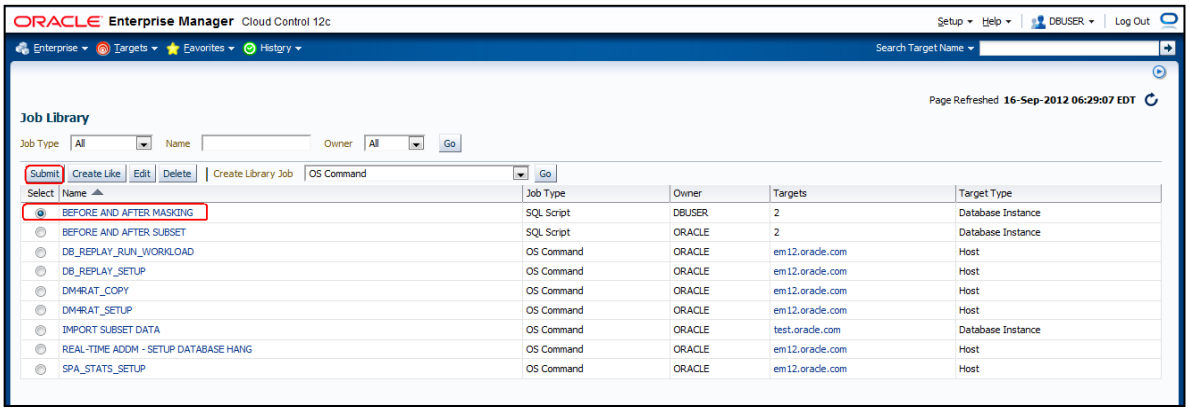


3.21 We are now going to compare the information between production and Masked test

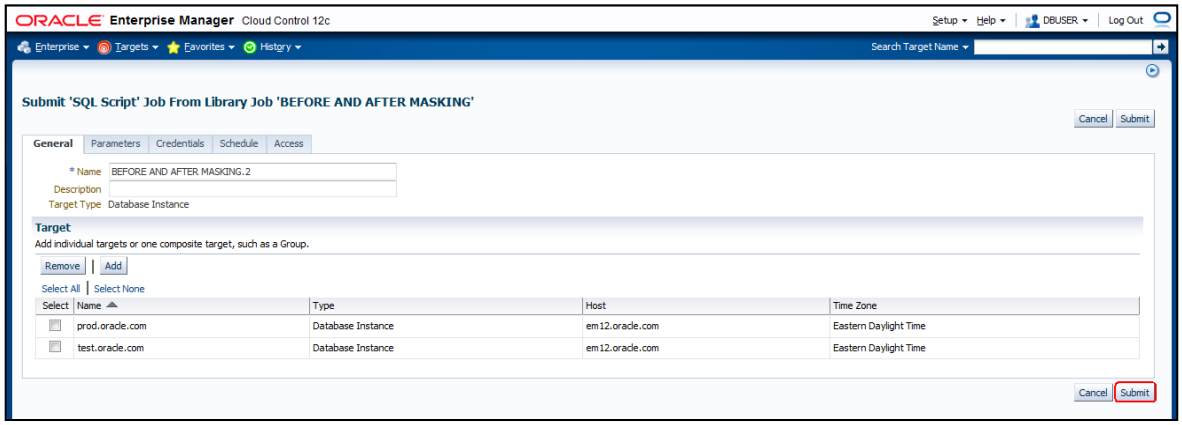
Navigate to the Jobs Library page: From the Menu, Enterprise → Job → Library



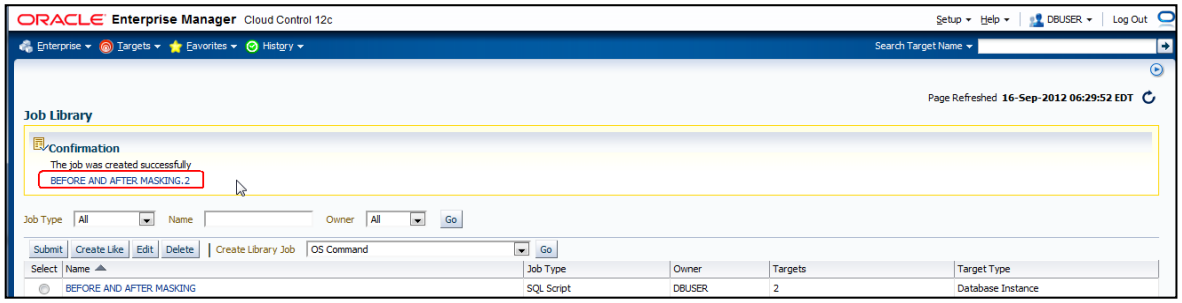
3.22 Select 'BEFORE AND AFTER MASKING', Click Submit



3.23 Click 'Submit'

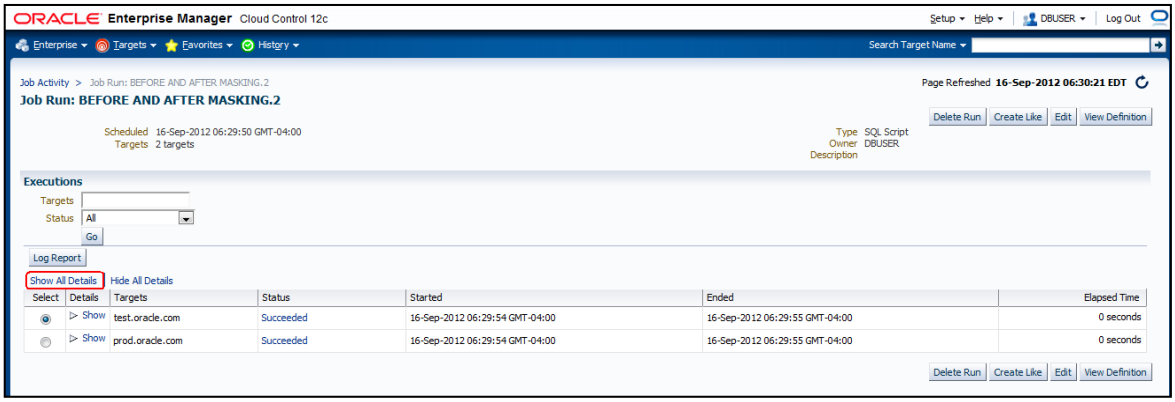


3.24 Click on the Confirmation Link 'BEFORE AND AFTER MASKING.<9>'

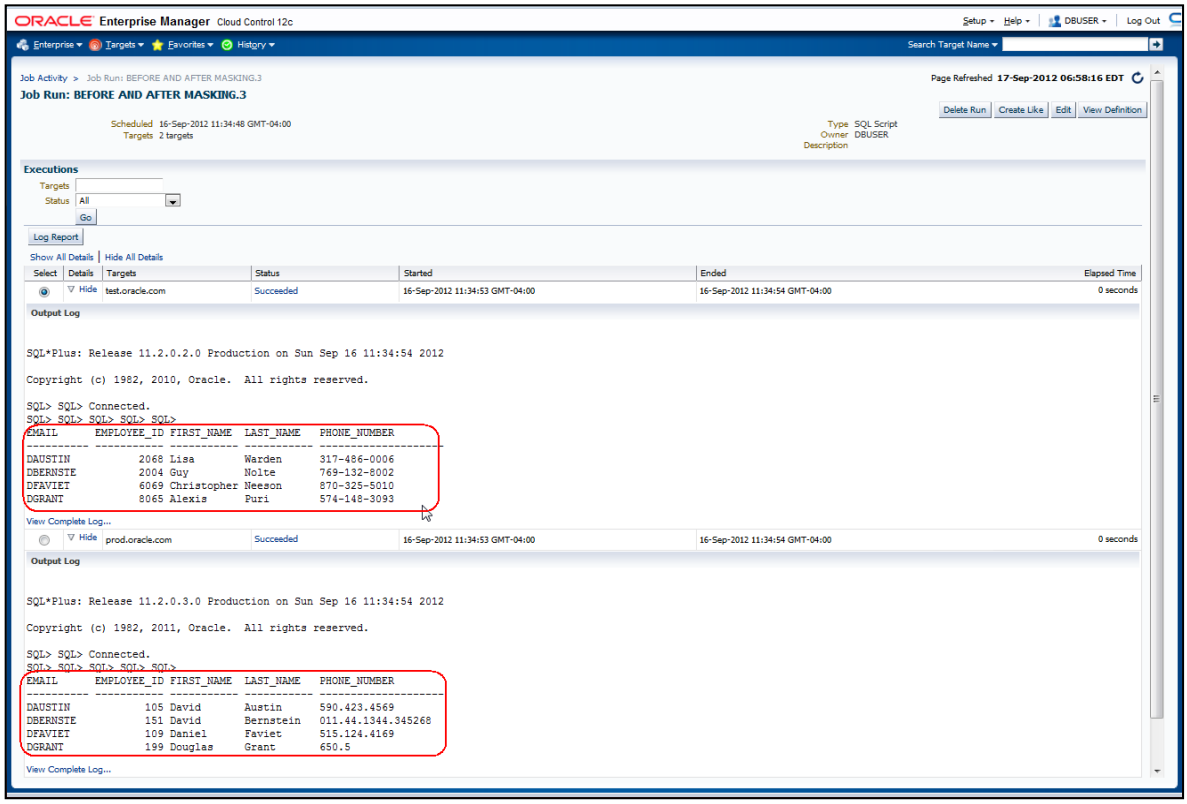


3.25 When Status is 'Succeeded' for both prod and test database.

Click 'Show All Details'



