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Advanced Database Performance Analysis Techniques Using Metric Extensions and SPA

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Oracle

Hardware and Software
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The Oracle Open World logo, featuring the words "ORACLE", "OPEN", and "WORLD" in a bold, sans-serif font. "ORACLE" and "WORLD" are white, while "OPEN" is black. The text is set against a red, 3D rectangular block that is tilted. A large, white, diagonal slash is positioned behind the block. The background is a dark red with a fine, white, grainy texture.

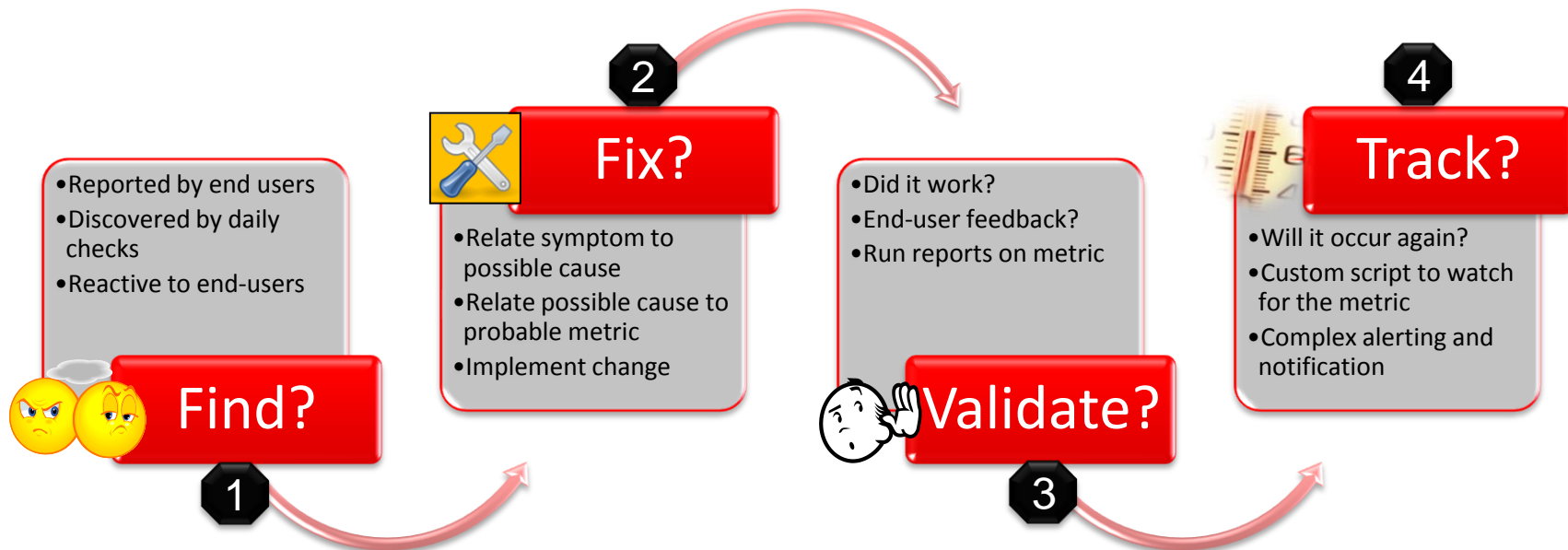
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Program Agenda

- Database Performance Analysis
 - Challenges
- Advanced Use Cases
 1. Detecting Run-away Queries Using Metric Extensions
 2. Identifying High Risk SQL in Growing Data Volume Environment

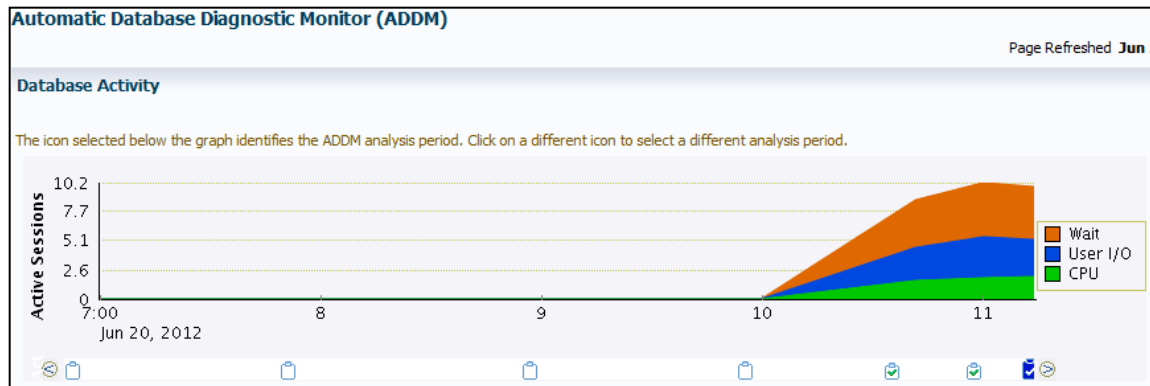
Database Performance Analysis

Challenges



1 – Find: Diagnostics

- For problem diagnosis use ADDM, EM Performance
- ADDM reveals significant problems including problematic SQL details and recommendations improve to performance
- ADDM family – Compare Period, Real-Time ADDM



Performance Finding Details: Top SQL Statements

Finding SQL statements consuming significant database time were found.

Impact (Active Sessions) 8.05

Percentage of Finding's Impact (%) 81.5

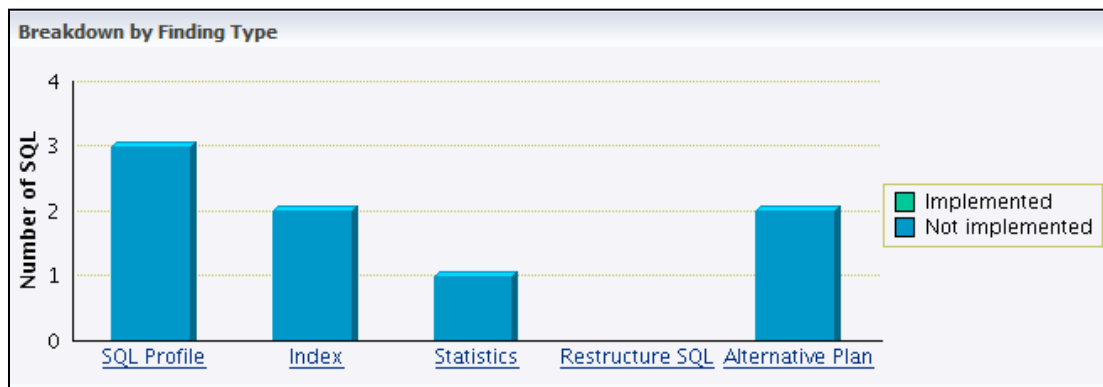
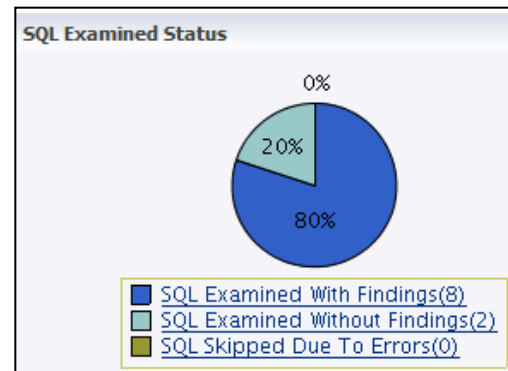
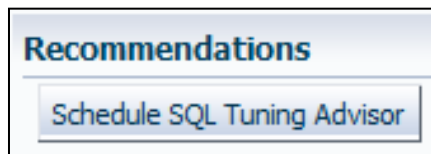
Period Start Time Jun 20, 2012 11:01:03 AM

