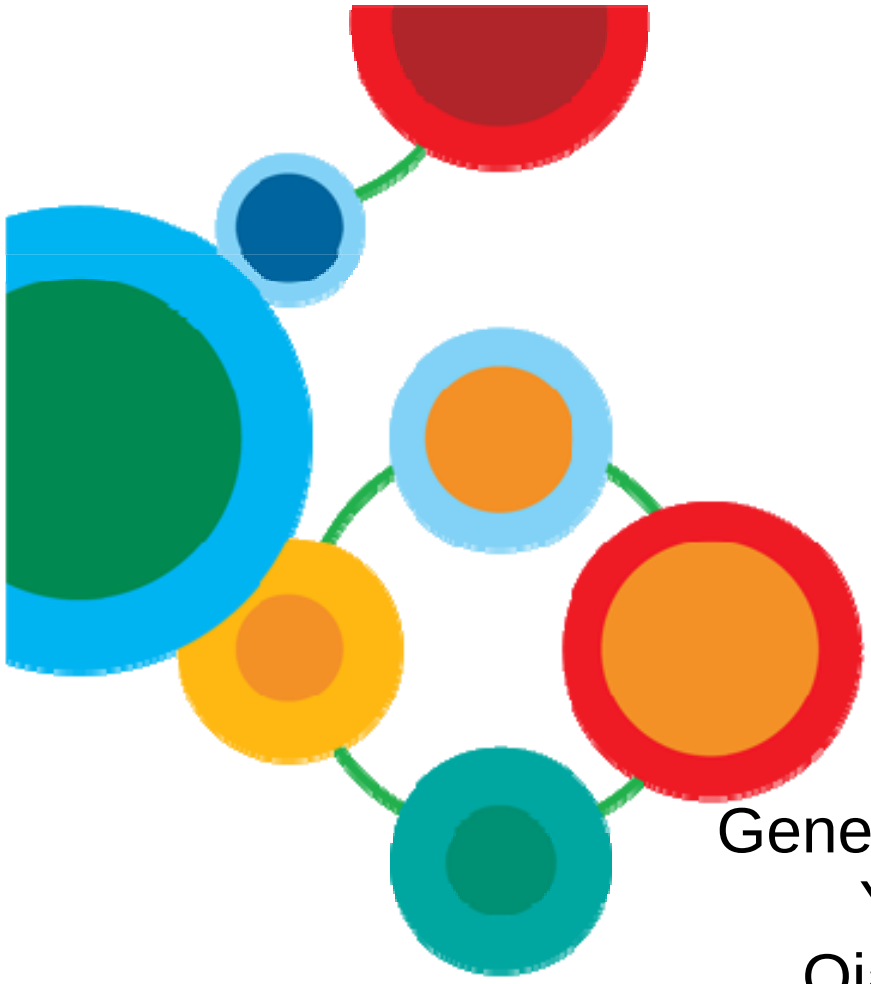

SQL Performance Tuning with Optim Query Tuner In a Top Bank In China

IDZ-1597

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IBM Software
Information On Demand 2011

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Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.

Agenda

- Customer Profile and Performance Challenges
- SQL Tuning Practice with Optim Query Tuner
- Managing Access Path Stability – To Be Continued
- Conclusion

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Customer Profile

- One of the top banks and large z installations in China
  - Host core banking application on DB2 9 for z/OS
  - More than 500 million accounts
  - Peak transaction volume: 100 million/Day and 3,000/Sec.
  - More than 6000 packages and 1500 tables in the core banking application
  - Rapid business growth drives application change and MIPS increase
- In-depth z skills available in house
- In transition to host other banking applications on z

Challenges in SQL Tuning

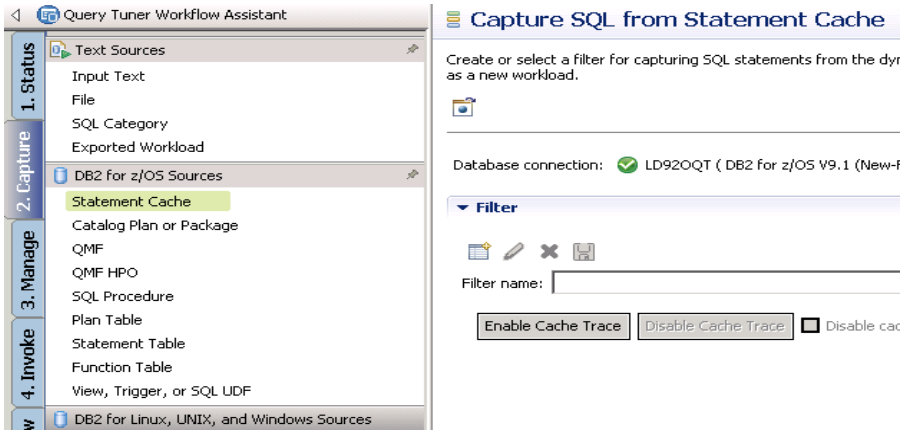
- 'Incremental tuning' for relevant statements
  - Most static SQL statements are simple and well-tuned
  - New tables could be added over the time
  - Existing tables could be changed as well
  - Perform SQL tuning against 'relevant' SQL statements

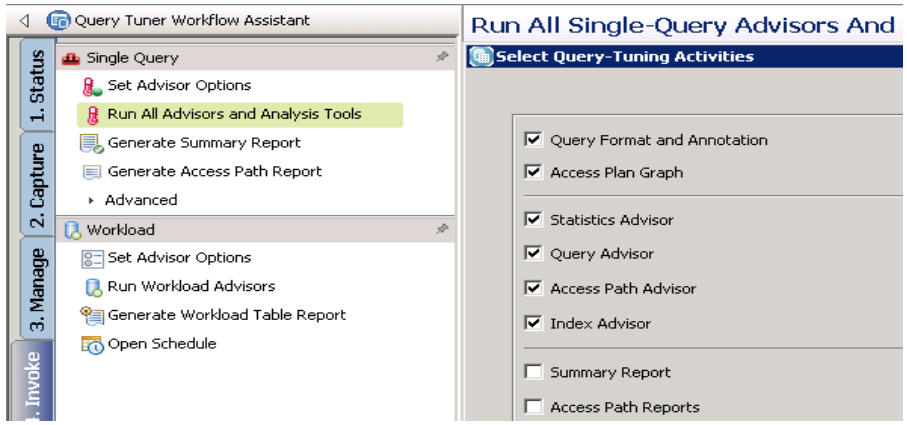
- SQL tuning for 'problem' packages
  - Baseline performance obtained through OMPE
  - Performance comparison at package level
  - Perform SQL tuning for 'top-N' packages or 'problem' packages

- Tuning for run-away dynamic SQL statements
  - Identification of poorly-performing queries
  - Fast diagnosis and analysis