3.26 Since email was not masked we made a selection of rows from both databases where email starts with 'D'.



End of Data Masking Lab

D. Define and Execute Subset Based on Application Data Model

Estimated Time to Complete Use Case: 20 minutes

Business Case

In the Data masking exercise we learned how to create an application Data Model (ADM). So in this exercise we will use a predefined ADM and go directly to Data Subsetting

Having discovered the application relationships, the application administrator now needs to create a smaller sized representation of this database so that the enterprise provide realistic-production data available to application developers for accurate application testing while reduce their storage costs by not having to provision a entire production environment for each developer.

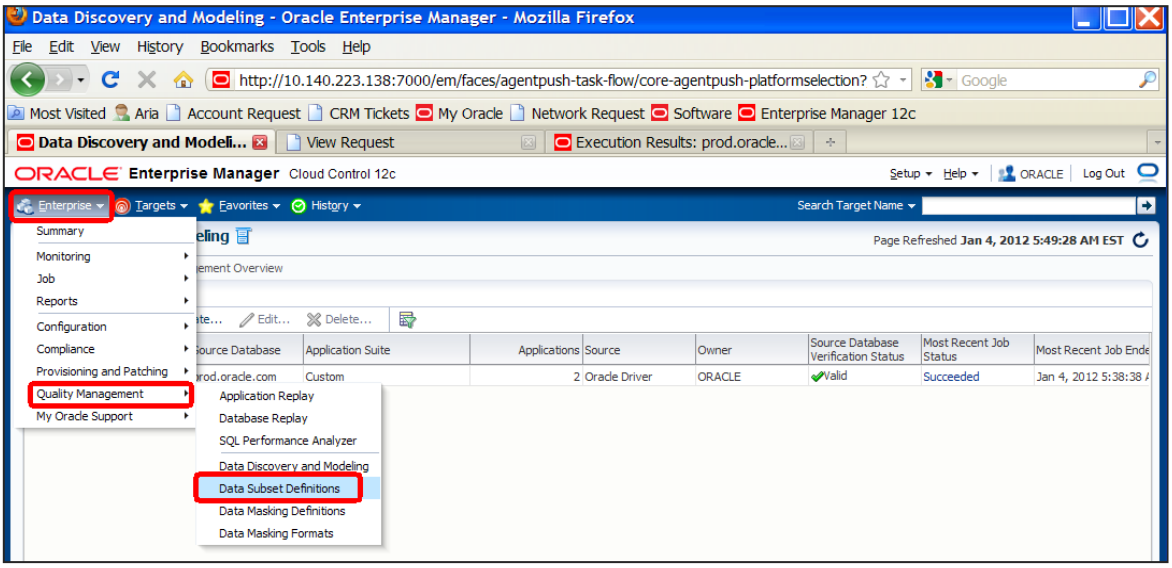
4. Execute Subset

4.1 You should already be logged on to Enterprise Manager. If you are not, please follow the instructions detailed in earlier section of this workbook.

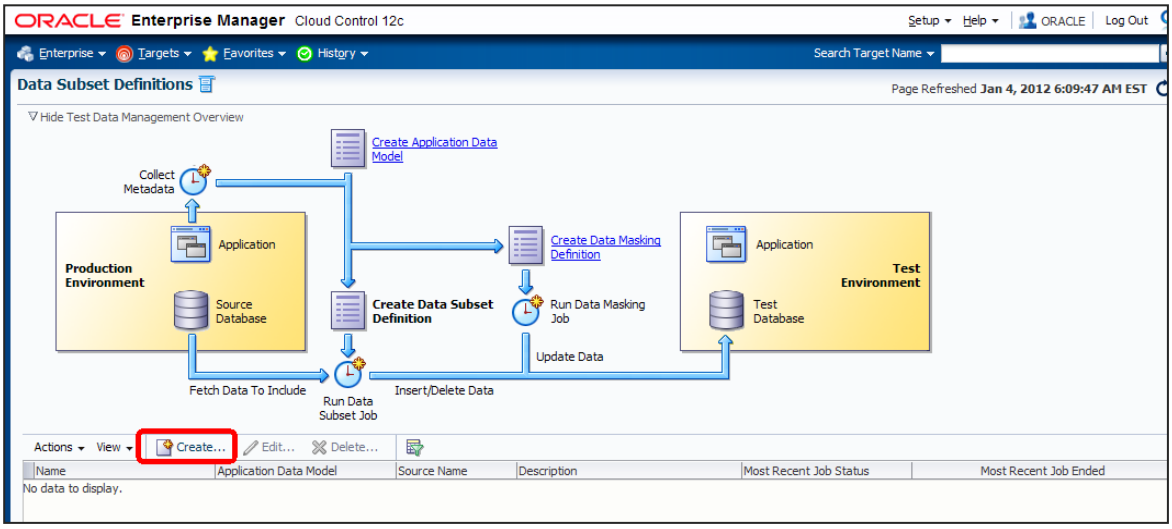
4.2 So, let's begin the subsetting operation.

Switch to the original tab Navigate to Data Subsetting:

From the Menu, Enterprise → Quality Management → Data Subset Definitions



4.3 Create a subset definition for 'TDM' schema. Click 'Create'



4.4 Complete the dialog box:

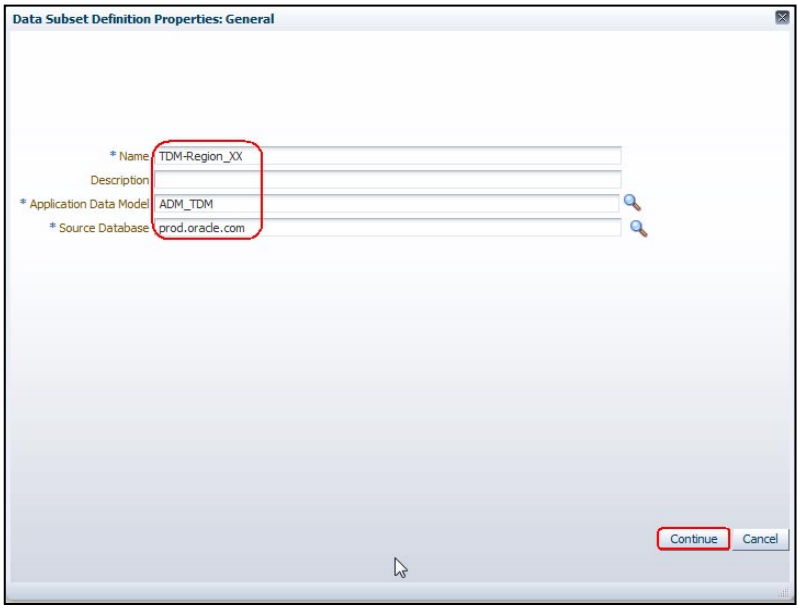
Name : TDM-Region_XX

(Note: You can create subset definition with new name, such as TDM-Region_<XX> where XX are yor initials)

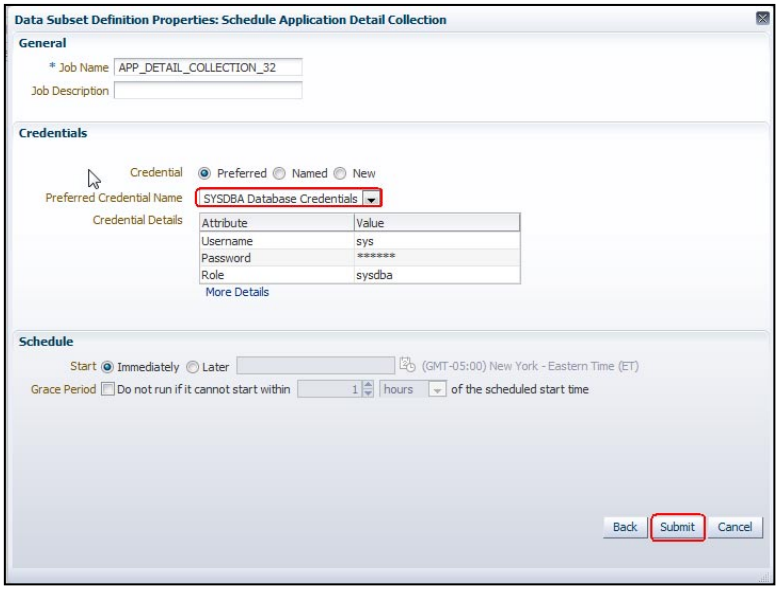
Application Data Model : ADM_TDM (use search option)

Source Database : prod.oracle.com (use search option)

Click Continue.