End Time Jun 20, 2012 11:15:06 AM

Filtered No

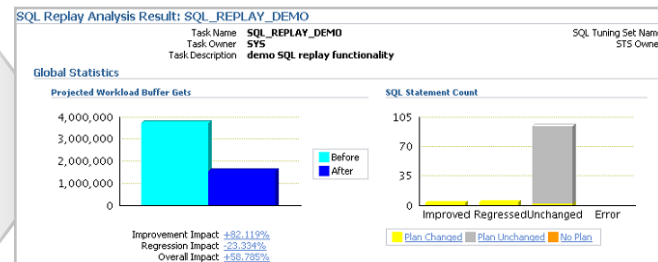
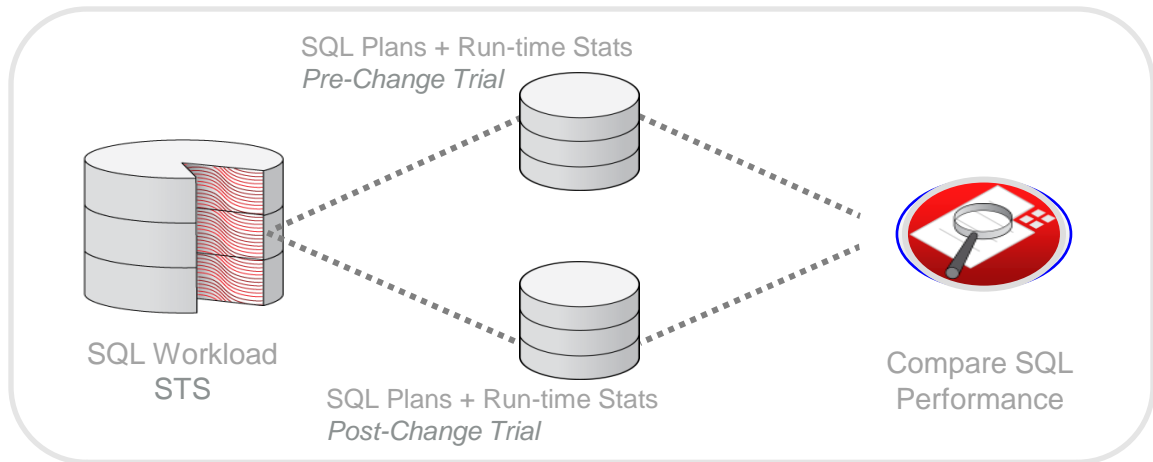
2 – Fix: Tuning

- Seamless integration between Find and Fix
- In-depth analysis and recommendation of the fix
- Gather statistics for this example...
- How would we validate this changes?



3 – Validate: Real Application Testing

SQL Performance Analyzer (SPA)

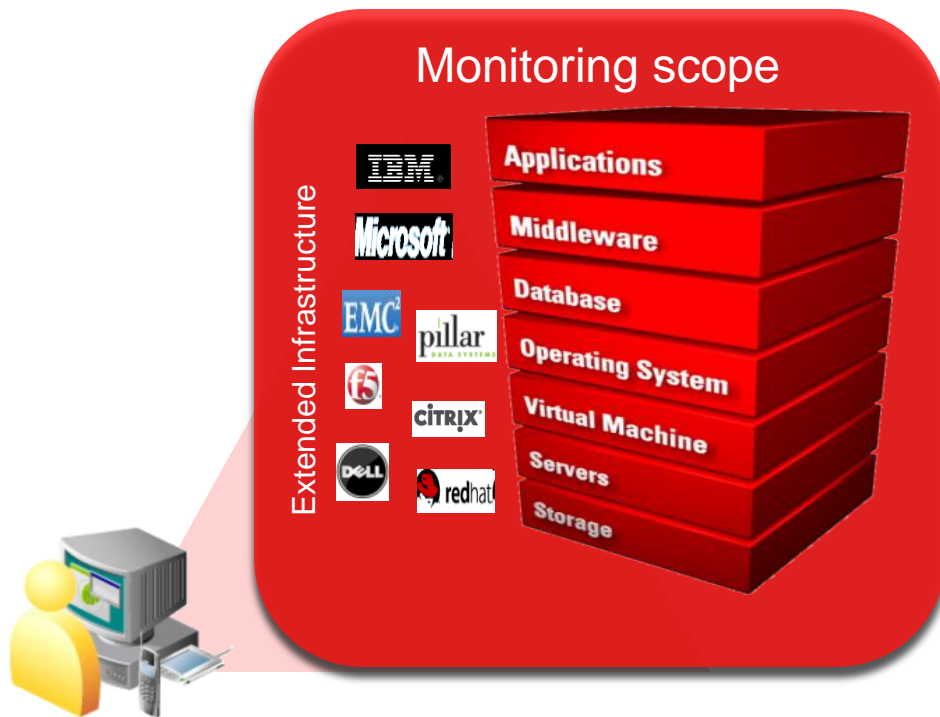


Analysis Report

- Test and predict impact of system changes on SQL query performance
- Analyze performance changes for improvements and regressions
- Comprehensive performance analysis and reporting
- Re-execute SQL queries in the given environment
- End-to-end solution: STS, SQL Plan Baselines, and SQL Tuning Advisor