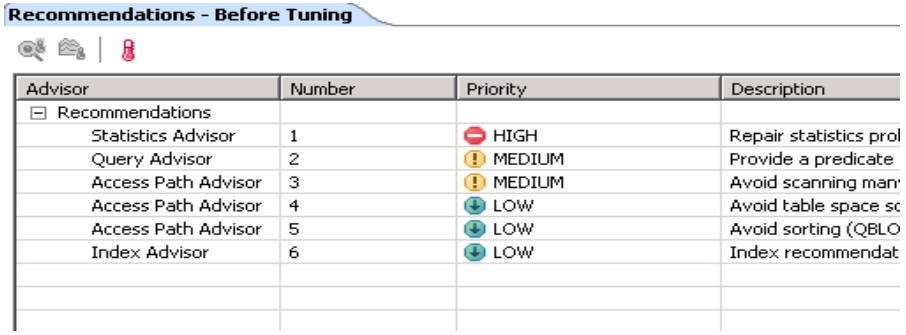
Streamlined SQL Performance Tuning

Identify Problem Query → **Tune Problem Query**

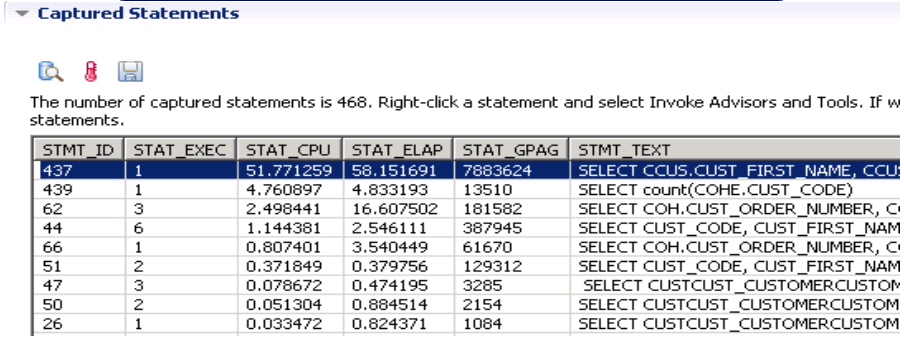




Implement Recommendations → **Validate Improvement**

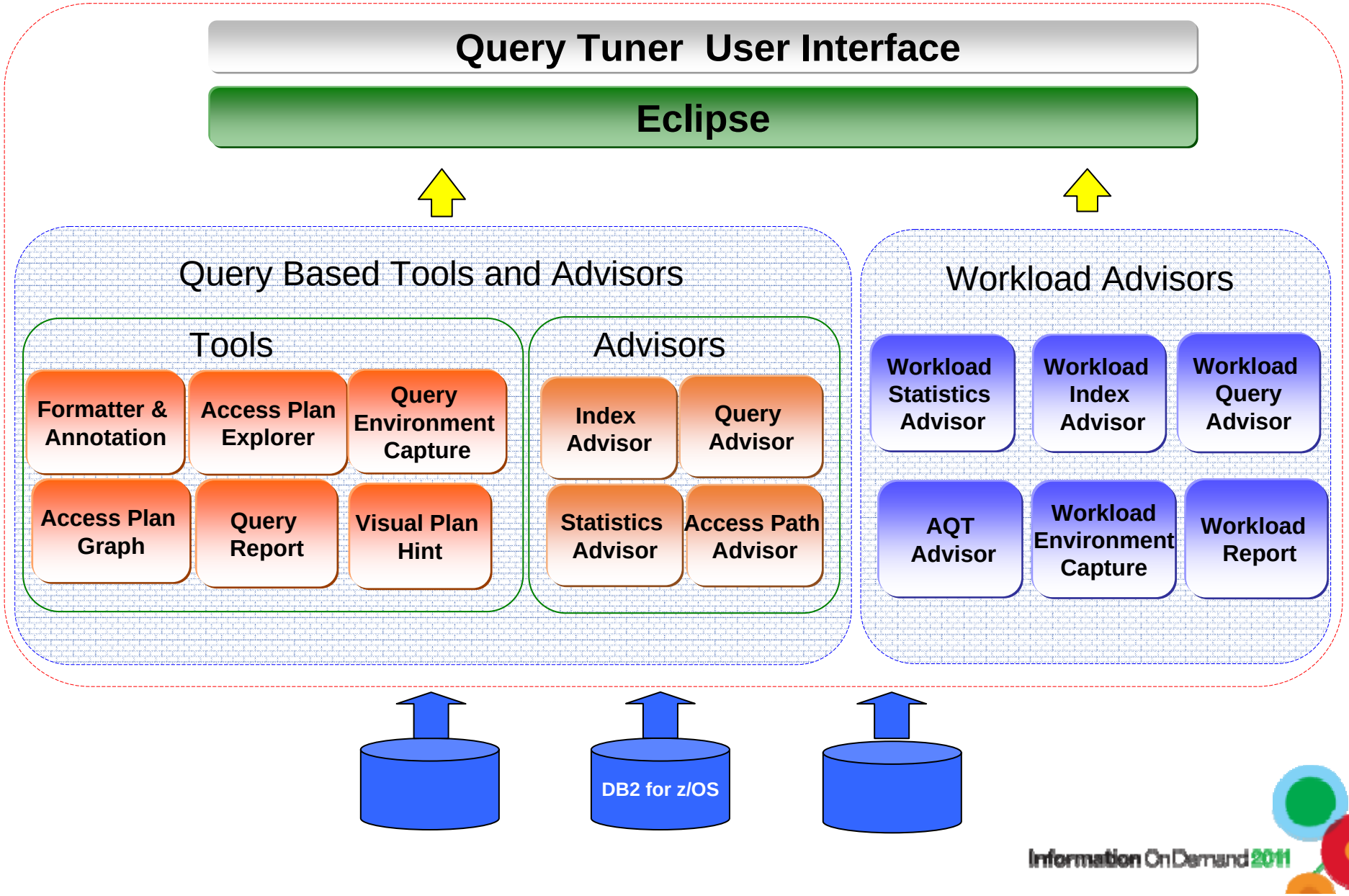


Advisor	Number	Priority	Description
Recommendations			
Statistics Advisor	1	HIGH	Repair statistics prol
Query Advisor	2	MEDIUM	Provide a predicate
Access Path Advisor	3	MEDIUM	Avoid scanning mar
Access Path Advisor	4	LOW	Avoid table space sc
Access Path Advisor	5	LOW	Avoid sorting (QBLO
Index Advisor	6	LOW	Index recommendat



STMT_ID	STAT_EXEC	STAT_CPU	STAT_ELAP	STAT_GPAG	STMT_TEXT
437	1	51.771259	58.151691	7883624	SELECT CCUS.CUST_FIRST_NAME, CCU
439	1	4.760897	4.833193	13510	SELECT count(COHE.CUST_CODE)
62	3	2.498441	16.607502	181582	SELECT COH.CUST_ORDER_NUMBER, C
44	6	1.144381	2.546111	387945	SELECT CUST_CODE, CUST_FIRST_NAM
66	1	0.807401	3.540449	61670	SELECT COH.CUST_ORDER_NUMBER, C
51	2	0.371849	0.379756	129312	SELECT CUST_CODE, CUST_FIRST_NAM
47	3	0.078672	0.474195	3285	SELECT CUSTCUST_CUSTOMERCUSTOM
50	2	0.051304	0.884514	2154	SELECT CUSTCUST_CUSTOMERCUSTOM
26	1	0.033472	0.824371	1084	SELECT CUSTCUST_CUSTOMERCUSTOM

Optim Query Tuner Key Features



Agenda

- Customer Profile and Performance Challenges
- SQL Tuning Practice with Optim Query Tuner
- Managing Access Path Stability – To Be Continued
- Conclusion

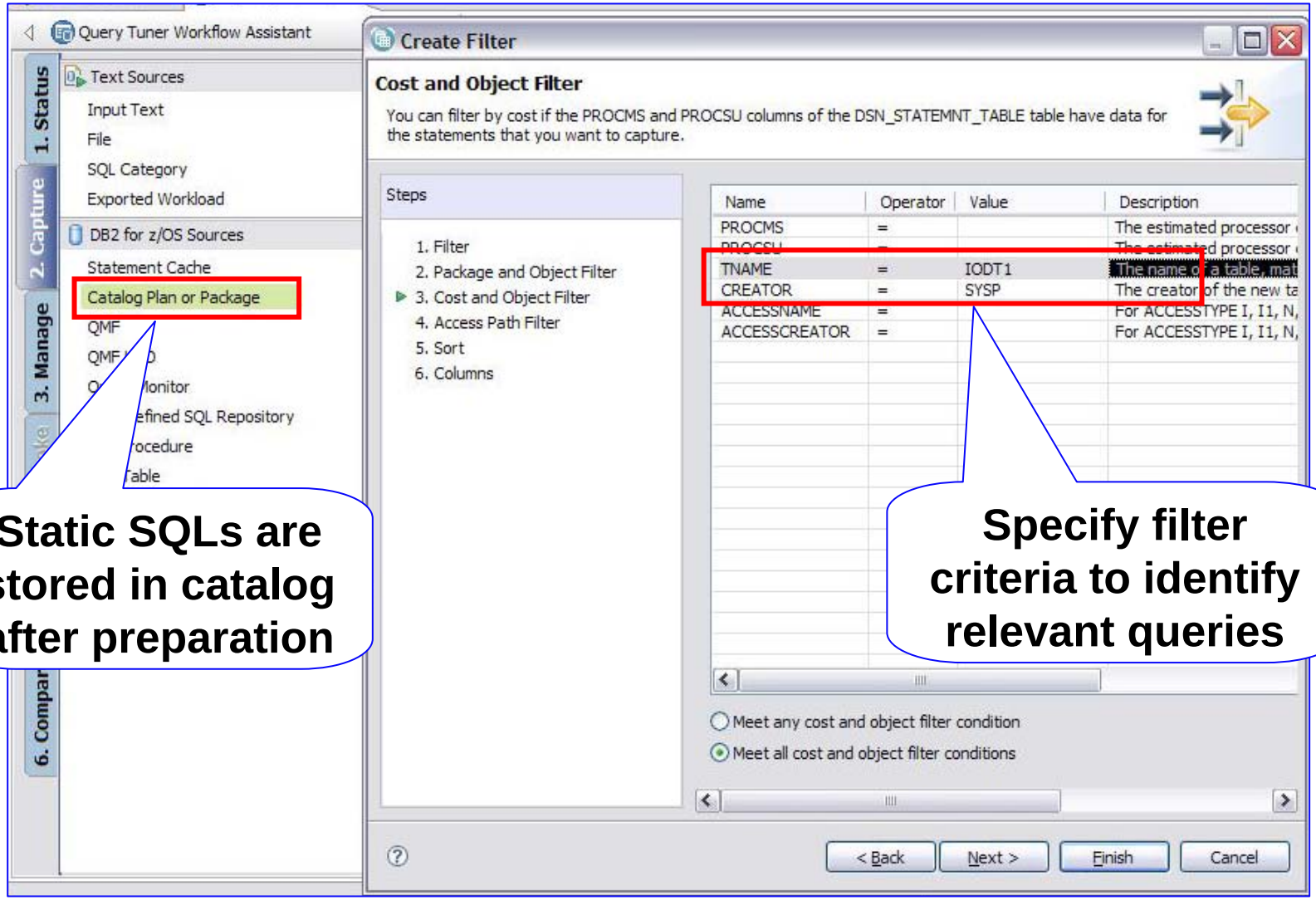
Scenario 1: Incremental Tuning

- Tuning entire application is often unnecessary
  - Large number of packages, tables, and SQL statements
  - Most SQL statements are simple and well tuned
  - Performance problem usually caused by the introduction of new tables and change to existing tables by the application team