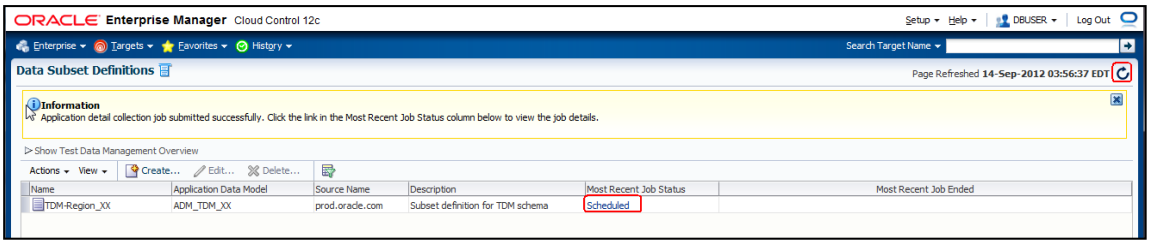


4.5 For Credentials select
Preferred : SYSDBA
Click 'Submit'.

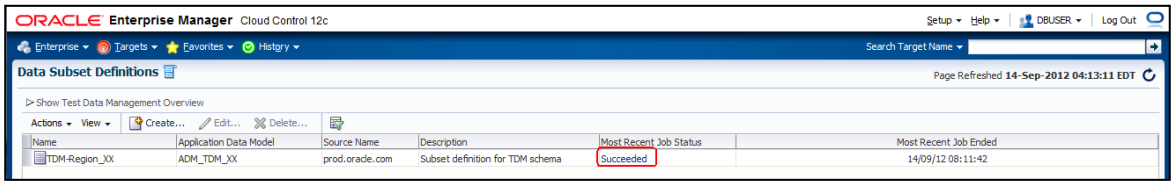


4.6 Monitor the job and ensure successful completion.

Click the refresh icon periodically and check the 'Most Recent Job Status' column.

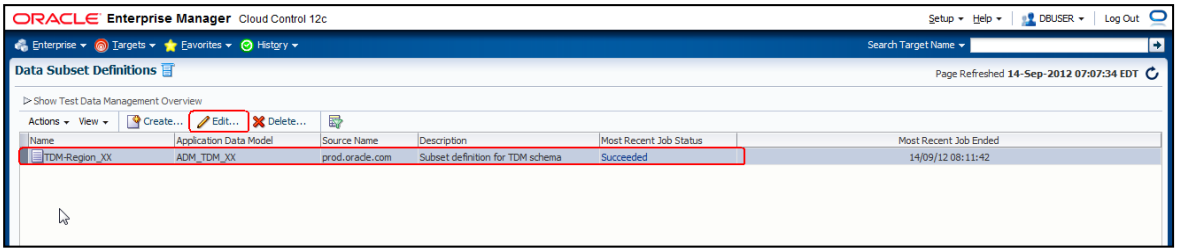


Job should complete within a minute. When completed, you'll see 'Succeeded' status.

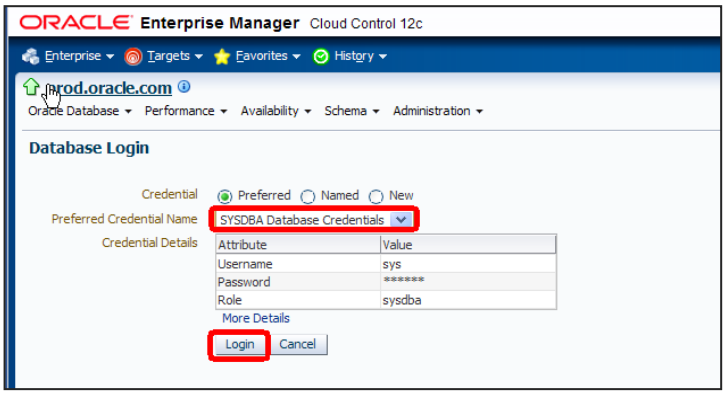


4.7 Once the creation process has completed, we need to define the subset criteria.

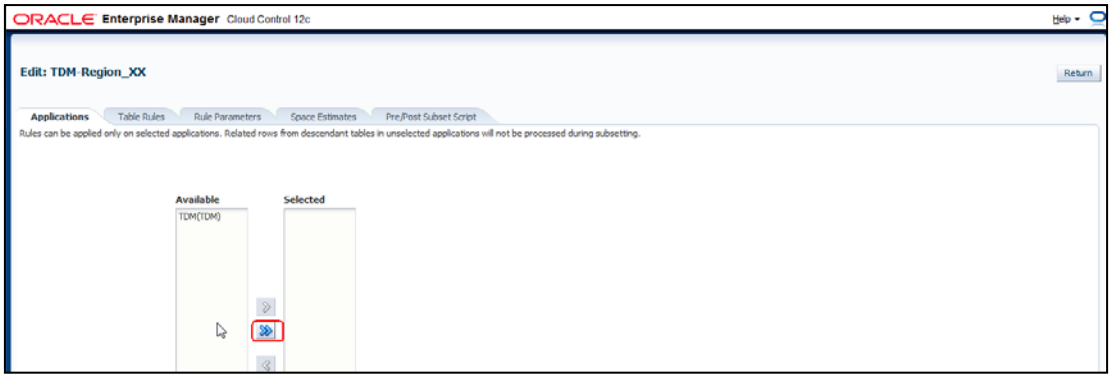
Select the newly created subset definition and click 'Edit'.



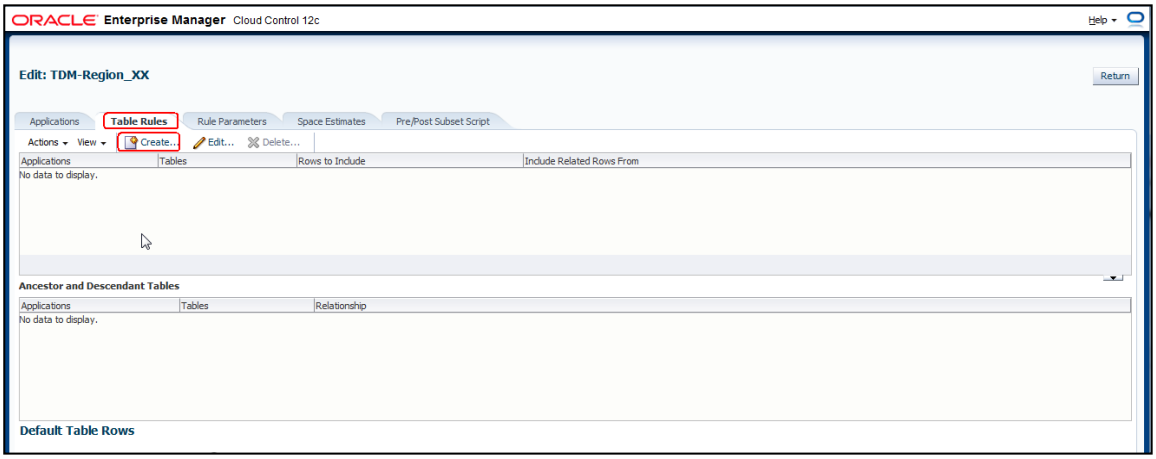
4.8 On the Database login page, select 'SYSDBA Database Credentials', wait for login credentials to auto-populate and click login button