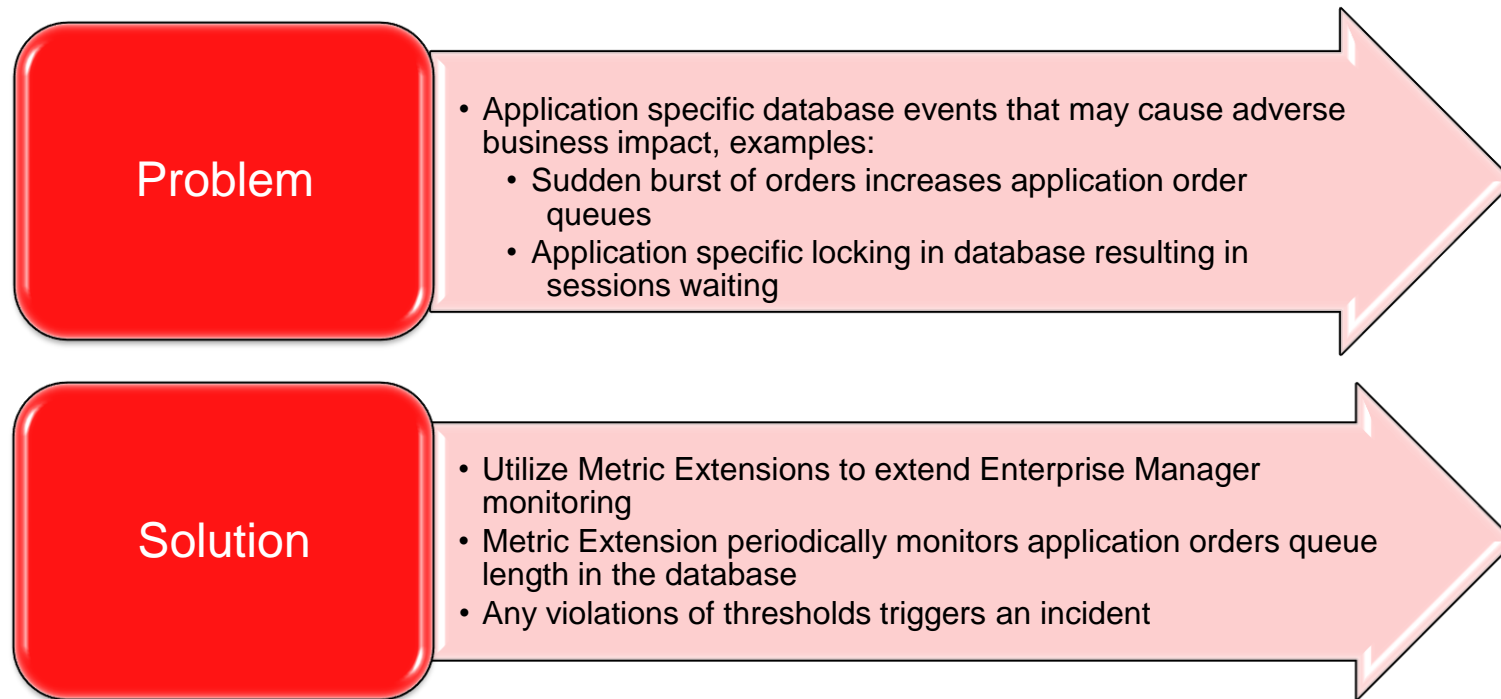
4 – Track: Monitoring in Enterprise Manager (EM)

- Lights-out data center monitoring
 - Manage by exception
 - Notifications
 - Integrated with My Oracle Support
- Complete and integrated across stack
 - Entire Oracle stack
 - Heterogeneous infrastructure monitoring via plug-ins
 - Extensible
- Integrates with third-party systems
 - Helpdesks and other management systems
- Metric Extensions (12c)
 - Next generation User Defined Metrics (UDM)
 - Can be defined for any target type, including applications



4 – Track: Metric Extensions

EM Metrics for Application Monitoring



4 – Track: Orders Queue Length Metric Extension

- Create a Metric Extension that monitors ORDERS_QUEUE table
- Set Warning and Critical limits for New and Processing status
- Set Incident Rules – notify when warning or critical limits are violated

Basic Properties

SQL Query

```
select decode(status,1,'NEW',2,'PROCESSING',3,'COMPLETE') as STATUS,count(status) as  
ORDER_STATUS  
from oe.order_queue  
group by status  
having STATUS in (1,2)
```

Sql or PL/SQL statement. Either SQL Query or SQL Query File should be provided

SQL Query File

Absolute path to file containing SQL script. Either SQL Query or SQL Query File should be provided

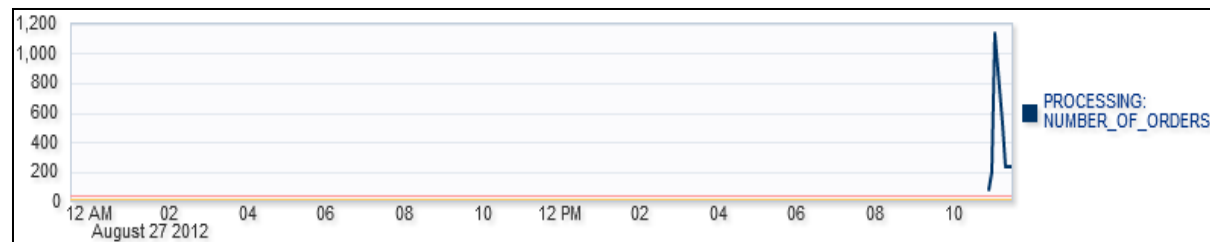


Alert Threshold		
Comparison Operator	Warning	Critical
>	20	40

4 – Track: Monitoring

- Your custom metric integrated natively into OOB metrics
- Historical metric view in one pane shows past trend of orders queues, stored in EM repository
- Alert history summary with actions taken
- Email notification sent when violations occur

NUMBER_OF_ORDERS							
ORDER_STATUS	Average Value	Low Value	High Value	Last Known Value	Current Severity	Alert Triggered	Last Collection Timestamp
NEW	209.09	20	1,080	60	✖	Aug 27, 2012 11:11:29 PM GMT	Aug 27, 2012 11:41:29 PM GMT
PROCESSING	464.57	73	1,136	No data	✔	-	-



✖	Aug 27, 2012 11:01:29 PM GMT	Order Status of PROCESSING is 1136	E-mail sent to To: [redacted]@oracle.com (Rule Owner=WAHMED, Rule Name=ORDER_QUEUE_RS,eMail Rule for OrderQueue)	✖
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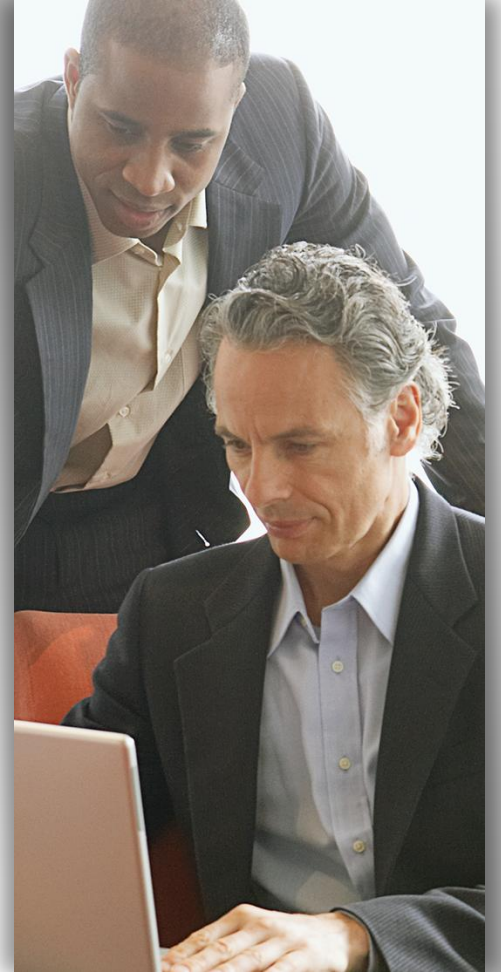
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EM DEV SUCCESS STORY

