Exploiting Operational Intelligence Within Database Management Tools

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Attend this session to get a close-up look at currently embedded operational intelligence in database management utilities. Discover how to exploit these available capabilities as well as the possibilities for you to build you own! You will learn how advanced automation requires unique operational intelligence that can further evaluate which additional tasks can be automated and to what degree. Additionally, learn how to simplify your day to day decision making to minimize the time required to effectively manage and run an efficient database system. The effects of all this? How about helping to lower DB2 operating costs and improve user productivity, including manual effort and specifically “specialized or expert” manual requirements.
Agenda

1. USING DATABASE ANALYZER FOR AUTOMATING OBJECT MAINTENANCE
2. IDENTIFYING SQL TO ANALYZE FOR IMPROVING APPLICATION PERFORMANCE
3. IMPROVING QUERY PERFORMANCE WITH PLAN ANALYZER
4. IDAA ACCELERATION WITH RC/QUERY AND SYSVIEW FOR DB2
5. FUTURE OF OPERATIONAL INTELLIGENCE IN DB2
CA Database Management Portfolio Vision
Managing Growth and Complexity to Address Evolving Data Management Needs

CA Administration Suite
CA Utilities Suite
CA Recovery Suite
CA Performance Suite

Experience
DBA

Planned
Available

Web App Server
CA Analytics for DB2
External Apps

Mobile Developer
Next Gen DBA
Next Gen DBA
Big Data Analyst

IMS
DB2

CA
Administration
Suite
CA
Utilities
Suite
CA
Recovery
Suite
CA
Performance
Suite

REST API

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Database Analyzer Provides Operational Intelligence for DB2 Object Maintenance
Database Analyzer – Past and Present

1. STATISTICS EVOLUTION IN DB2
2. QUICK OVERVIEW OF DATABASE ANALYZER PROCESSING
3. TRADITIONAL STATISTICS COLLECTION AND ANALYSIS
4. OBJECT MAINTENANCE USING DB2 REAL TIME STATISTICS (RTS)
5. PRIORITIZED OBJECT MAINTENANCE
Statistics evolution – let’s step back and remember

- **RUNSTATS Since Day-1**
  - Collected statistics for the optimizer
  - Collected statistics for the DBA to determine when REORG needed
    - Extents a lot easier to trigger than CLR, LEAFDIST, FAROFF, NEAROFF etc.

- **Some issues / problems with this approach**
  - DB2 catalog got updated with potentially “bad” statistics
  - BIND’s and REBIND’s should be postponed until statistics fixed by REORG and another RUNSTATS
Statistics evolution – let’s step back and remember

- REPORT YES and UPDATE NONE
  - Great improvement to verify objects health condition
  - No need to worry about BIND, REBIND, dynamic SQL due to “bad” statistics
  - Had to change applications to interpret RUNSTATS SYSOUT as opposed to using SQL against the DB2 catalog determining REORG etc.

- Objects kept growing in number and size
  - RUNSTATS expensive
  - Sampling introduced late in the game
  - Inline stats can be used when loading/reorganizing object - Limited
Statistics evolution – let’s step back and remember

- RTS introduced in DB2 V7 – from DB2 9 mandatory
  - New challenges introduced (more later)

- Many ways to trigger the reorg of an object?
  - Performance metrics – when application performance start to degrade
  - Fixed schedule – Weekly, Monthly, etc. based on object size / type
  - Partitioned objects - Entire Table Space or a Partition at a time?

- RTS is commonly used today for Object Maintenance

- Tools like Database Analyzer or DB2’s DSNACCOX SP
RTS Driven REORGs and Space Administration

- Some limitations to think about based on requirements
  - Is the object (or partition) over- or under allocated?
  - Do you want to alter QTY based on current conditions / metrics?
  - Can you save an INDEX-LEVEL by doing a reorg (one RTS column might help)
  - Do you need to provide accurate space trending/forecasting
  - Do you have requirements to generate your own SQL based conditions to drive the process
  - Do you have a need for IF-ELSE logic driving the processes or dynamically decide how the utility should be generated
  - Sliding scale algorithm resolves many space allocation concerns
Database Analyzer Process Overview

- **Database Statistics Extract**
- **Actions Conditions**
- **Database Analyzer Extract and Action Processing**
- **DB2 Utility JOBs**
Database Analyzer – Traditional (Old Style) Space/Reorg

- Very common to build an Extract Procedure on one or more Databases (could process entire subsystem)

- Action Procedures can be created or selected from list of best practice DB2 maintenance options (Reorg, RUNSTATS, Image Copy, etc.)