4.9 On the Applications tab, click on  to move the 'TDM' to 'Selected' column.

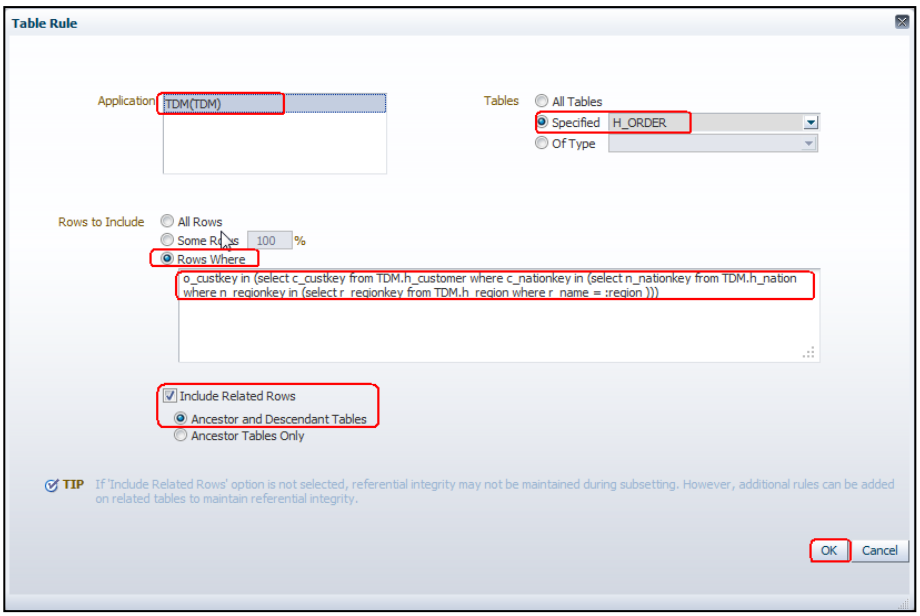


4.10 Click on the 'Tables Rules' Tab followed by click on 'Create' button.

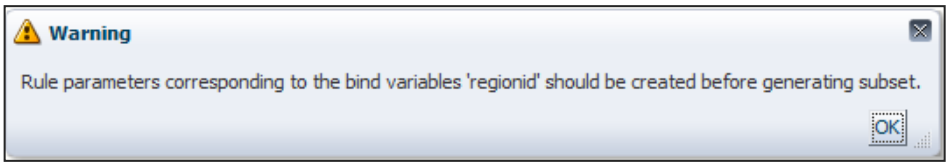


4.11 On the dialog box,

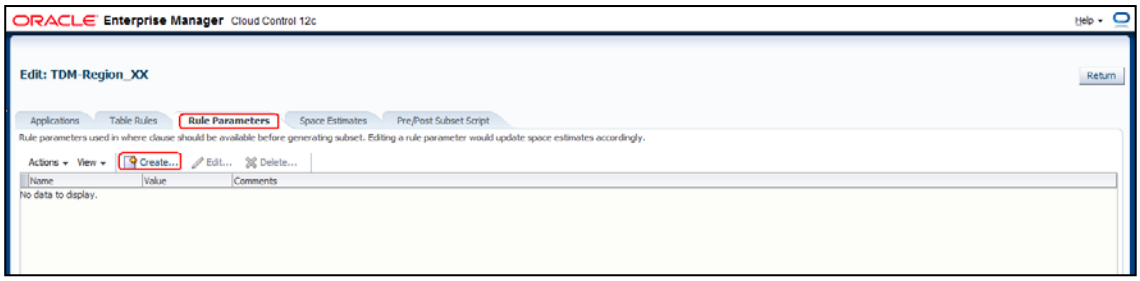
Application:	Select TDM
Tables:	Select 'Specified' → Select 'H_ORDER'
Rows to include:	Select 'Rows Where' → copy & paste following SQL: *o_custkey in (select c_custkey from TDM.h_customer where c_nationkey in (select n_nationkey from TDM.h_nation where n_regionkey in (select r_regionkey from TDM.h_region where r_name = :region)))*
Include Related Rows:	select 'Ancestor and Descendant Tables'
Click OK	



4.12 Click OK on the warning dialog.



4.13 Click on the 'Rule Parameters' Tab. Click 'Create'



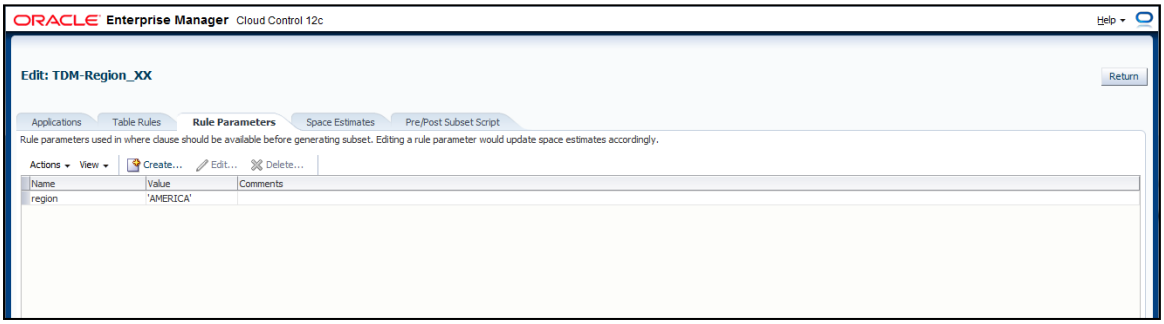
4.14 In the dialog, enter following values.

Name : region (without the **:**)

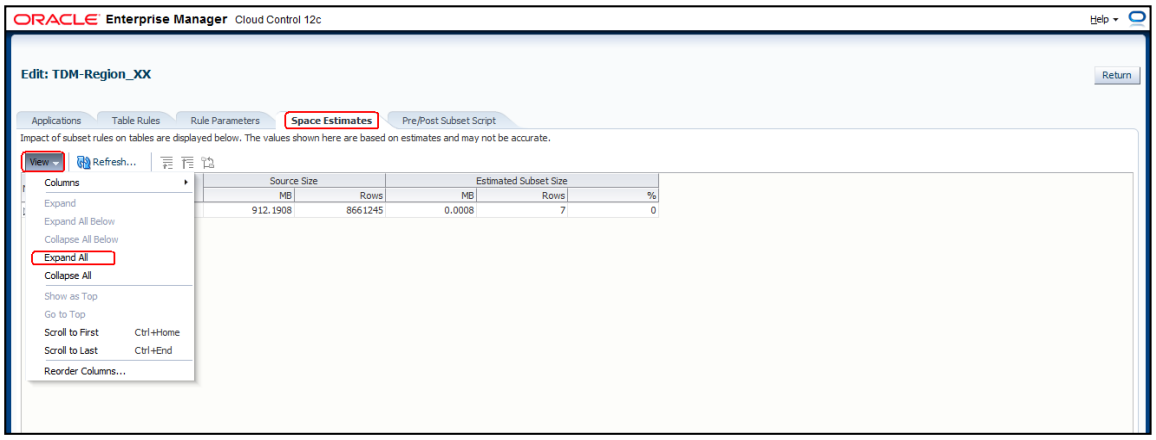
Value : 'AMERICA'

Click OK

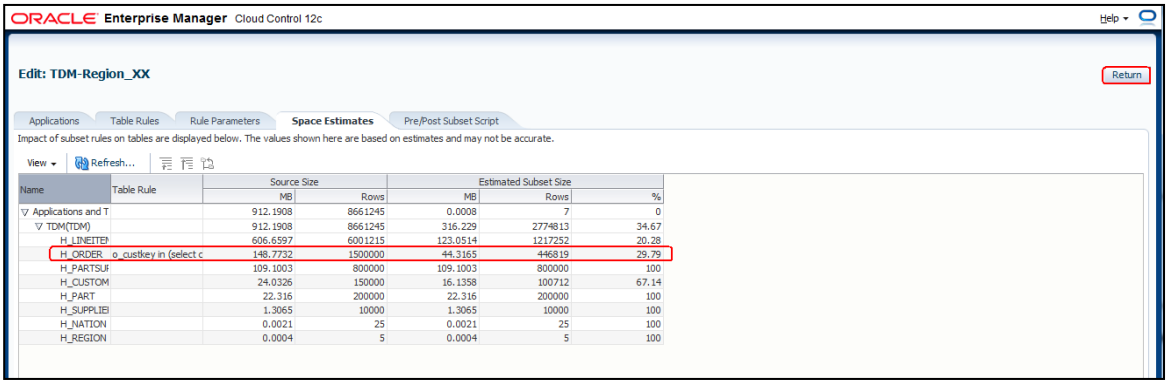
Note: If you get an error message, eliminate any spaces in the name.



4.15 Click on the 'Space Estimates' Tab. Click on View -> Expand All.



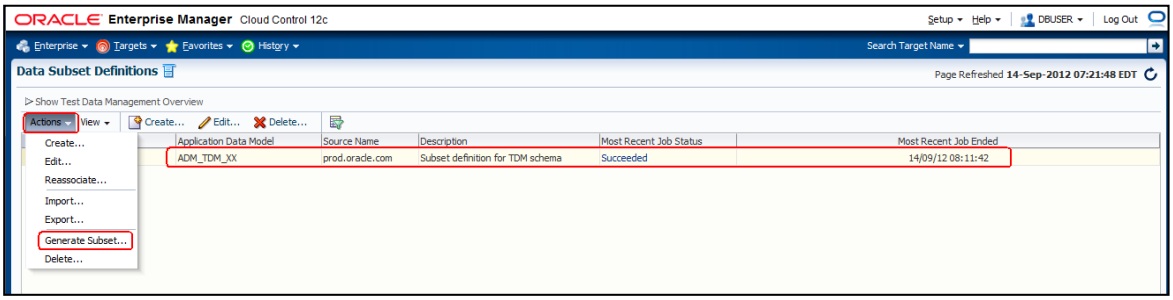
Confirm the reduction in size in the TDM schema.