Case Study 1: Detecting Run-Away Queries Using Metric Extensions

Author: John Beresniewicz, Oracle



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Metric Extension (ME) Lifecycle



- Develop and unit test privately
- Deploy and system test on actual targets
- Publish for general use in EM
- Export/import to propagate to other EM environments

Find Metric Extensions

The screenshot displays the Oracle Enterprise Manager Cloud Control 12c interface. The top navigation bar includes 'Enterprise', 'Targets', 'Favorites', and 'History'. A dropdown menu is open under 'Targets', showing options like 'Summary', 'Monitoring', 'Job', 'Reports', 'Configuration', 'Compliance', 'Provisioning and Patching', 'Quality Management', 'My Oracle Support', 'Cloud', 'Chargeback', and 'Consolidation Planner'. The 'Monitoring' option is selected, and its sub-menu is visible, containing 'Incident Manager', 'Logs', 'Blackouts', 'Corrective Actions', 'Metric Extensions' (highlighted), 'Monitoring Templates', 'Support Workbench', and 'Template Collections'. The main content area shows a 'Performance' section with an 'Activity Class' chart for 'Services' and a 'Resources' section with charts for 'Host CPU', 'Active Sessions', and 'Memory'.

Manage Metric Extensions

ORACLE Enterprise Manager Cloud Control 12c

Setup Help GUEST_SUPER_ADMIN

Enterprise Targets Favorites History

Search Target Name

Page Refreshed Sep 19, 2012 1

Metric Extensions

Metric Extensions e metrics integrate se

Show Overview

Deploy Operat

Search Metr

Actions View

Name

ME\$9771

ME\$IdleVFDLocker

ME\$LastFullBackup

ME\$LastFullBackup

ME\$LastFullBackup

ME\$RunawaySQL

ME\$session_mon

ME\$LastFullBackup

ME\$LastFullBackup

ME\$LastFullBackup

Columns Hidden

Actions

- Create...
- Create Like...
- View
- Edit
- Create Next Version...
- Delete
- Manage Access
- Import...
- Export
- Deploy To Targets...
- Manage Target Deployments
- View Template Associations
- Save As Deployable Draft
- Publish Metric Extension

Import Metric Extension

File Name Browse...

Name ME\$

OK Cancel

Description	Deployed Targets	Monitoring Templates	Status	Owner	Last Edited By	Last Edited
	2	1	Published	SCHINTAL1	SCHINTAL1	Sep 3, 2012 9:56:12 AM
	1	0	Deployable Draft	SYSMAN	SYSMAN	Sep 1, 2012 2:17:10 PM
Checks if last full backup is within last 7 days	0	1	Published	AMCCOLLU1	AMCCOLLU1	Sep 7, 2012 10:25:13 PM
Checks if last full backup is within last 7 days	0	0	Published	AMCCOLLU1	AMCCOLLU1	Sep 11, 2012 8:55:51 PM
Checks if last full backup is within last 7 days	3	1	Published	AMCCOLLU1	AMCCOLLU1	Sep 11, 2012 8:59:42 PM
Checks for CPU consuming or long-running SQL using SQL Monitoring V\$ views.	1	0	Deployable Draft	SYSMAN	SYSMAN	Sep 1, 2012 3:05:53 PM
	1	0	Deployable Draft	SYSMAN	SYSMAN	Sep 1, 2012 3:10:02 PM
Checks if last full backups have been done within last 7 days.	0	1	Published	AMCCOLLU1	AMCCOLLU1	Sep 7, 2012 10:27:49 PM
Checks if last full backups have been done within last 7 days.	0	0	Published	AMCCOLLU1	AMCCOLLU1	Sep 11, 2012 8:54:37 PM
Checks if last full backups have been done within last 7 days.	1	1	Published	AMCCOLLU1	AMCCOLLU1	Sep 11, 2012 9:00:45 PM

Advanced Saved Search

“Runaway Query”

- SQL that consumes too much CPU or executes too long
 - BUGS: Need to find during Development and Testing contexts
- Real-time SQL Monitoring introduced in DB 11g
 - Monitors long-running and parallel query (PQ) SQL executions
 - Rich interactive user interface and Active Report
- GV\$SQL_MONITOR or V\$SQL_MONITOR

Design Metric Extension

- GV\$SQL_MONITOR query
 - SQL_ID: key column
 - TotalCPUsecs
 - TotalElapsedSecs
- Execute every 15-minutes (to not miss anything)
- Set alert thresholds on CPU and Elapsed times

```
WITH SQLM as
(select sql_id,sql_exec_start,sql_exec_id
    ,MAX(M.user#) as UserNum
    ,MAX(M.username) as UserName
    ,MAX(NVL(PX_QCInst_ID,M.inst_id)) as ExecInst
    ,MAX(NVL(PX_QCSid,M.sid)) as ExecSId
    ,MAX(NVL(PX_QCSid,M.session_serial#)) as ExecSerial
    ,MAX(CASE PX_QCSid WHEN null THEN null ELSE M.status END) as Status
    ,DECODE(count(distinct px_server#),0,'SERIAL','PARALLEL') as PQ_SERIAL
    ,COUNT(DISTINCT M.inst_id) as instances
    ,MAX(NVL(PX_MAXDOP,1)) as MaxDOP
    ,MAX(last_refresh_time) as last_refresh_time
    ,SUM(elapsed_time/1000000) as DBtimeSecs
    ,ROUND((MAX(last_refresh_time)-
        MIN(sql_exec_start))*24*60*60,1) as ExecElapsedSecs
    ,ROUND((MAX(last_refresh_time)-
        MIN(sql_exec_start))*24*60*60 +
        SUM(NVL(queuing_time,0)/1000000),1) as TotalElapsedSecs
    ,ROUND(SUM(NVL(queuing_time,0)/1000000),1) as QueuingSecs
    ,SUM(cpu_time/1000000) as CPUsecs
    ,SUM(user_io_wait_time/1000000) as IOsecs
    ,SUM((application_wait_time+concurrency_wait_time+cluster_wait_time)/1000000) as waitsecs
    ,SUM((plsql_exec_time+java_exec_time)/1000000) as JavaPLSQLsecs
    ,SUM(buffer_gets) as BuffGets
    ,SUM(disk_reads) as DiskReads
    ,SUM(direct_writes) as DirectWrites
from gv$sql_monitor M
group by sql_exec_id,sql_exec_start,sql_id
)
select sql_id as SQL_ID
    ,ROUND(SUM(CPUsecs)) as TotalCPUsecs
    ,SUM(ExecElapsedSecs) as TotalElapsedSecs
    ,IOsecs
    ,waitsecs
    ,SUM(BuffGets) as TotalBuffGets
    ,SUM(DiskReads) as TotalDiskReads
    ,MAX(UserName) as SampleUser
    ,COUNT(*) as NumExecs
from SQLM
where
    ( status like 'EXECUTING%' -- currently executing or
    OR (status like 'DONE%' AND last_refresh_time > SYSDATE - 15/(24*60)) -- finished last 15 minutes?
```