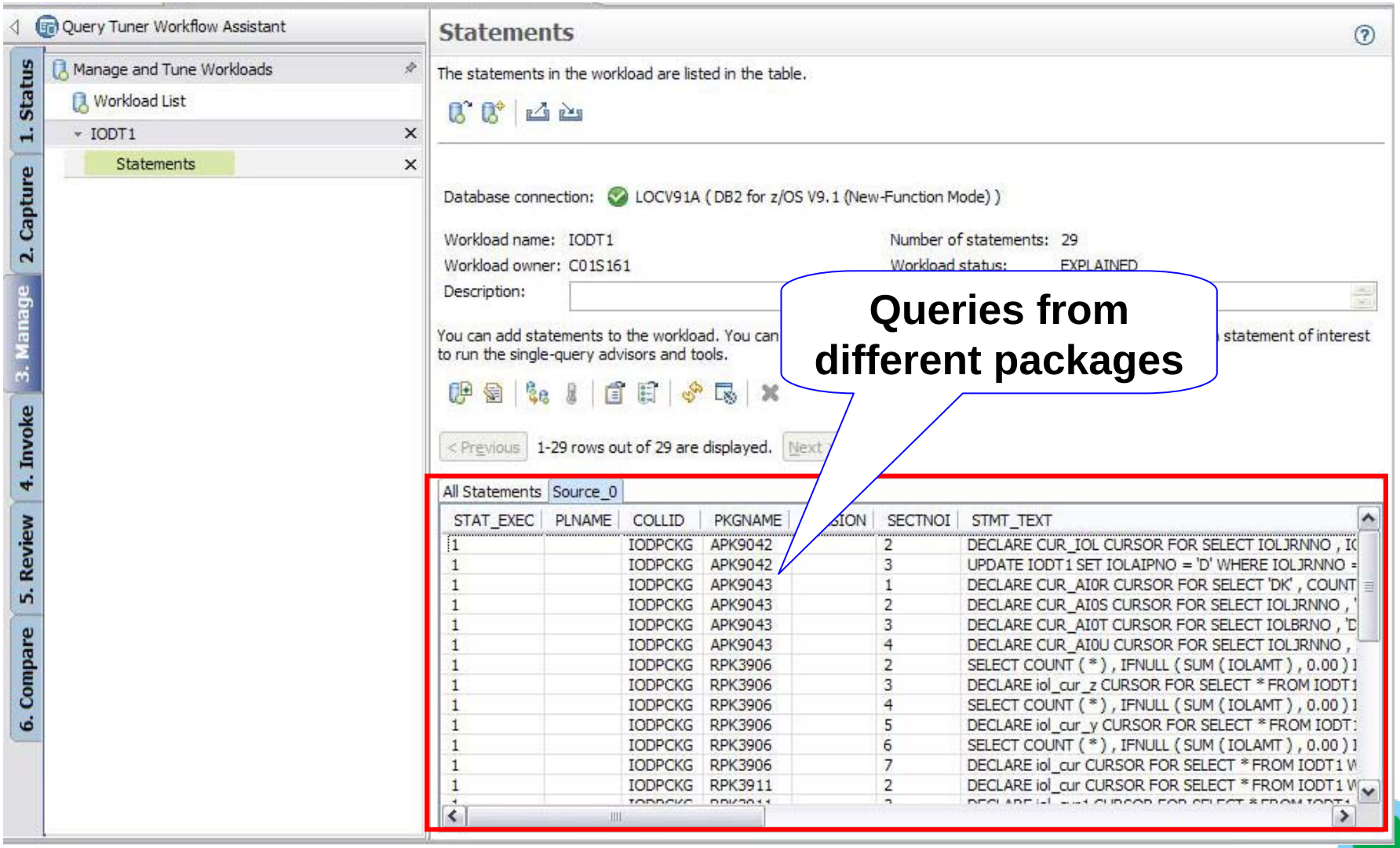
- New tables and tables changed are known by test team and production team
  - Small number of new tables added to the application
  - Small percentage of tables changed
  - Impacted statements, however, are not directly known

- It's cumbersome to find the relevant SQL statements for SQL tuning – Optim Query Tuner makes it easier