Click on 'Return'. *Note : In case you encounter an error after hitting return – please see the workaround provided at the end of this section.*

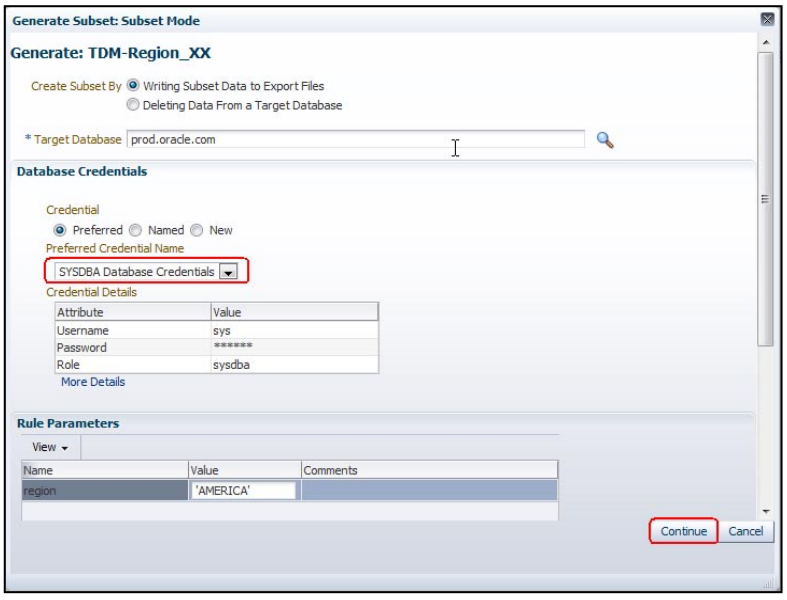
4.16 At this point, the Subset definition is complete. Now we will execute the subset operation, using that definition.

Return to Enterprise → Quality Management → Data Subset Definitions. Highlight the newly created definition and select Actions → Generate Subset.

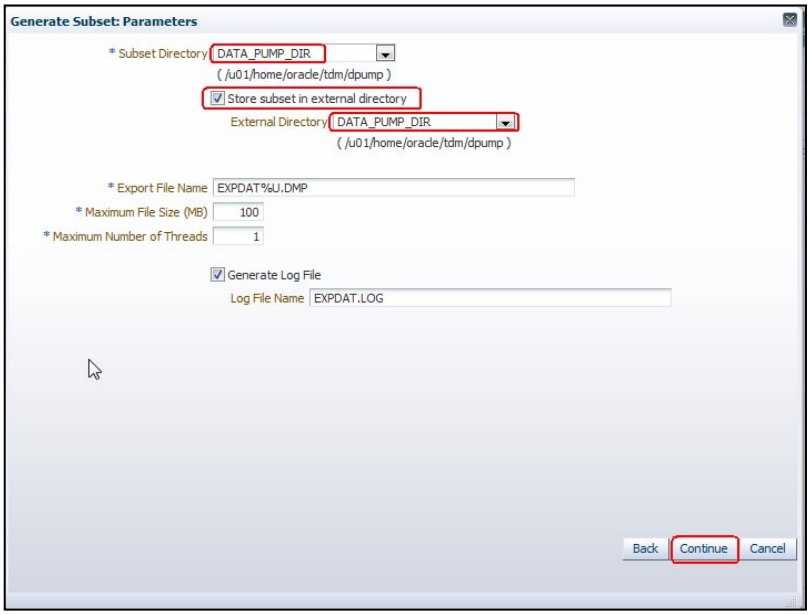


4.17 On the dialog box:

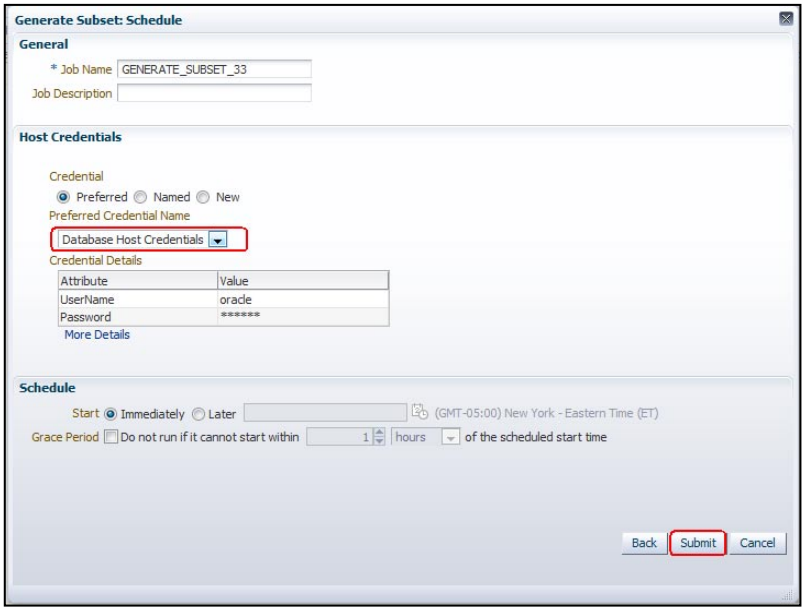
Create Subset By:	Select 'Writing Subset Data to Export Files'
Target Database:	prod.oracle.com (use search option)
Database Credentials:	Select 'Preferred' Credentials → 'SYSDBA' Credentials
Rule Parameters:	region = AMERICA
Click Continue.	



4.18 Select DATA_PUMP_DIR as the export File Directory.
Check the box to confirm that "Store subset in external directory" = DATA_PUMP_DIR.
Click Continue

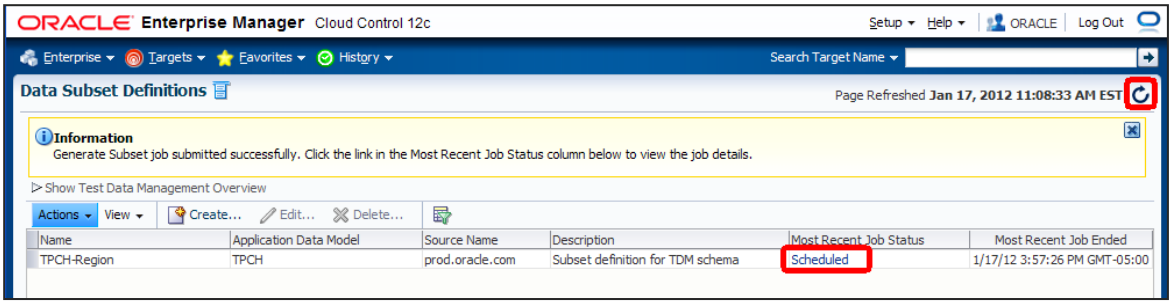


4.19 Click 'Submit'

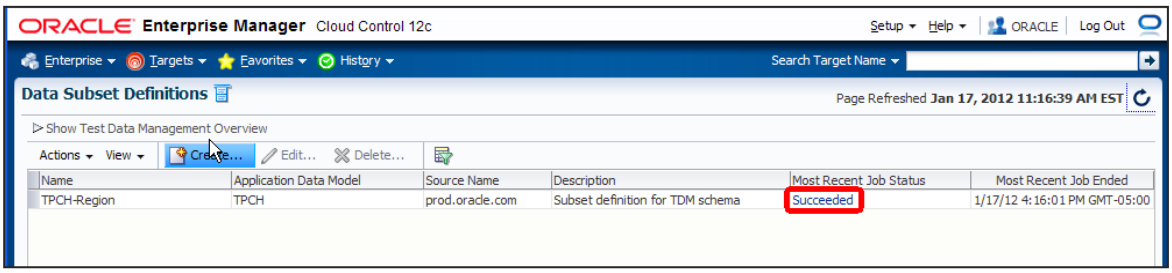


4.20 Monitor the job and ensure successful completion.

Click the refresh icon periodically and check the 'Most Recent Job Status' column.

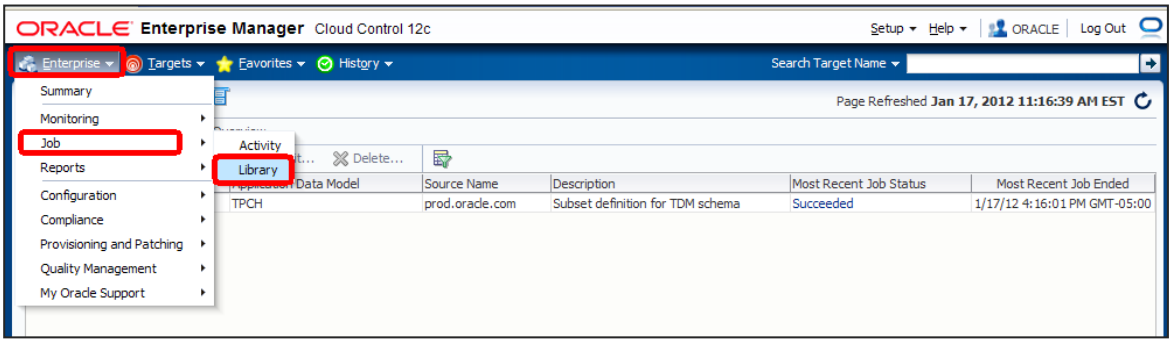


Job should complete approximately 10 minutes. When completed, you'll see 'Succeeded' status.