Create Metric Extension

- Guided wizard makes it easy
 - Well organized
 - Excellent explanations
- Develop and test on any database before deploying to production

ORACLE Enterprise Manager Cloud Control 12c

Metric Extensions

General Properties Adapter Columns Credentials **Test** Review

View Runaway SQL v2 (ME\$RunawaySQL) v1 : Test

You can perform real-time metric evaluations here on specified test targets.
It is recommended that you test your metric extension here first before deploying to targets. Targets that you select need to be up in order for your test to

[Back](#)

Test Targets

[+ Add](#) [X Remove](#) [▶ Run Test](#) [X Clear Results](#)

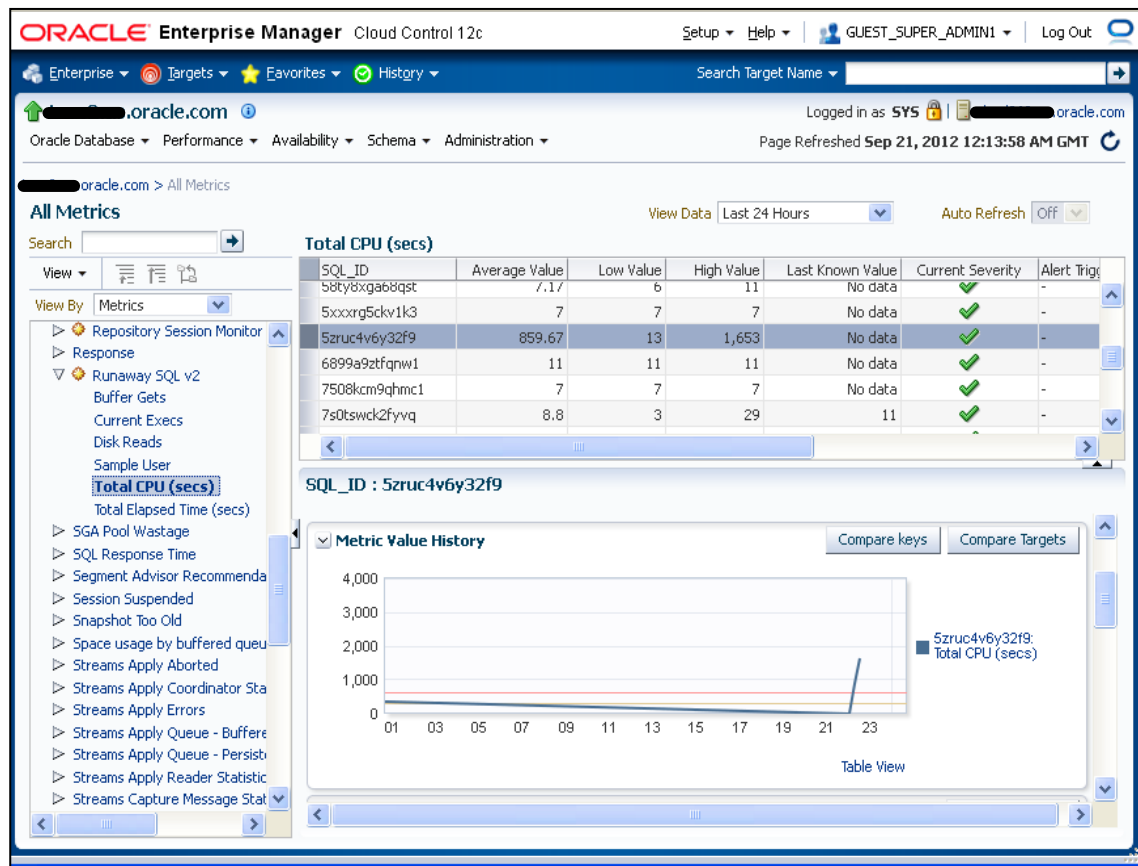
Target Name	Target Type	Hostname	Current Status	Agent
Lxrc2.us.oracle.com	Database Instance	slcad362.us.oracle.com	↑	https://slcad362.us.oracle.com

Test Results

Target Name	SQL_ID	Total CPU (secs)	Total Elapsed Time (secs)	Buffer Gets	Disk Reads	Sample User
▽ Target List						
▽ Lxrc2.us.oracle.com						
	7s0tswck2fyvq	10	10	1881777	66748	SYSMAN
	9v5rq4jb13htq	39	40	2320536	827	SYSMAN

Monitoring

- Email notification with custom subject line
- Informative email with context-sensitive hyperlinks into EM
- Your metric is a first-class EM metric



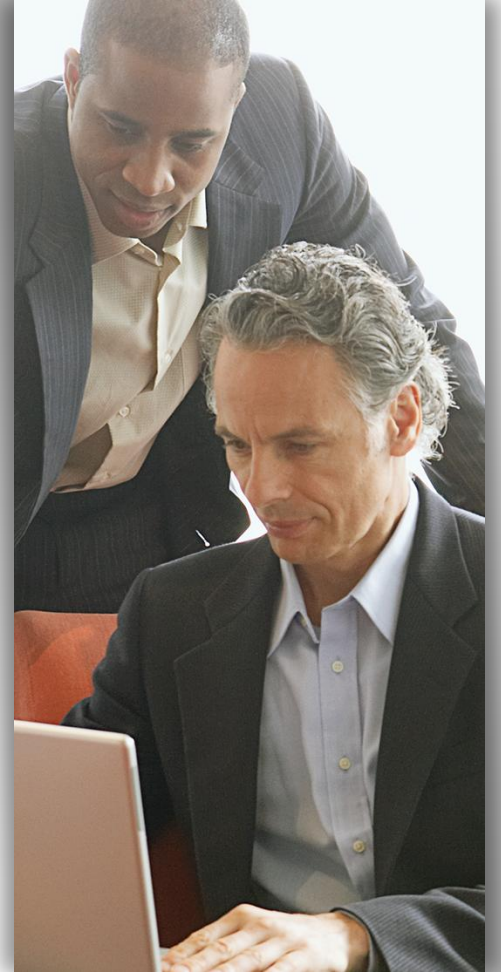
Metric Extensions are Cool!