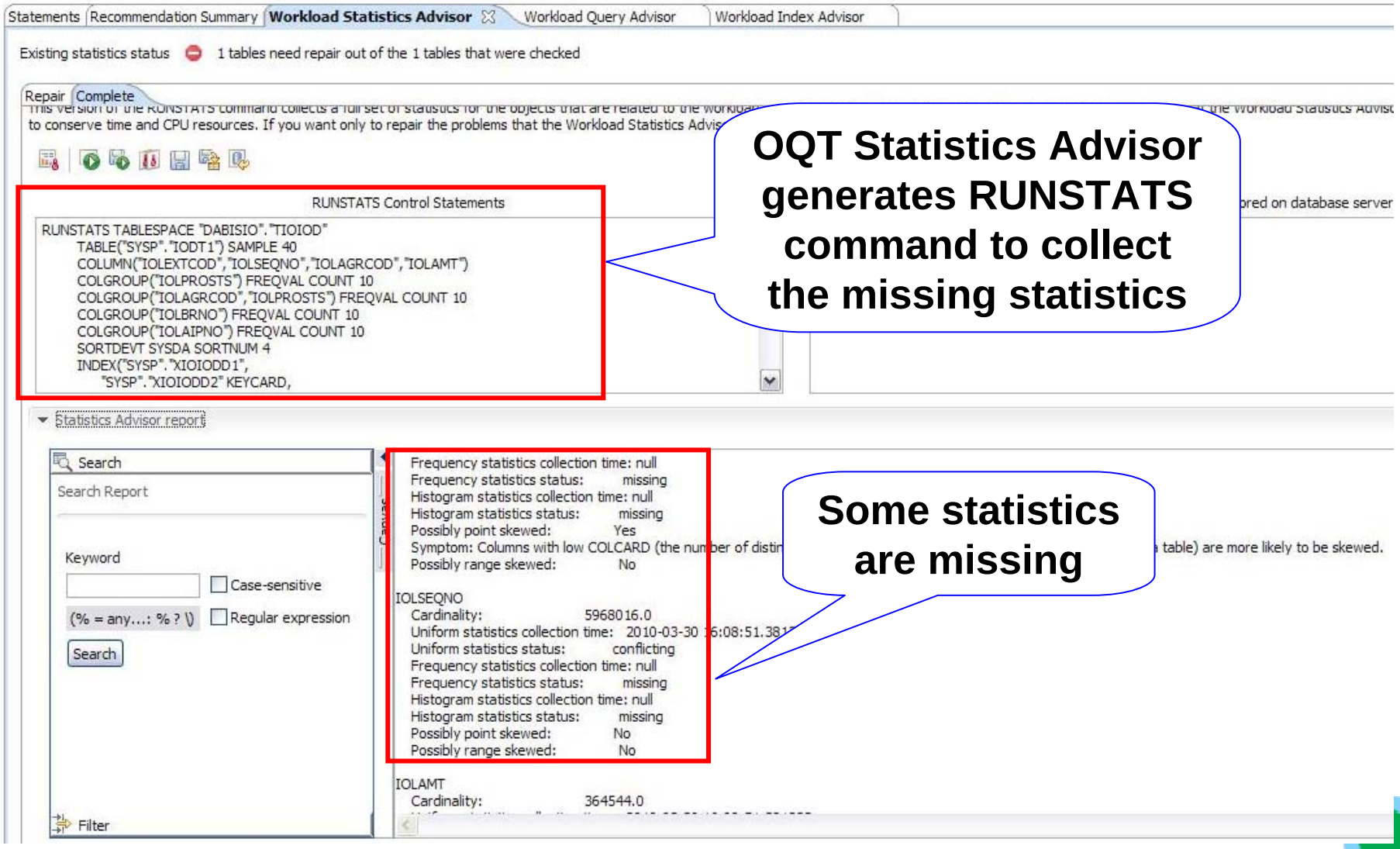
Step 1: Identify Relevant Queries



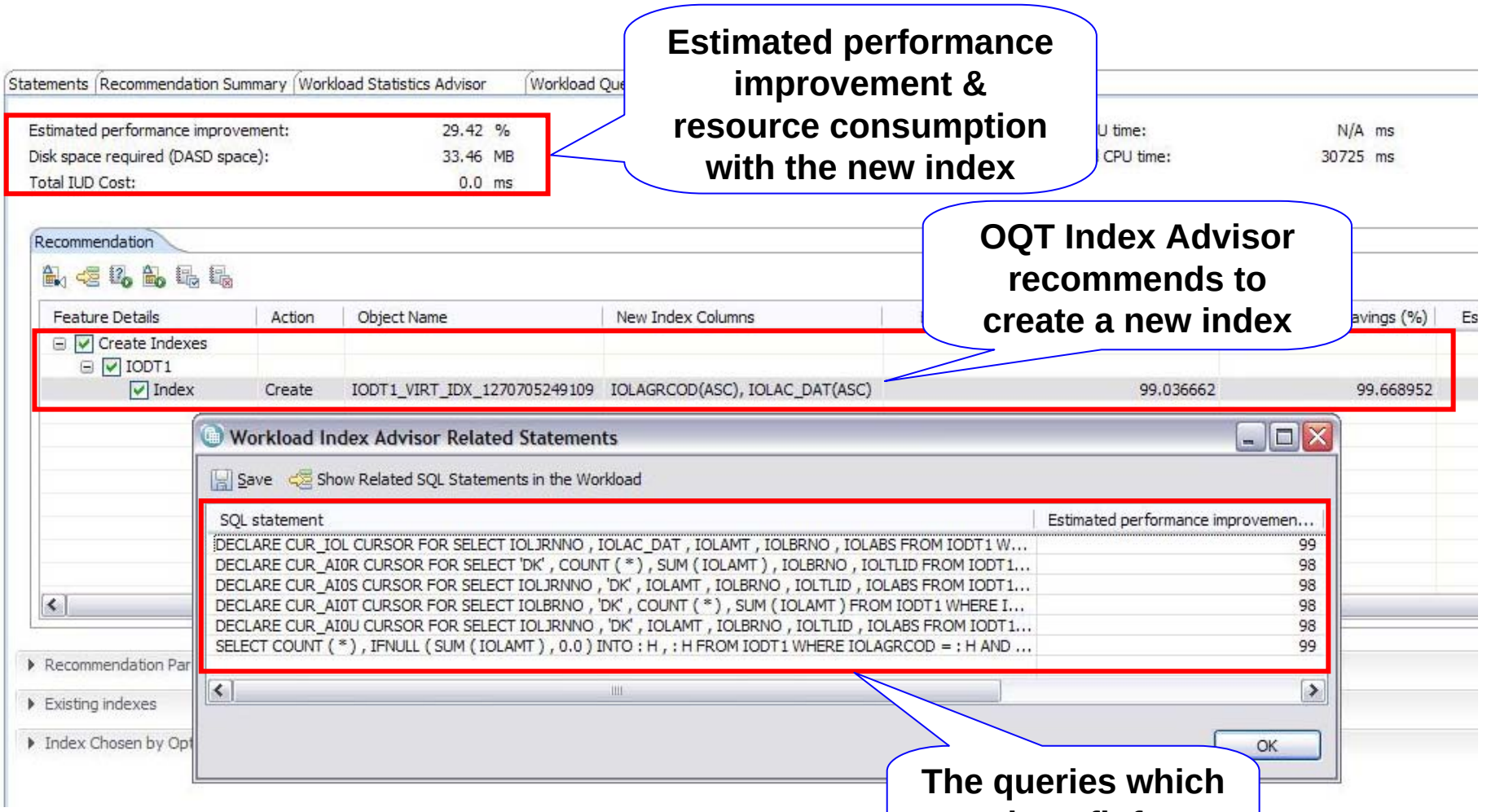
Step 2: View Captured Queries



Step 3: Analyze Statistics with OQT



Step 4: Analyze Index Design with OQT



Summary: Incremental Tuning

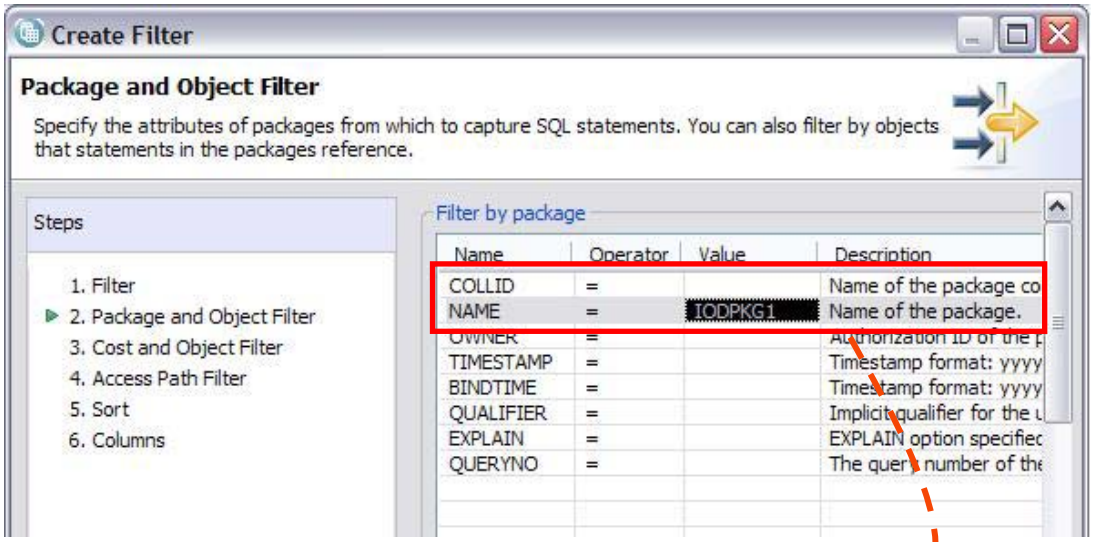
- Capture relevant statements from DB2 Catalog
  - Filter by table name and/or table creator
- Analyze captured workload with Workload Advisors
  - Workload Statistics Advisor
    Recommendation for critical statistics collection which may impact access path selection
  - Workload Index Advisor
    Recommendation for index design which could improve query performance

Scenario 2: Package-driven SQL Tuning

- Baseline performance obtained through OMPE
  - Conduct performance comparison periodically at package level
  - The ‘top-N’ packages are singled out for investigation
    - Based on increase of elapsed time or CPU time (tuning)
    - Based on consumption CPU time (optimization)

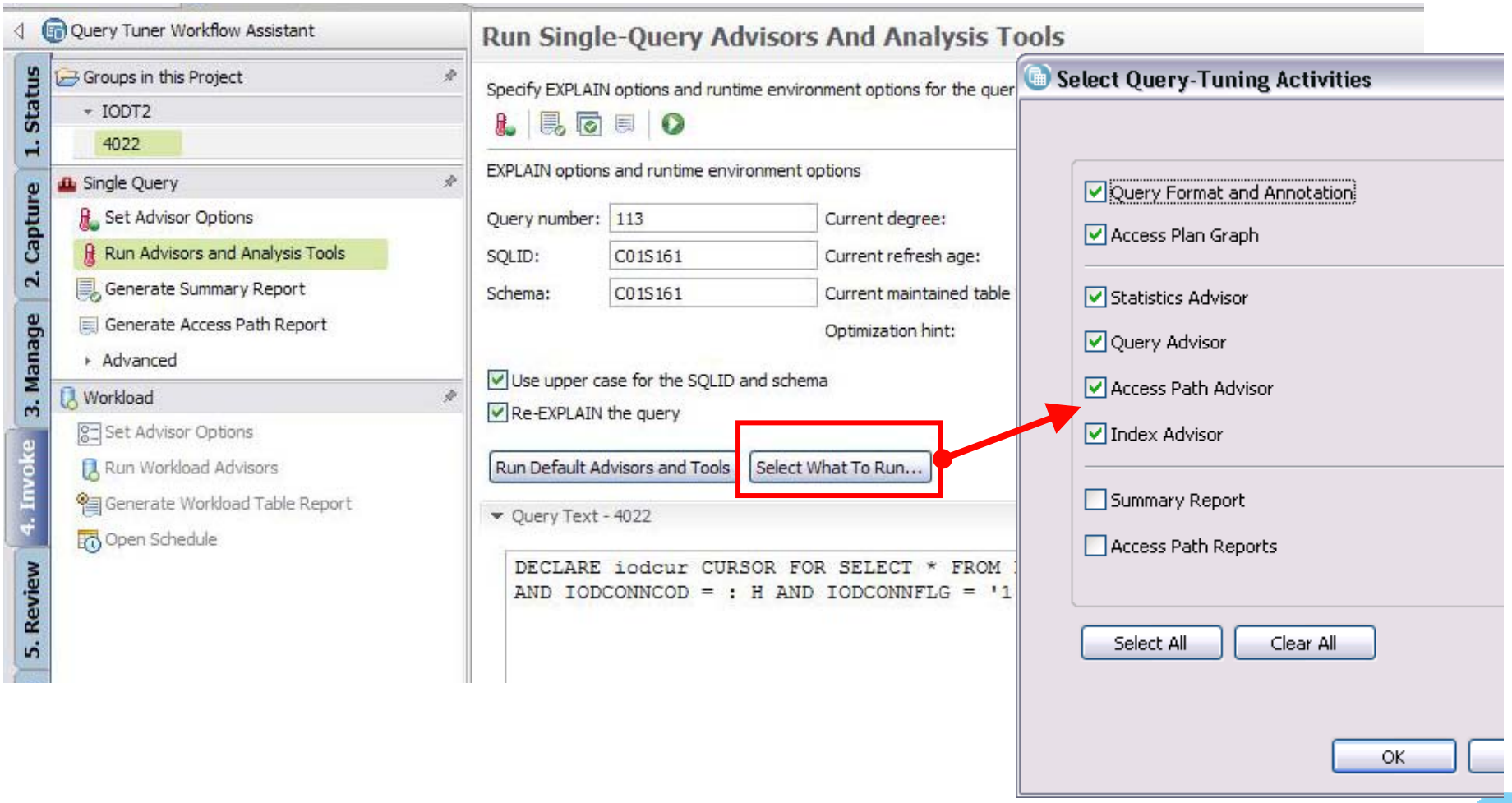
- Lack of tools to perform health check for the underlying access path of the SQL statements – Optim Query Tuner offers a viable option