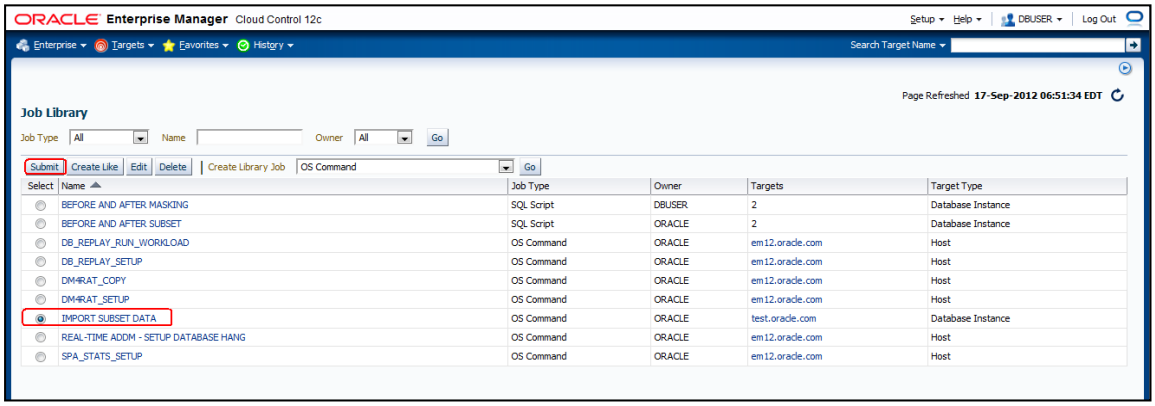


At this point Subset data is written to dump file. For using this data you'll need to import this data to a test database.

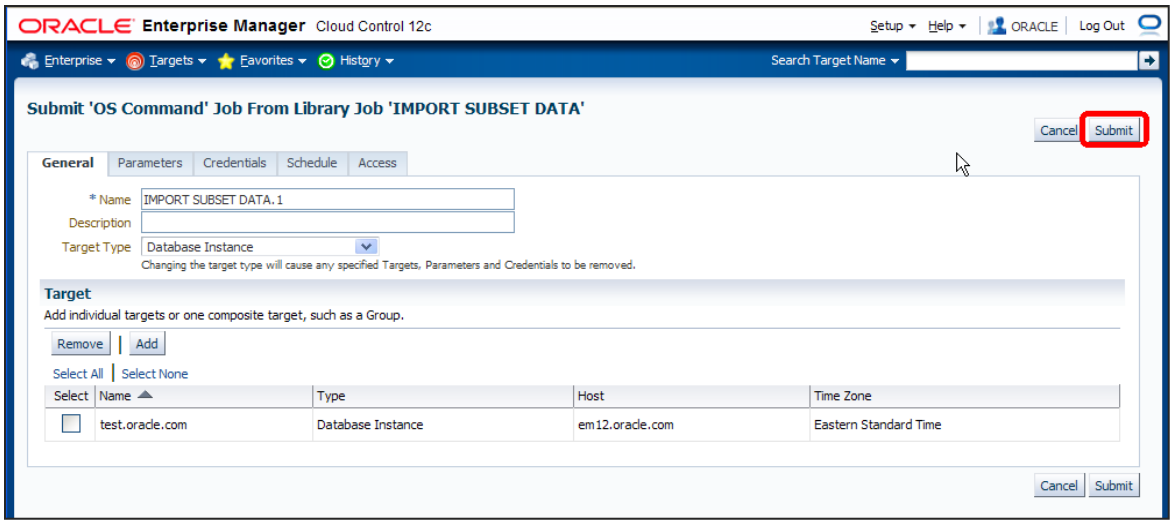
4.21 To import data to 'test', you'll run a predefined job 'Import Subset Data'. To navigate to job library click on the menu 'Enterprise' → Job→ Library



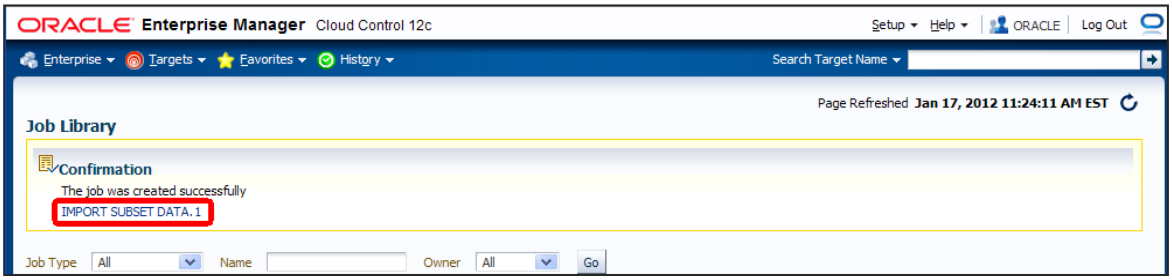
4.22 Select the "Import Subset Data job" and click 'Submit' button.



4.23 Click on 'Submit' button again.

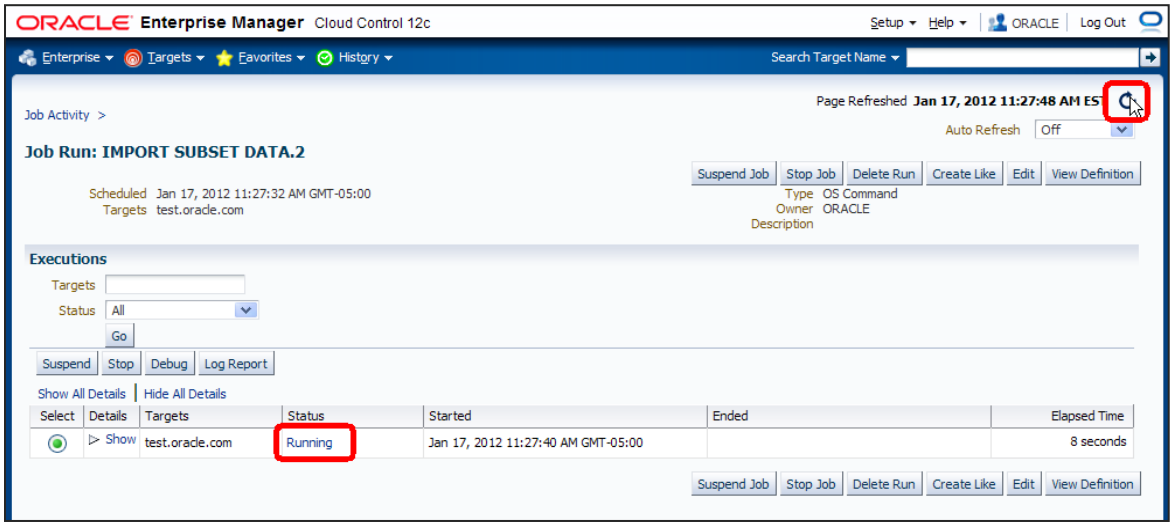


4.24 Check the 'Import Subset Data job' status, by clicking the job name link.

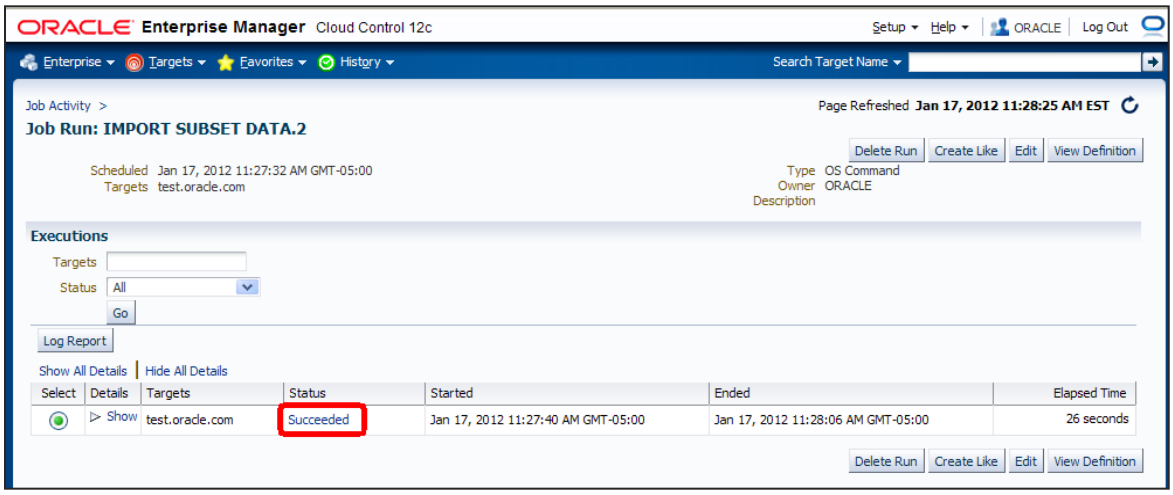


4.25 Monitor the job and ensure successful completion.

Click the refresh icon periodically and check the Job 'Status' column.