- First-class metrics of your own design
- Easy-to-use user interface makes it a snap
- Lifecycle support and export/import important value-adds
- Monitor targets for application-specific issues
 - OOB metrics are for the general case
- RunawaySQL ME has found many bugs
 - Using EM to improve EM

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Case Study 2: Identifying High Risk SQL in Growing Data Volume Environment



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Identify High Risk SQL with Growing Data Volumes



Problem

- Data stores and sources are expanding at a rate greater than ever
- The fast increase of data volume commonly results in performance slowdown
- Performance slow down can lead to unplanned downtime



Reactive Fix

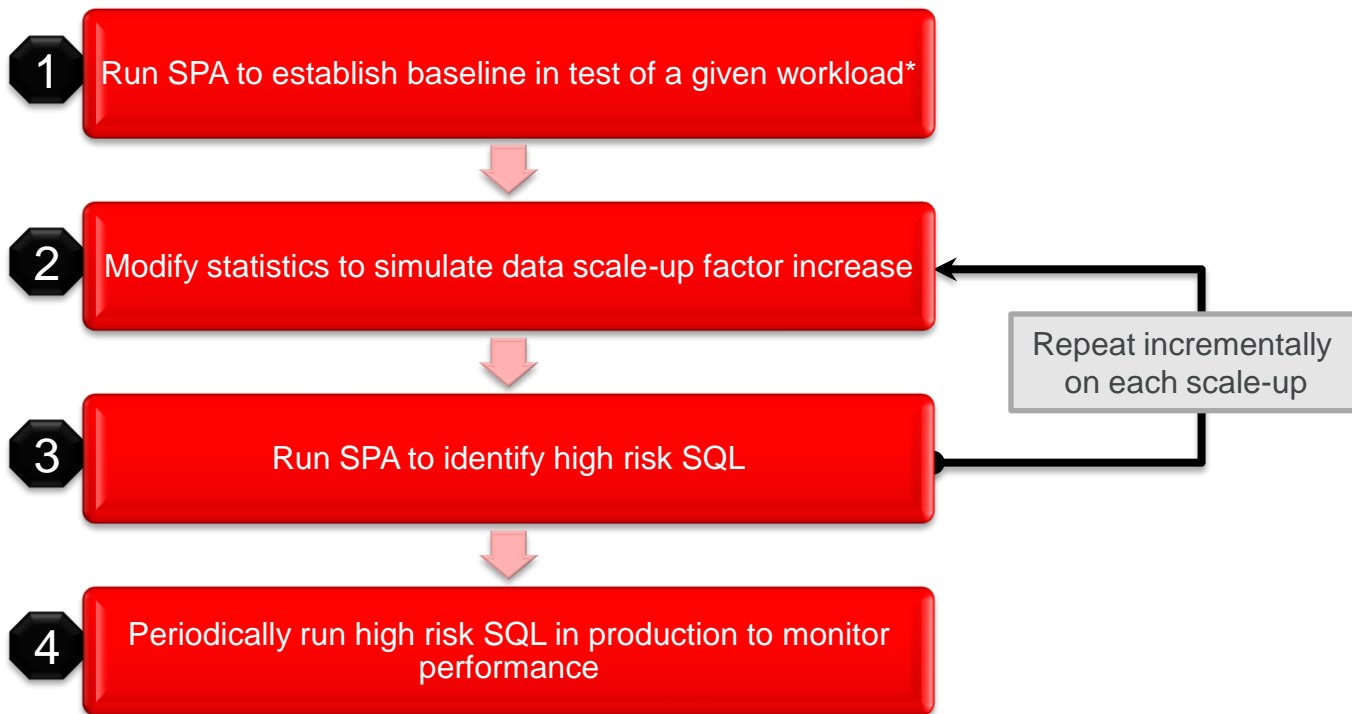
- Adjust system or db configuration
- Tune storage system or SQL reactively
- Provision more hardware
- Reduce or restrict user access



Proactive Optimization

- Identify SQL with potential volatile plans in increasing data volume DBs
- Preempt SQL performance reliably
- Assess and plan for data growth

Identify High Risk SQL with Growing Data Volumes



* Workload captured into SQL Tuning Sets (STS)

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1 – SPA Baseline Trial in Test

- Setup test environment either full or subset of data
- Ensure table and index statistics are same as that of production
- Run SPA trials in explain plan mode for the workload

Advisor Central > SQL Performance Analyzer > SQL Performance Analyzer Task: SYSTEM.SCALEUP_TASK Logged in As SYSTEM

SQL Performance Analyzer Task: SYSTEM.SCALEUP_TASK

[View Latest Report](#) Page Refreshed **Aug 28, 2012 3:34:37 PM PDT** [Refresh](#)

The SQL Performance Analyzer Task is a container for experimental results of executing a specific SQL Tuning Set under changed environmental conditions and assessing the impact of environmental changes on STS execution performance.

SQL Tuning Set

Name TPCB_STS01
Owner TPCB

Description
Number of Statements 34

SQL Trials

A SQL Trial captures the execution performance of the SQL Tuning Set under specific environmental conditions.

[Create SQL Trial](#)

SQL Trial Name	Description	Created	SQL Executed	Status
TRIAL1_EXP_0X	Performance of SQL in existing data volume - base trial	8/28/12 12:19 PM	No	COMPLETED

2 – Simulate Data Growth using Statistics

Backup existing table and index statistics

- Create table to hold original table and index statistics

```
dbms_stats.create_stat_table()
```

- Export current table and index statistics to this table

```
dbms_stats.export_table_stats()  
dbms_stats.export_index_stats()
```

Simulate scale up of data volume

- Assuming column data is uniformly distributed: ...For all tables increase number of rows and blocks by a factor of 1.1 (10%) using