Step 1: Capture Problem Queries from Package



Filter by package name and potentially 'bad' access path operations

Step 2: Perform ‘Health Check’ with OQT



Step 3: Review Problem SQL with OQT

Original | Transformed

The DB2 optimizer suggests the following revision of the query.

Annotations to display: All

Formatted Query	Annotation
SELECT *	
FROM SYSP.IODT2	CARDF=4,284,907 QUALIFIED_ROWS=1 NPAGESF=306,083
WHERE (SYSP.IODT2.IODCONNCOD = ?	COLCARDF=507,904 MAX_FREQ=(missing) FF=0.000002
AND SYSP.IODT2.IODPROCOD = ?	COLCARDF=34 MAX_FREQ=10.13% FF=0.029
AND SYSP.IODT2.IODCONNFLG = '1'	COLCARDF=3 MAX_FREQ=(missing) FF=0.333
)	
ORDER BY SYSP.IODT2.IODCONTNO ASC	
WITH UR	

Formatted Query

Query Annotation

Access Plan Graph

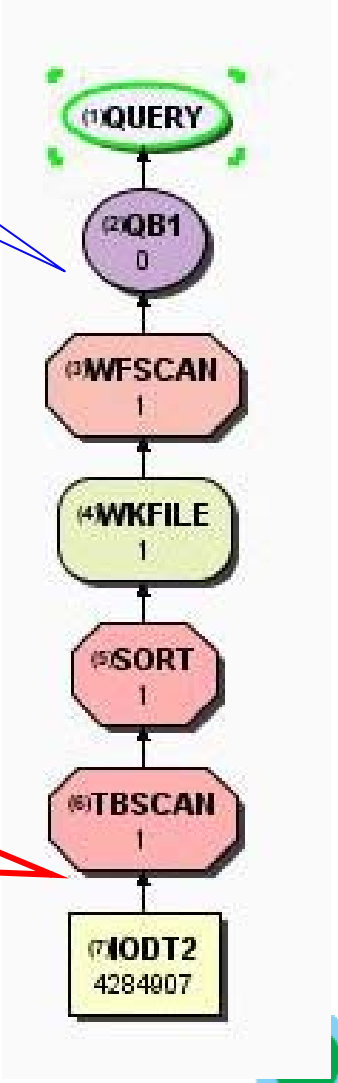
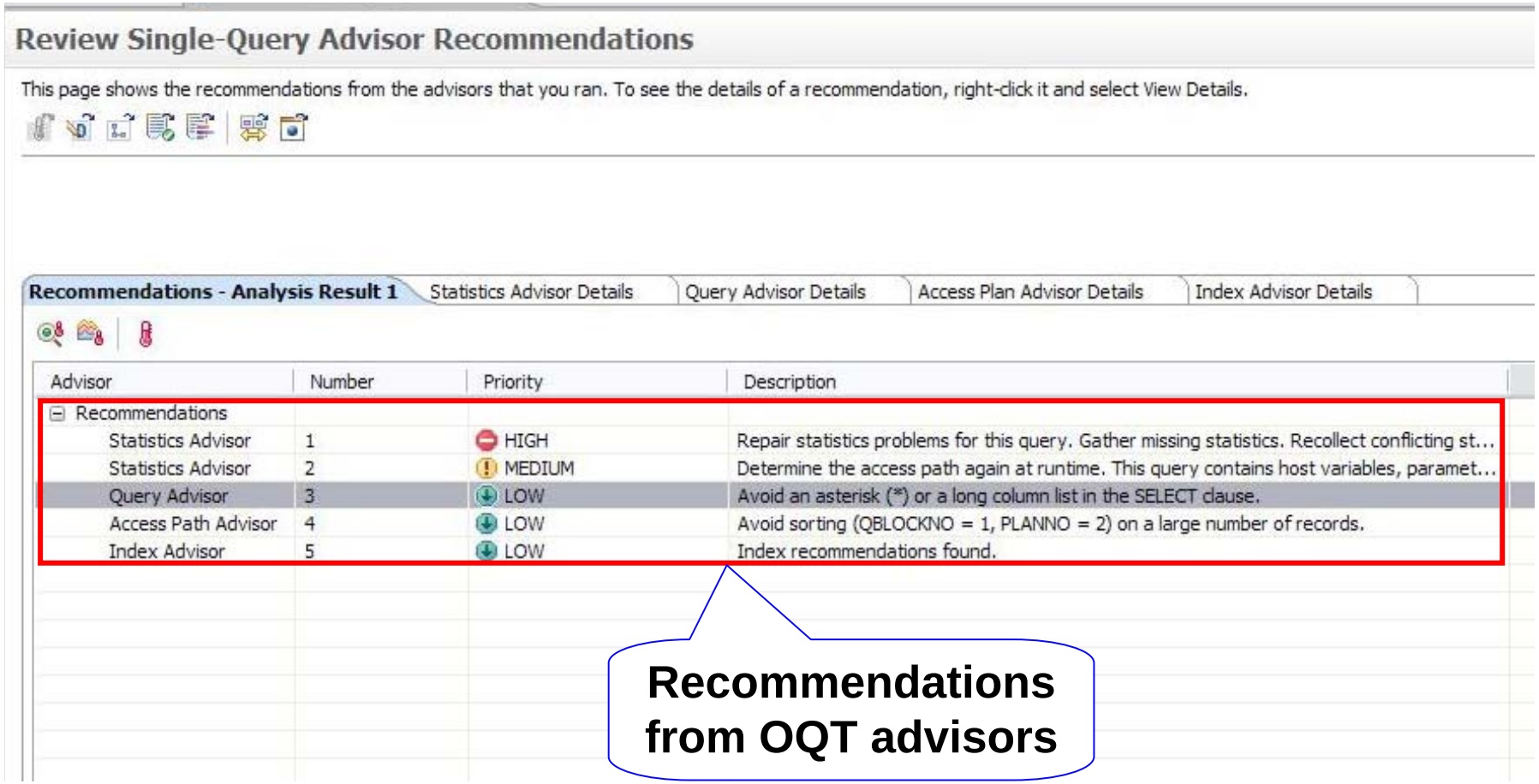
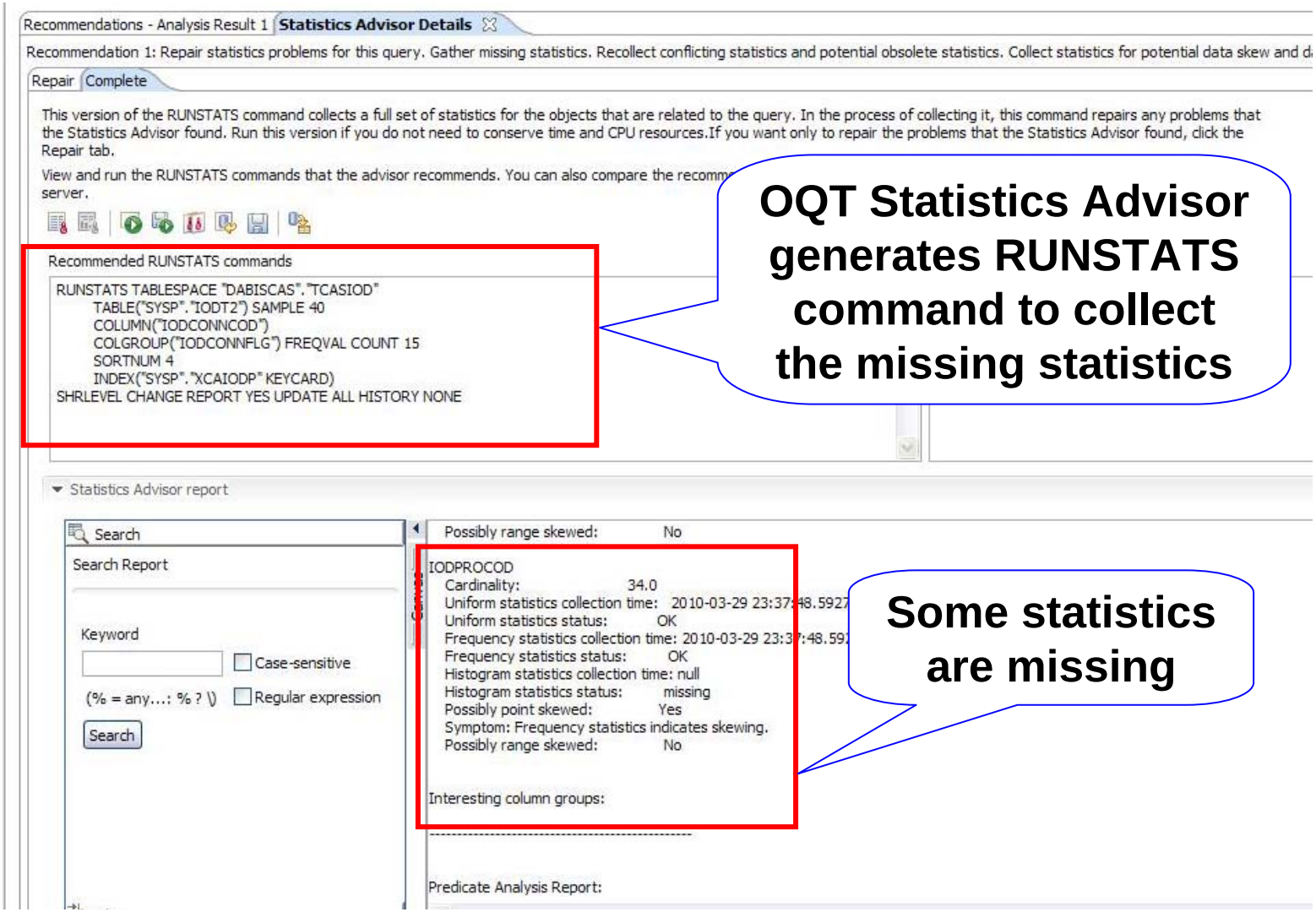