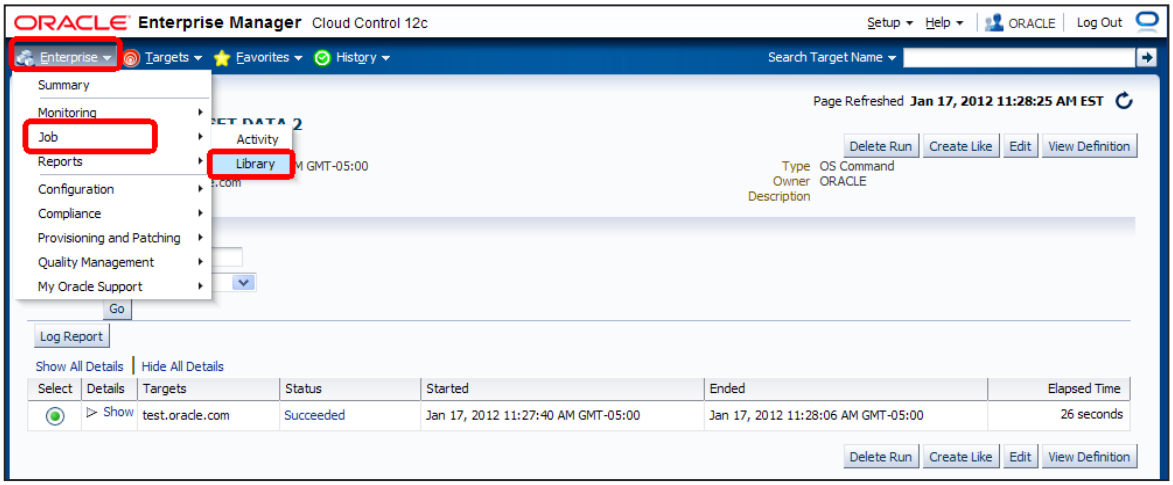


Job should complete approximately 1 minutes. When completed, you'll see 'Succeeded' status.

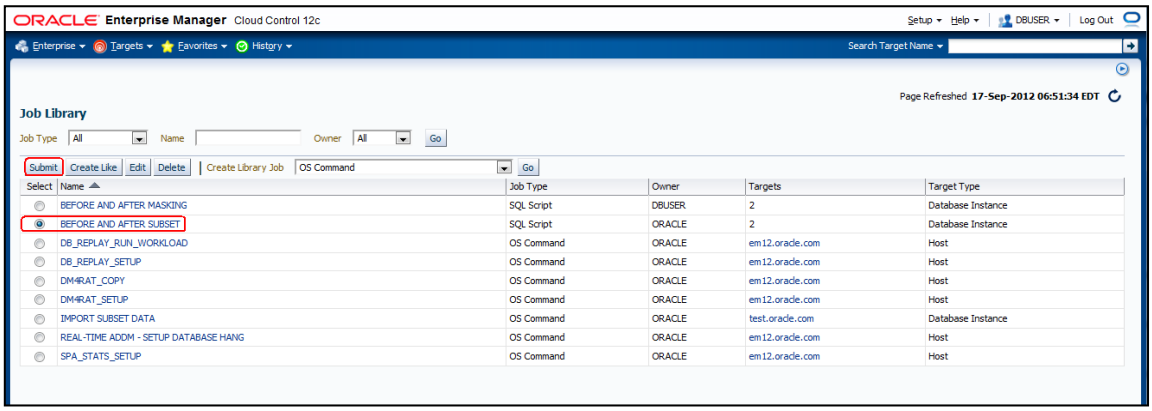


Subset data has been imported to the test database. Next you'll verify the difference between the original dataset and subsetted data.

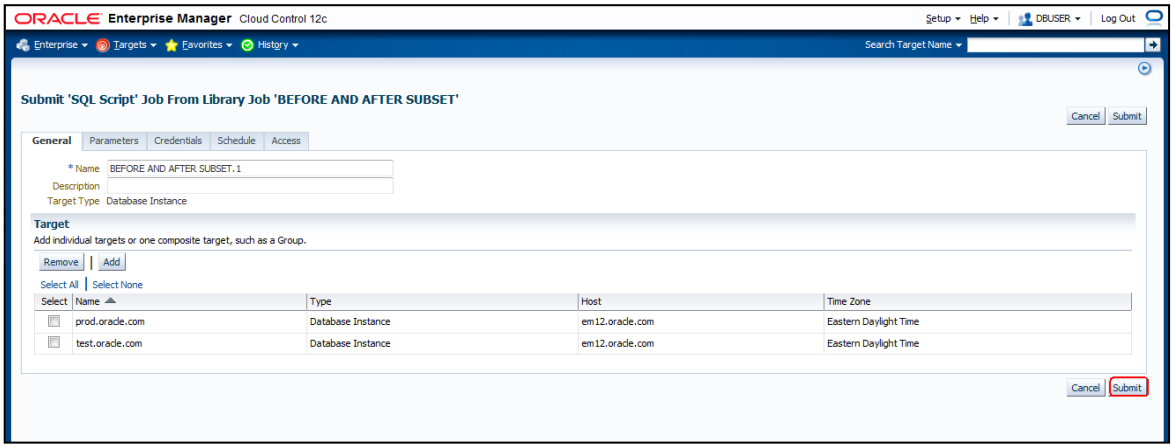
4.26 To compare the data before and after subsetting, you'll run a predefined job 'Before And After Subset'. To navigate to job library click on the menu 'Enterprise' → Job→ Library



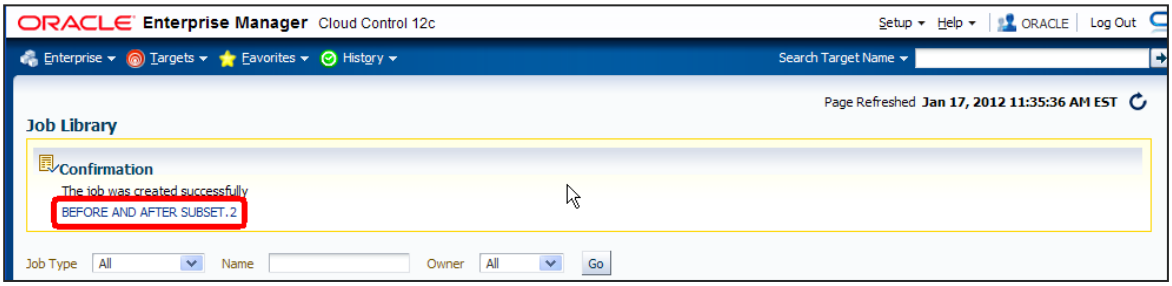
4.27 Select the 'Before And After Subset' to submit.