- Problem with Traditional Database Analyzer Automation
  - Too many objects to process, only subset may need attention
  - CPU intensive collecting all the stats needed to do Reorg or Alter
  - RTS has been available for sometime and can provide necessary stats
Database Analyzer – Preferred Method is RTOS

- **Real Time Object Selection (RTOS) uses DB2 RTS**
  - New with R19 - Object Selection Profile (OSP) linked to Extract procedure to filter objects to be processed (Database and Table space masks)
  - Can generate action JCL for selected Utility processing based on RTS conditions (Best practice are values available)
  - Or can generate Database Analyzer Statistics on the subset of objects and continue to take advantage of the extensive “traditional” action conditions
  - New with R19 – Prioritized Object Maintenance (POM) profiles can be linked to Extract Procedures to enable the Action JCL generated to be prioritized based on Prioritized Object Conditions (POC)
Operation Intelligence with Detector SQL Collection
Detector – SQL Collection for Accelerated Performance

- Analytics Accelerator Usage Scenarios
  - Rapidly accelerate business critical queries
    - Often challenging to tune queries that also support OLTP workload
  - Improve access to historical data
  - New business intelligence use cases

- Use CA Detector to help identify long running queries
  - Sort Queries by High IN-DB2 time
  - Identify DB2 Tables associated with these long running queries
    - If running Subsystem Analyzer, Option T in Detector will show tables associated with Query
Plan Analyzer to Determine Potential Accelerated Performance Improvements
Plan Analyzer - ACCEL Profile Support - Profile Services

- Create and use ACCEL profiles using the DB2 Profile Services facility. The facility uses these DB2 tables:
  - SYSIBM.DSN_PROFILE_TABLE
  - SYSIBM.DSN_PROFILE_HISTORY
  - SYSIBM.DSN_PROFILE_ATTRIBUTES
  - SYSIBM.DSN_PROFILE_ATTRIBUTES_HISTORY

- ACCEL profile costing is only applied when DSNZPARM QUERY_ACCELERATION is one of these options:
  - ENABLE
  - ENABLE WITH FALBACK
Plan Analyzer : IBM DB2 Analytics Accelerator support

Threshold values details to be used when Accelerator access is considered

```
19.0  --------  PPA DB2 Profile Services Create -------- 2016/04/05
03:32
COMMAND ===>

PROFILEID ===> 5000  FUNCTION ===> ACCEL  ENABLED ===> Y
REMARKS ===> AIG DEMO

----------------------------------------------- RASST02

ACCELERATOR THRESHOLDS:
TABLE CARDINALITY ===> 2000000  N/A | -1 | 1 thru 2,147,483,647
RESULT SIZE ===> 1  N/A | -1 | 1 thru 2,147,483,647
TOTAL COST ===> +.0E+00  N/A | -1 | 0 thru +7.2E+75
```
Plan Analyzer: IBM DB2 Analytics Accelerator support

STARTPROF on command line will activate new DB2 Profile

---

```
19.0  ------------------ PPA DB2 Command Display ------------------ 2016/04/05 03:36
COMMAND ==> SCROLL ==> PAGE

DSNT741I !DB2G DSNT1SDV START PROFILE IS COMPLETED.
DSN9022I !DB2G DSNT1STR 'START PROFILE' NORMAL COMPLETION

Profile Services Status Report
Profile ID: 5000 Function: ACCEL Status TS: 2016-04-05-03.36.11.397468
Status : ACCEPTED BY DB2G
Attribute : ACCEL_RESULTSIZE_THRESHOLD
Value : 1
Status : ACCEPTED

Attribute : ACCEL_TABLE_THRESHOLD
Value : 2,000,000
Status : ACCEPTED

Attribute : ACCEL_TOTALCOST_THRESHOLD
Value : 0
Status : ACCEPTED

Profile ID: 8661 Function: ACCEL Status TS: 2016-04-05-03.36.11.397468
Status : REJECTED BY DB2G - DUPLICATED SCOPE SPECIFIED
```

ID = 8661 was already active.