Table scan over a big table with only one qualified row!

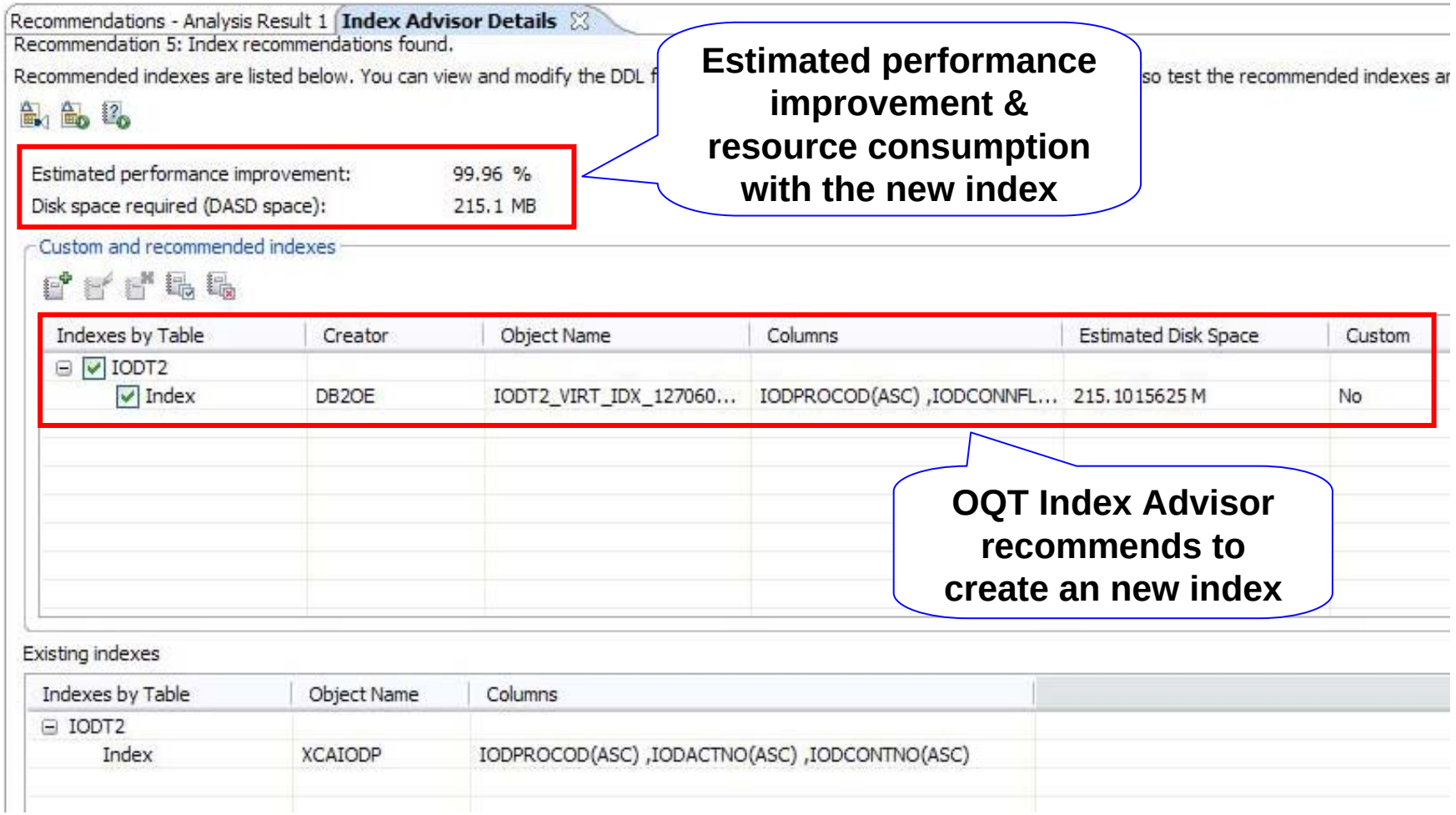
Step 4: Review Heath Check Report



Step 5: Drill Down to Statistics Report



Step 6: Drill Down to Index Report



Summary: Package-driven SQL Tuning

- Use OMEGAMON XE to identify packages for SQL tuning

- Search for queries with ‘catchy’ plan operations
  - Filter by package name
  - Filter by potential “bad” access plan
    - Table scan, Non-matching index scan, etc
  - Sort by PROCMS or PROCSU