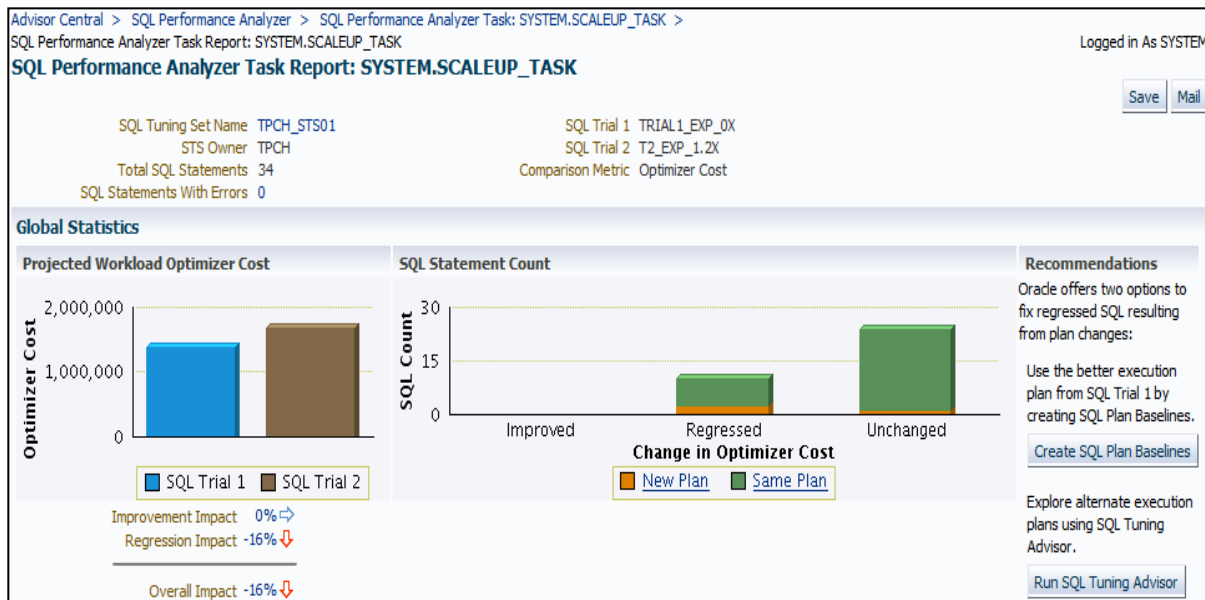
```
dbms_stats.set_table_stats()
```

- For all indexes increase number of rows, number of leaf blocks, number of distinct keys and clustering factor by a factor of 1.1 (10%), using

```
dbms_stats.set_index_stats()
```

3 – Run SPA Trial Analysis

- Run SPA Trial with the scaled-up optimizer statistics to assess the impact of data volume growth
- Identify High Risk SQLs (SQL with plan changes) due to data volume growth



4 – Periodically Test High Risk SQL in Production

Subset high risk SQL (SQL with volatile execution plans) into a separate SQL Tuning Set

- Create a new empty SQL Tuning Set:

```
dbms_sqltune.CREATE_SQLSET()
```

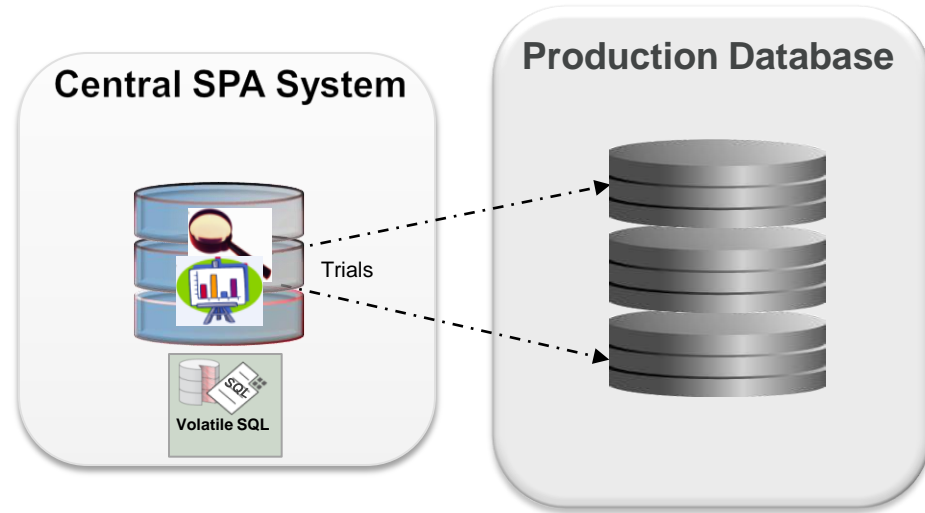
- Load high risk SQL into the new SQL Tuning set from the SPA task

```
dbms_sqltune.load_sqlset()
```

Using this STS, run SPA trials periodically with per execution time limits in production to monitor and tune volatile SQL Plans

4 – Periodically Test High Risk SQL in Production

- Baseline STS on production once with SPA
- On a routine basis run SPA Analysis and compare to baseline to identify SQL regressions
- Preempt performance degradation and fix proactively in rapidly growing data volume environments



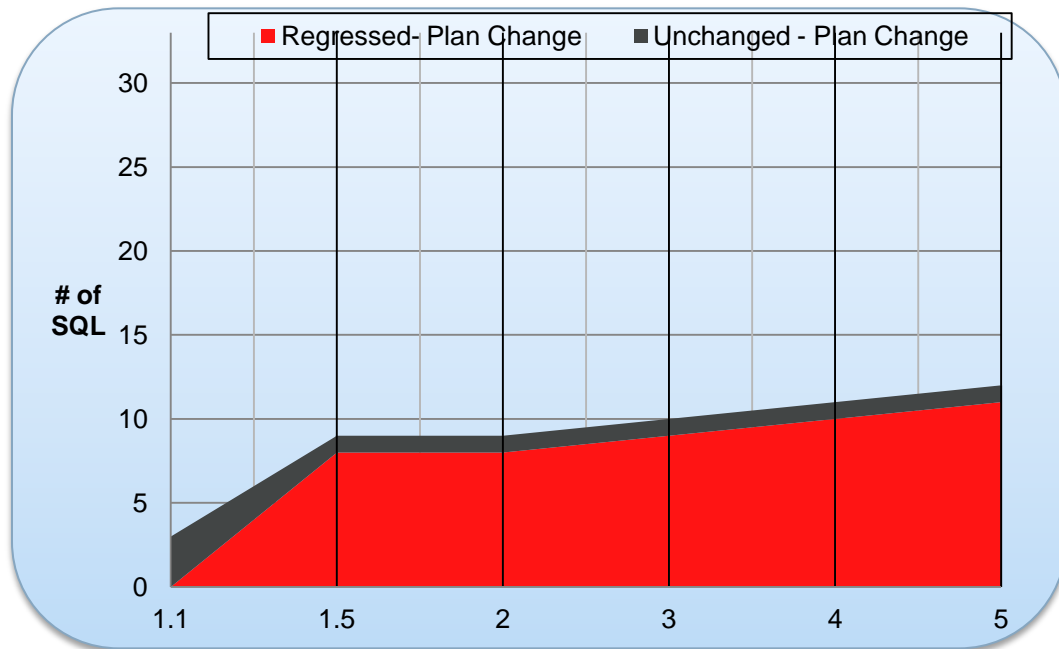
Case Study: Predict Data Growth Effect on SQL Performance

Using Optimizer Statistics and SPA, test incrementally, SQL Plan volatility with data volume growth

- TPCCH workload containing 33 queries
- Run SPA tests at increments of 1.1, 1.5, 2, 3, 4 and 5 times the original data size using `dbms_stats` to simulate this data volume increase
- Tests were done assuming uniform column data distribution
- Optimizer Cost was measured for the workload
- SPA Trials were run in explain plan mode