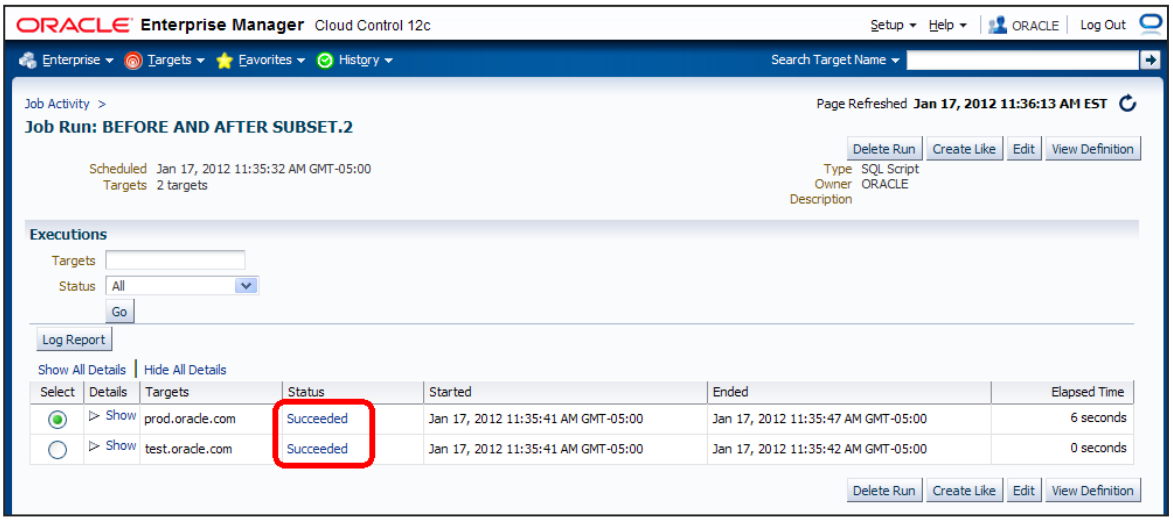
4.28 Click 'Submit'



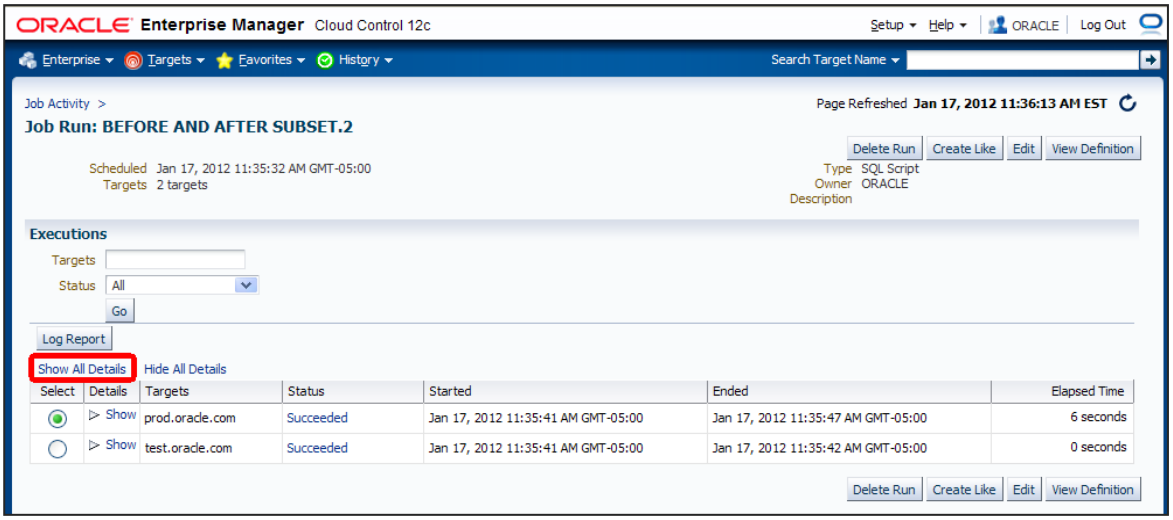
4.29 Check the 'Before and After Subset' job status, by clicking the job name link.



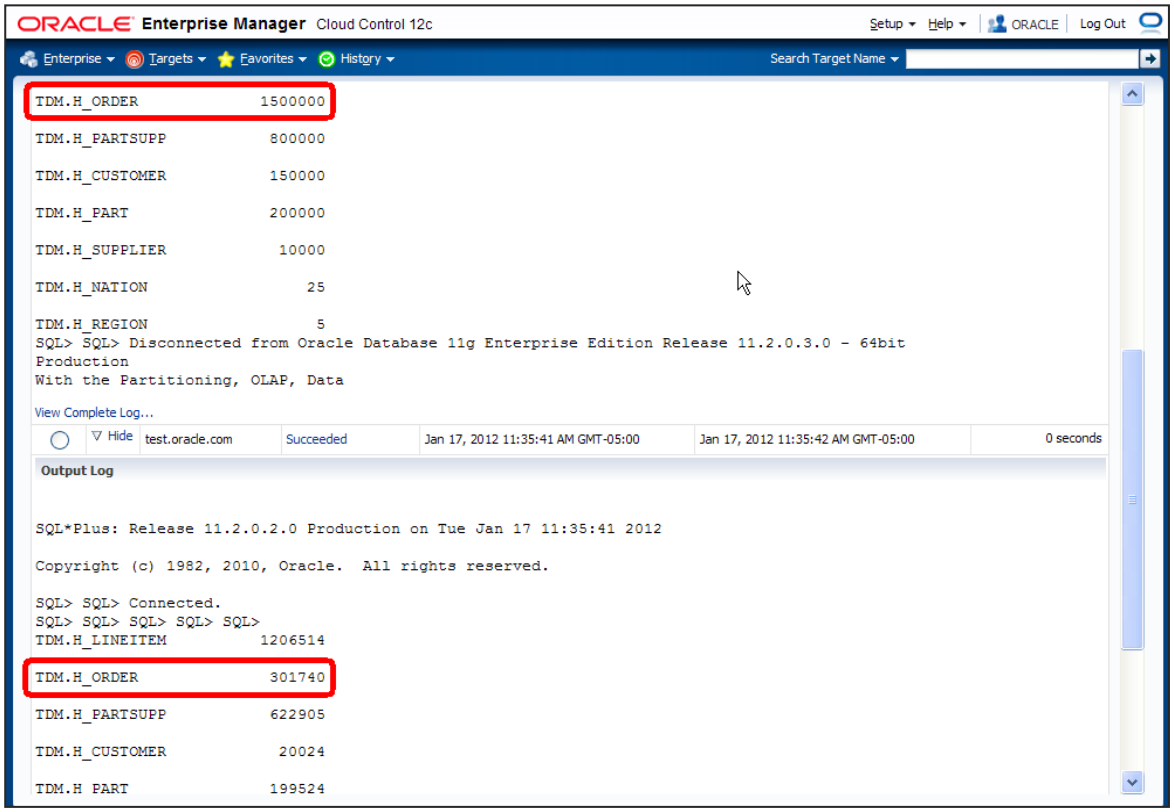
4.30 Make sure that job has succeeded for both the databases. Job takes about 10 second to complete.



4.31 To view the results, click on the 'Show All detail'.



4.32 Observe the row sizes for all the tables for original Production and subsetted Development database.



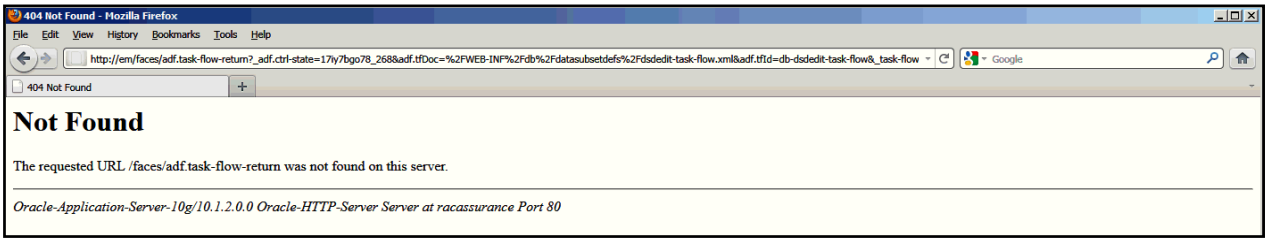
This concludes the Test Data Management section.

Stop the Database Testing Lab environment

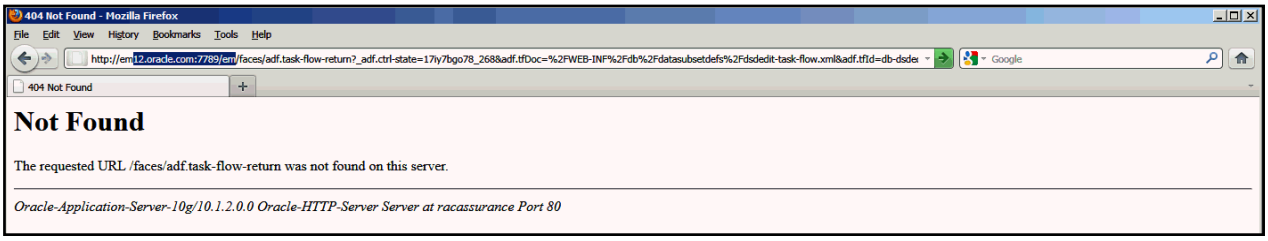
This concludes Database Testing lab. Before moving to next lab, please make sure to stop this lab environment by running the EM job '**2-STOP DB TESTING LAB'**. To execute this EM job, refer the steps given in the 'Getting Started' section.

WORKAROUND in case of error in Section D step 4.15

You may encounter the following error when you click on 'Return'



- To fix this, replace **http://em** with **http://<your VM IP Address>:7000/em** in the browser address bar like below. Click on the Go button and you'll be able to continue.



Oracle EM12c Cloud Control
Database Performance Testing, Data Masking, and Data Subsetting Workshop
February, 2013
Author: Bjorn Bolltoft
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