- Perform health check with OQT for each problem SQL

- Review reports and implement recommendation

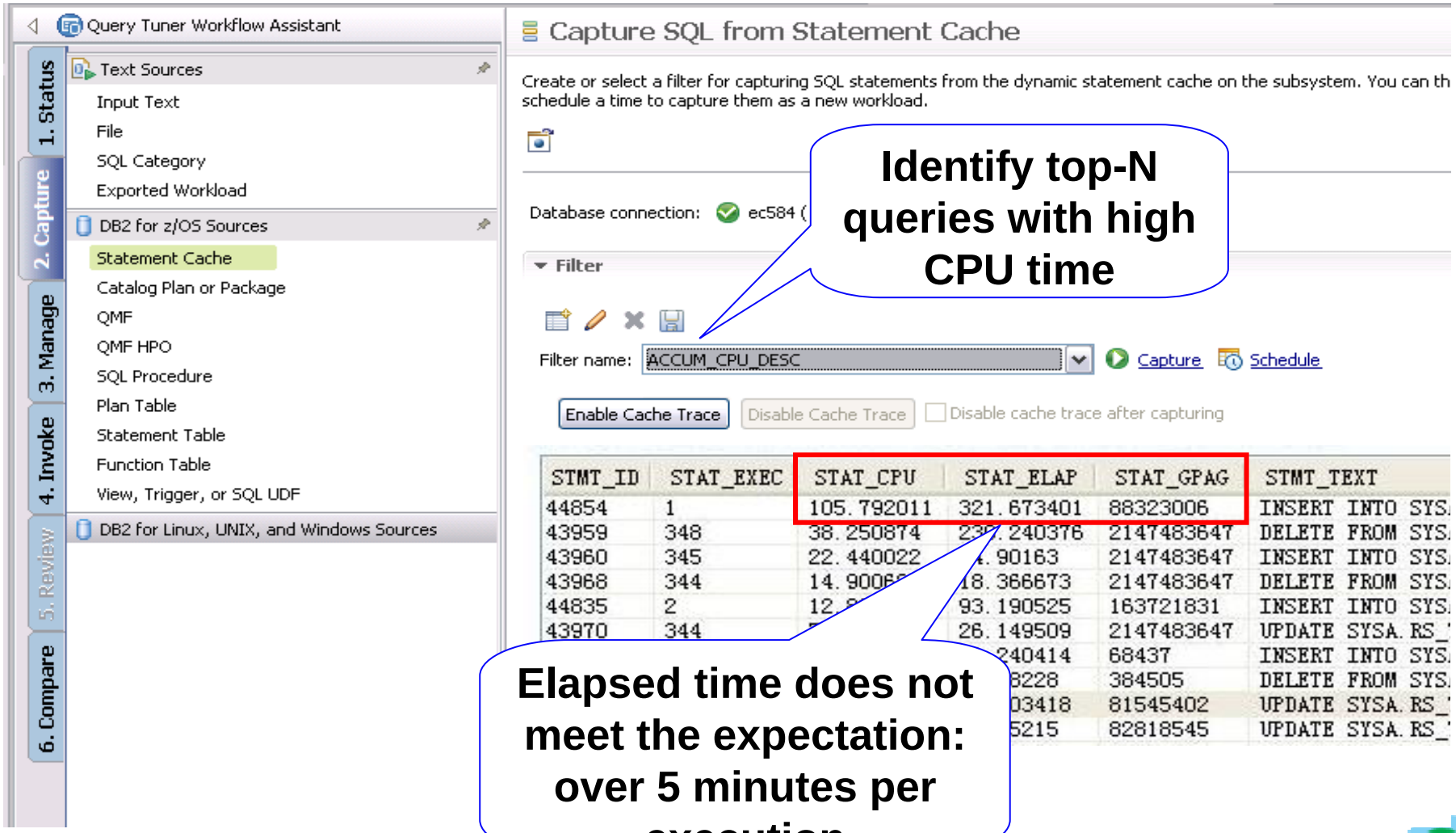
Scenario 3: Tuning Dynamic SQL Statements

- New applications contain dynamic SQL statements
  - Ad hoc dynamic queries with complex structure
  - Not as well-tuned compared to legacy applications
  - New statements introduced as part of application change

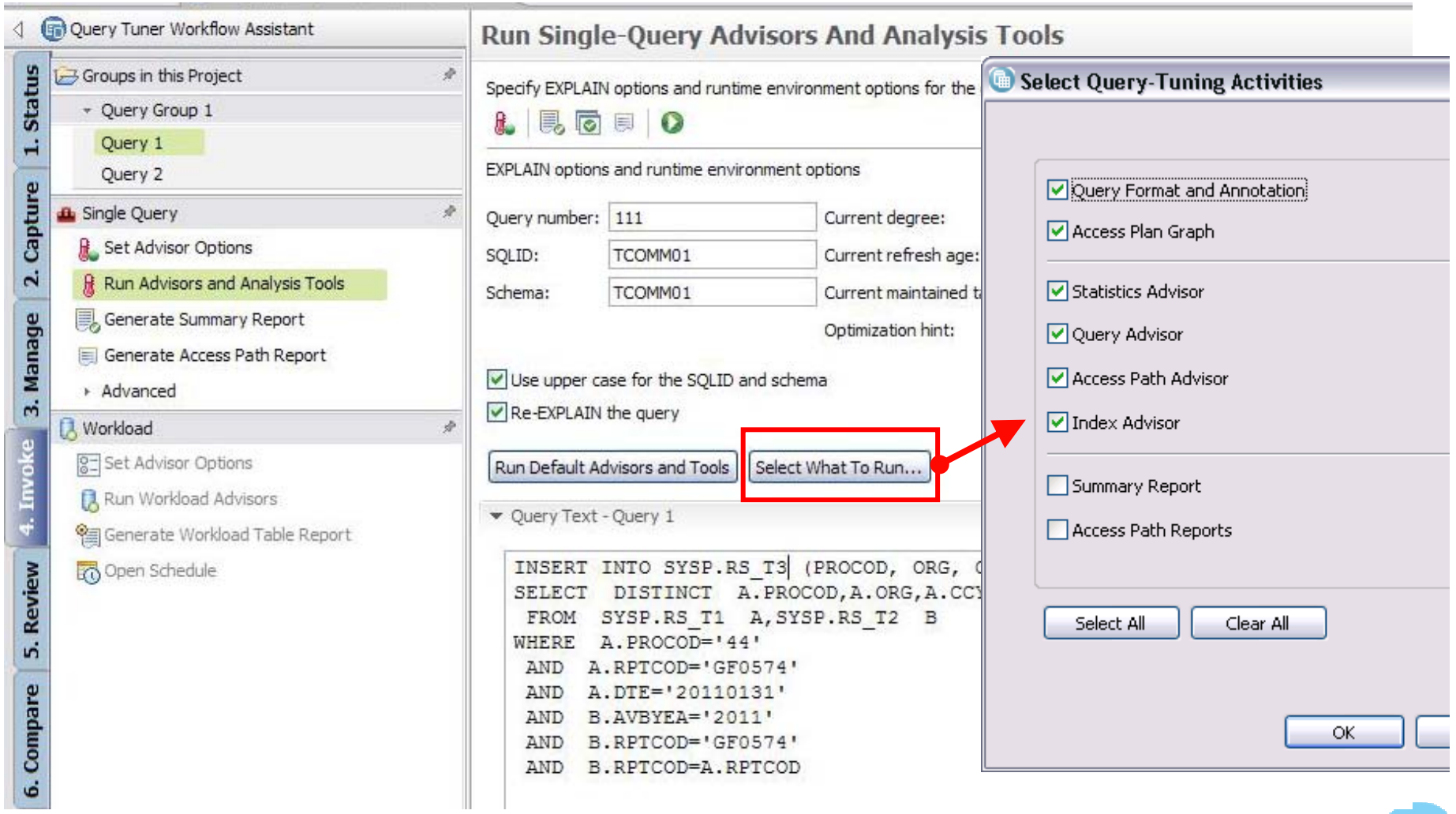
- Tuning these SQL statements is more challenging than legacy applications
  - Queries are dynamically generated
  - Queries are more complex

- Optim Query Tuner helps identify problem queries and diagnose the root cause of performance problems