Toggle command on Profile Services panel can be used to enable/disable
Plan Analyzer : IBM DB2 Analytics Accelerator support
Support for new BIND / REBIND cards for packages

- Possible values for QUERY ACCELERATION are obtained from SYSACCELERATEDPACKAGES and assigned to the special register
  - (ENABLEWITHFAILBACK) Behaves like ENABLE, but if an error occurs on the first OPEN of the accelerated static query DB2 prevents the query from failing. Instead, DB2 performs a temporary statement-level incremental bind of the query, and the query executes in DB2.
  - (ELIGIBLE) Indicates that static queries are bound for acceleration, but are accelerated only when they meet all acceleration criteria with the exception of cost and heuristics criteria. Queries that do not meet this criteria are bound for execution in DB2.
  - (ALL) Indicates that all static queries are bound for acceleration, and routed to the DB2 Accelerator. If DB2 determines a query cannot be accelerated and the query references a user base table or view, the bind or rebind package fails with an error.
EXPLAIN with QUERY ACCELERATION

- Generate the access path information for packages that were bound with this option, without issuing a REBIND.
- FUTURE explain will SET the special register CURRENT QUERY ACCELERATION before the dynamic explain to reflect the value bound in the catalog for the package.
- If DSNZPARM ACCELMODEL=YES, Future Explain overrides the value that is specified in the QUERYACCELERATION bind option to NONE. This action allows the access path to generate successfully.

(next slide will illustrate)
ACCESS type illustrates the query can be executed on the IBM DB2 Analytics Accelerator.

View DSN_QUERYINFO_TABLE when using Explain Profile – PLAN_TABLE Option ==> ALL
Accelerate and Monitor IDAA Tables with RC/Query, Batch Processor and Sysview for DB2
CA Database Administration for DB2 for z/OS

- CA RC/Query & Batch Processor (can use with automation)
  - No need to navigate between multiple solutions
  - Manage DB2 Analytics Accelerator within your CA DB2 solutions
    - Display / Start / Stop Accelerator
    - Add / Remove tables to DB2 Analytics Accelerator
    - Load table to the accelerator
    - Enable / Disable table acceleration / replication
    - Alter Accelerated table Dist. & Org Keys
    - Archive Accelerated table
    - Force Remove Table from DB2 Analytics Accelerator
    - Restore the archived moved partitions data

New with R19
Manage DB2 Analytics Accelerator

Use CA RC/Query for IDAA administration

Use “?” line command to see available commands.

IDAA Table level functions are available to Define, Alter, Remove, Load, etc.
Manage DB2 Analytics Accelerator

Use CA RC/Query for IDAA administration

- Load DB2 Table into IDAA
  - RC/Q ALOAD Command
  - Can load range of partitions or entire Table
  - Uses IDAA Loader utility
  - Most commands such as ALOAD are available using Batch Processor Scripts
SYSVIEW for DB2 – IDAA Subsystem Statistics

- New accelerator related fields were added to records:
  - Database statistics (IFCID 2 and 1002)
  - DB2 system parameters (IFCID 106 and 1006)

- Updated reports:
  - SYSACCEL / SYSACDTL: Accelerator List/Detail
  - HSACCLST / SYSCCDTL: Accelerator Server List/Detail (history)
  - HSUACLST / HSUACDTL: Accelerator Server List/Detail Summary (history)
  - BTSTATR1: Statistics Data Trace (batch)
  - BTSTASM2: Summary of DB2 database address space statistics (batch)
  - SYSSTATS/SYSTATA, GRPSTATS/GRPSTATA: System Overview
DB2 Analytics Accelerator
CA SYSVIEW® Performance Management for DB2

- Subsystem statistics:
  - Accelerator Details
    - SYSACDTL: Accelerator Details
    - HSACCDTL / HSUACDTDL: Accelerator Server Details/Summary
Data Driven DB Performance Management
Mainframe Operational Intelligence
Evolution of Operational Intelligence
Actionable analytics with significant advances towards zero touch operations

ANALYTICS 1.0
BUSINESS INTELLIGENCE

BI & STATISTICAL ANALYSIS
- Analysis of Historical Data
- BI Reporting, Slicing/Dicing
- Basic Navigation Tools

ANALYTICS 2.0
BIG DATA

DATA MINING & DECISION SUPPORT
- Analysis of Historical & Near Real-time Data
- Data Mining, Aggregations & Decision Support
- Navigation Tools with Traffic Updates

EXPERT SYSTEMS & MACHINE LEARNING

- Analysis of Historical, Near Real-time plus Live data
- Data Mining, Machine Learning & Autonomics
- Self Driving Cars