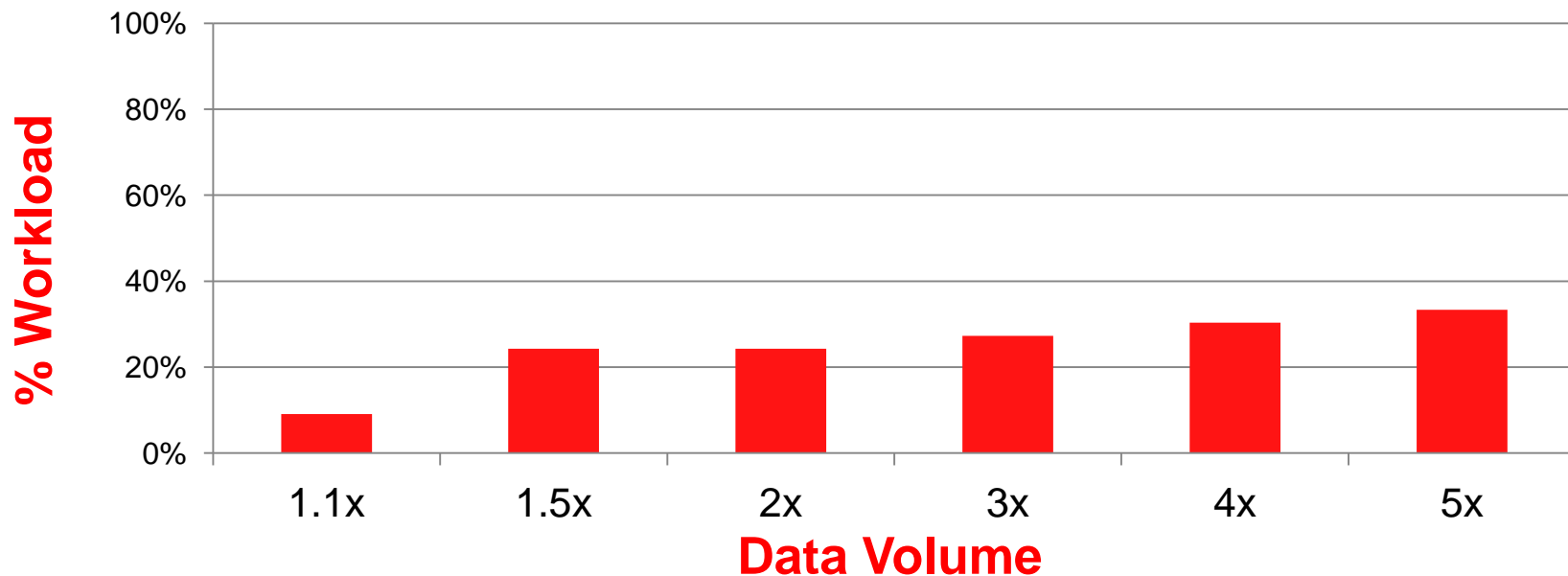
Predict Data Growth Effect on SQL Performance

- Using TPCH, captured **33** SQL and ran SPA Analysis on increasing data volumes
- Focused on queries with plan changes
- Unchanged performance with new plans also requires testing to minimize risk
- Regressed SQL represents only 11% of total workload (worst case scenario at 1.5X)
- Significant Cost changes past 1.5X, investigate partitioning or additional access structures at this point (SQL Access Advisor)



Data Growth (x)	1.1X	1.5X	2X	3X	4X	5X
Cost Regression %	-3	-59	-146	-436	-1480	-3679

Plan Sensitivity Distribution



SPA with Growing Data Volume

Summary

SPA can be used to identify high risk SQL with minimal effort in environments with

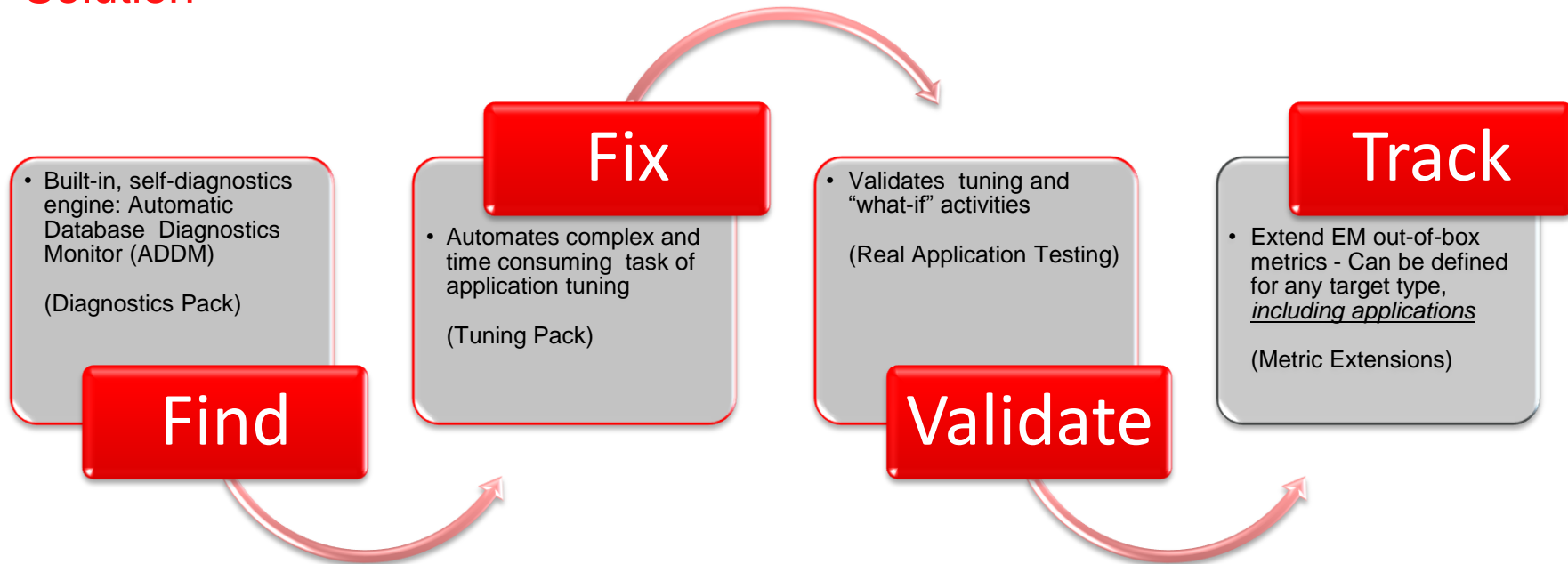
- Large workloads and increasing data volumes

Prevent unexpected performance degradation proactively

- Test high risk SQL in production and tune

Advanced Databases Performance Analysis

Solution



Safe Harbor Statements

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Plan Sensitivity to Data Volume Growth

- *Plan Sensitivity Index (PSI) =
Optimizer Cost Change % / data
volume growth factor
- Linear optimizer cost increase
observed with data volume scale
increase up until 2X
- When data volume is double the
original size, significant regression
can be predicted
- For OLTP workload, increasing PSI
index signals regressing
application performance
- Use SQL Tuning Advisor and/or
Plan Baseline to remediate
regression(s)