ANALYTICS 3.0
DATA-DRIVEN APPLICATIONS

Technology Trend
Data Analytics and the Mainframe Opportunity

ANOMALY DETECTION

70% of transactions flow through mainframe

55% of apps depend on mainframe

BUSINESS SERVICE MANAGEMENT

EXPERT SYSTEMS

70% world’s corporate data is on a mainframe

64% Increase in mainframe workloads

SECURITY BREACH DETECTION

Industry Opportunity

Data Analytics and the Mainframe Opportunity
Mainframe Operational Intelligence
Leverage technology trend to solve an important Mainframe problem

**MTTR & Firefighting**
- **REPORTING MODERNIZATION**
  - React to threshold events
  - Self service views
  - Modern U/X
- **ANOMALY DETECTION**
  - Predict anomalies
  - Proactive response
- **BUSINESS SERVICE PERSPECTIVES**
  - Topology discovery
  - Business service perspectives
  - Predict business service disruption

**Optimized Performance & Efficiency**
- **EXPERT SYSTEMS**
  - Root cause hypothesis
  - Resolution guidance
  - Automate response

**BI/Statistical Modeling**
**Data Analytics**
**Data Driven Operations**
**Automation**

**ENTERPRISE SUPPORT**
- Automation
- Generalist
- Specialists
- Experts

**MAINFRAME OPERATIONS**
- **USERS**
  - USERS
  - Automation
  - Generalist
  - Specialists
  - Experts

- **DATA**
  - Analytics
  - BI/Statistical Modeling
  - Data Analytics
  - Data Driven Operations
  - Automation

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Intelligent Mainframe Operations - Lifting the Burden

ANALYTICAL TOOLS & SKILLS

IN-HOUSE DATA SCIENCE

IN-HOUSE DOMAIN EXPERTISE

YOUR BURDEN

Mainframe Team Center

DATA-DRIVEN APPLICATIONS

Let the DATA do the WORK for you

Fueled by:
- advanced analytic algorithms
- machine learning

Do MORE with LESS!
Mainframe Operational Intelligence

Key capabilities being developed to manage the lifecycle of your data assets

**Multi-Channel Data Capture**

- **Mainframe**
  - VSAM, DB2, IMS DB, IDMS, DATACOM, SMF, Syslogs, Vtape, CICS
- **Distributed**
  - DB2, Oracle, MySQL, Cassandra ...

**Data Lifecycle Management**

- Transport & Integration
- API Management
- Master Data Management
- Scalable Data Storage
- Data Science and Anomaly Detection

**Analytics Processing**

- Expert Systems Autonomics
- IT Operations Intelligence
- Business Intelligence

**Multi-Channel Delivery**

- Report Distribution
- Anomaly Alerts
- Ad-Hoc Analysis Tools
- API based data access
- Automation frameworks

"It's your data, leverage it to do the work for you!"
Data Driven DB Performance Management
Problem, Opportunity and Proposed Solution
The Situation

Ever increasing application volumes and complexity

Companies are developing complex SQL applications on DB2. Performance often degrades over time without anyone noticing (the creeping trend).

A DBA often does not recognize degradation until customers complain or service level agreements have been missed.

An intelligent system that can recognize and prioritize significant changes in SQL performance before it starts to impact resource overheads and service level agreements.
The Challenge

How do you resolve performance problems?

- How do you determine when performance started to degrade?
- How long does it take to identify the problematic SQL statements?
- Do you know how the statements executed before the performance degraded?
- Do you have a log of application performance problems and resolutions?
  - Can you compare this log with current problems?
- Many customers offload CA Detector datastore into DB2 tables
  - Query heaviest plans/packages & manually compare to “baselines”
  - No efficient method to re-evaluate baselines when “the world changes”
  - How to monitor “standard deviation” and “creeping trend” is complex and cumbersome
The Solution

Mainframe Team Center – Operational Intelligence

Capture

CA Detector collects SQL interval performance metrics for analysis. Creates an historical view of application performance, which will be stored in the cloud.

Baseline

Baselines are created that contain a statistical analysis of application SQL performance for a chosen, representative, period-in-time. Baseline repository can be updated when baselines are determined to no longer be representative.

Analyze

Analyzes application performance deviations from normal execution behavior (i.e., deviations from baselines) and logs in an events repository.

Review

In addition to output from Capture, Baseline, and Analyze the application will allow you to review application performance history through a web browser interface. Deeper analytics and visualization are available through the browser dashboard.

Notify

During the Analyze step, notifications of performance deviations can be sent to key personnel via email.

Review
Anomaly Detection – Problem Avoidance/Prediction

PERSONA:
Operations, Systems Programmer, Network Engineer, Application DBA

USE CASE:
Sherman, Debbie, and Fred have deep experience and skills in their respective areas. They hate being called after a system problem has occurred and being asked to prove that their area was at fault or innocent. They would like a system that tells them when their area is behaving abnormally, so that they can address it before it comes to the attention of the Systems Performance Engineer.

PROBLEM
- “Avoid, detect and predict issues that might be a problem”
- “Thresholds are hard to maintain and generate large amount of false positives”
- “Ability to see multiple views of data”
- “Ability to create views of information faster”
- “The current U/X prevents easy collaboration and access to analytics”
Anomaly Detection – Problem Avoidance/Prediction

SOLUTION

- Detect anomalies & predict issues real-time, alert based on predefined rules
- Leverage historical data and machine learning for dynamic thresholds
- Simplified U/X – browser access & designed for collaboration

BOTTOM LINE

- High Availability
- Problem avoidance
- Reduced MTTR
- Reduce SME dependence for issue detection
Anomaly Detection – Deep Dive

Let data do the work for you

- Utilize Historical data
- Define bands of Likely and unlikely values
- Map real time metric streams against system defined normal
- Multi-point alerts generated using industry-standard Western-Electric rules
- Make static thresholds optional!

Unlikely

Less Likely

Most Likely

Typical

Volatility

Anomaly

Tasks ready to be dispatched

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USE CASE:
As someone owning IT operations and responsible for technology progress, my MF systems should exploit platforms like Linux (X86 & Z) to offload data processing and non essential management capabilities. Lack of this capability limits the ability to extend the strengths of the mainframe with next generation technology that is supported on Linux.

PROBLEM
- “Help me deploy your analytics solution in hours not days”
- “No significant increase on my teams workload, we are not linux experts”
- “We plan to expand our z ecosystem to include Linux and require tools to leverage our strategy”
- “Ensuring technology progress without losing the reliability/security of MF is high value goal”
- “Ensure analytics solution do not increase my operations costs significantly”
Simplified Deployment – Minimize Cost and Risk

**z/OS**

**EXISTING PRODUCTS**
- Performance Management
- Database Management
- Storage Management
- Web-based UI

**ANALYTICS STREAM**
- Metric Baseline
- Aggregation
- Anomaly Detection
- Historical Data

**Correlations**
- Software Virtual Appliance

**BENEFITS**
- Low Cost computing
- Non-Invasive
- Retains Security
- Setup in Minutes

**SOLUTION**
- Virtual appliance
- Containerized Plug-n-play
- Simple Config GUI

**ANALYTICS**
- Correlations
- Baseline
- Aggregation
- Anomaly Detection
- Historical Data
Business Service Perspectives & Topology Views

SOLUTION
- Monitor service level metrics
- Analyze metrics with ability to drilldown across entire topology
- Track and prioritize events affecting services, consolidate alerts
- Correlate metrics via machine learning
- Quick root cause analysis and reduced MTTR

BOTTOM LINE
- Reduced MTTR
- Reduce SME dependence for issue triage/investigation
- Improved end user experience
Expert Systems – Intelligent Mainframe

**SOLUTION**

1. Assisted triage that helps faster RCA, reduced MTTR and facilitates better decisions
2. Utilize correlation data science to find clusters of alerts and relationships
3. Leverage machine learning & your data to the system triage and isolate the problem
4. System learns from experts, helps onboard junior staff faster

**BENEFITS**

- Reduced MTTR
- Higher productivity of junior staff
- Transfer of Tribal knowledge to an expert system
- Lower costs of operations, no increase in risks
Wrap Up and Key Takeaway
Mainframe Operational Intelligence & DB2 Tools

LEVERAGE DATA
ITS YOUR ASSET

MOVE FROM REACTIVE
TO PROACTIVE

DETECT ANOMALIES
AVOID PROBLEMS

Expert users with decades of experience
Highly customizable, flexible toolkits
Basic software intelligence
Inexperienced users new to Mainframe
Tools that guide users to decisions
Predictive software intelligence

We Invite you to participate in Design@CA and Tech Preview!
Mainframe and Workload Automation

For more information on Mainframe and Workload Automation, please visit: [http://cainc.to/9GQ2JI](http://cainc.to/9GQ2JI)
## Recommended Sessions

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