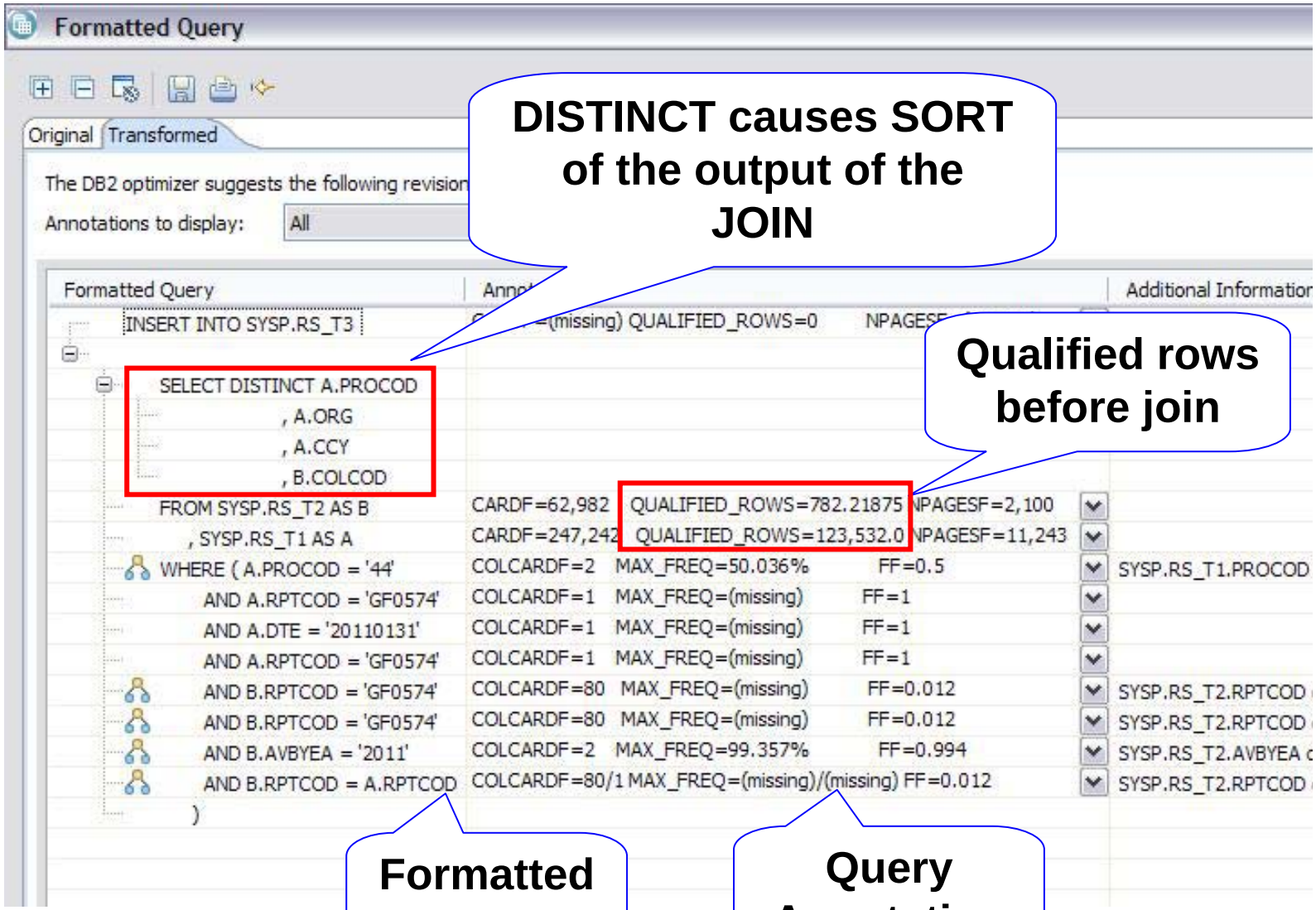
Step 1: Identify Problem Queries



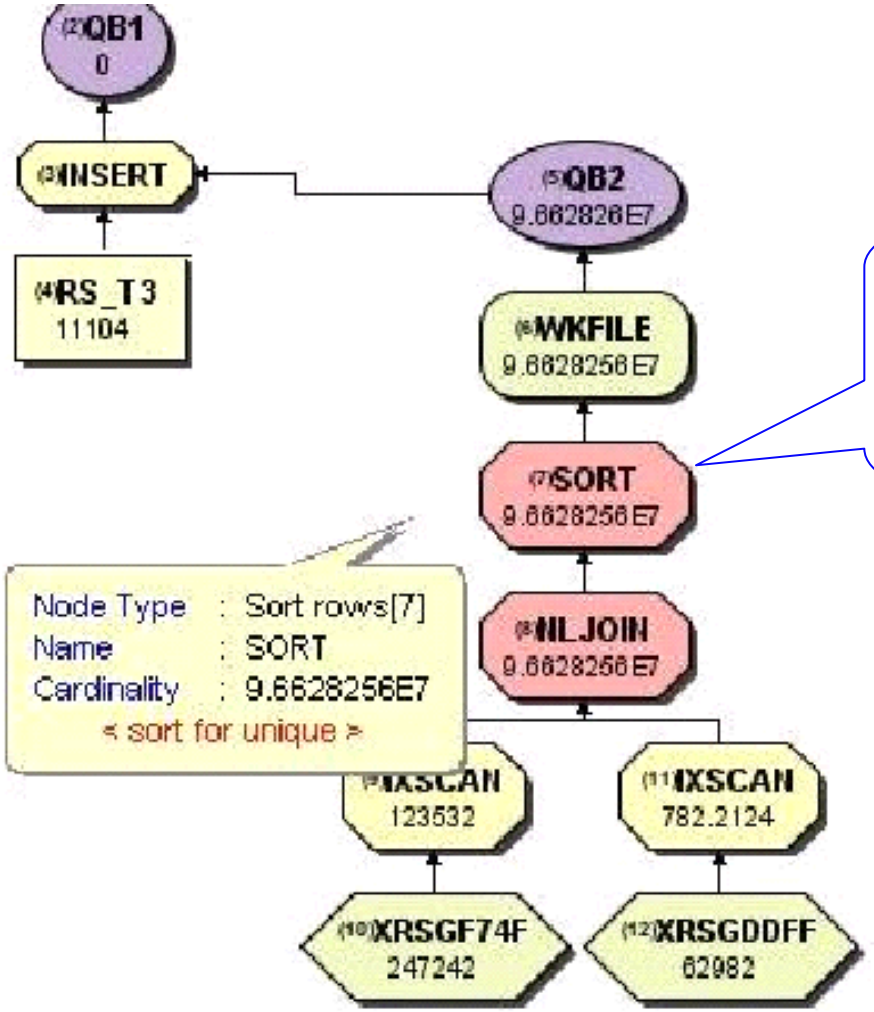
Step 2: Analyze the Problem Query with OQT



Step 3: Review the Query with QQT



Step 4: Review Access Path with OQT



Sort on join output which contains large number of records

Can the SORT be pushed down ?

Step 5: Rewrite the Problem Query

```
INSERT INTO SYSP.RS_T3 (PROCOD, ORG, CCY, DATAINFO)
SELECT T1.PROCOD, T1.ORG, T1.CCY, T2.COLCOD
FROM
(SELECT DISTINCT PROCOD, ORG, CCY
 FROM SYSP.RS_T1
 WHERE PROCOD = '44' AND RPTCOD = 'GF0574' AND DTE = '20110131') AS T1,
(SELECT DISTINCT COLCOD
 FROM SYSP.RS_T2
 WHERE AVBYEA = '2011' AND RPTCOD = 'GF0574') AS T2
```

- Push down DISTINCT to avoid large SORT
- Elapsed time reduced to 125 ms from 321.67 seconds

Summary: Tuning Dynamic SQL Statements

- Identify top-N problem queries from statement cache
  - Filter by authorization ID, runtime information, etc
  - Sort by elapsed time, CPU time, get pages, etc
- Analyze problem query with OQT
- Review problem query and the access path with OQT
- Tuning opportunity identified while reviewing the problem query with OQT
- Significant performance improvement obtained

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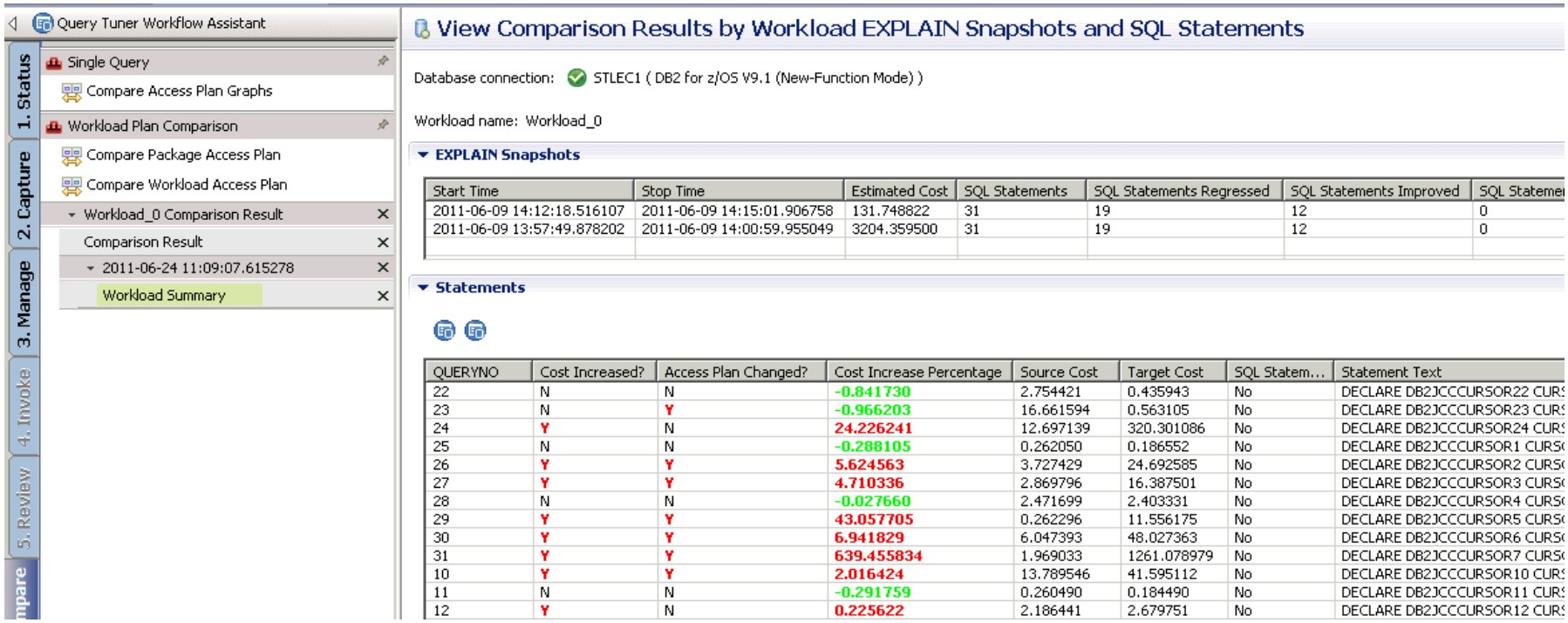
Still an Outstanding Issue with the Customer

- Massive bind/rebind takes place when
  - Migrate to a new DB2 for z/OS release
  - Apply new DB2 for z/OS maintenance level
  - Roll out application change
  - Conduct performance tuning (stats collection, new indexes, etc)

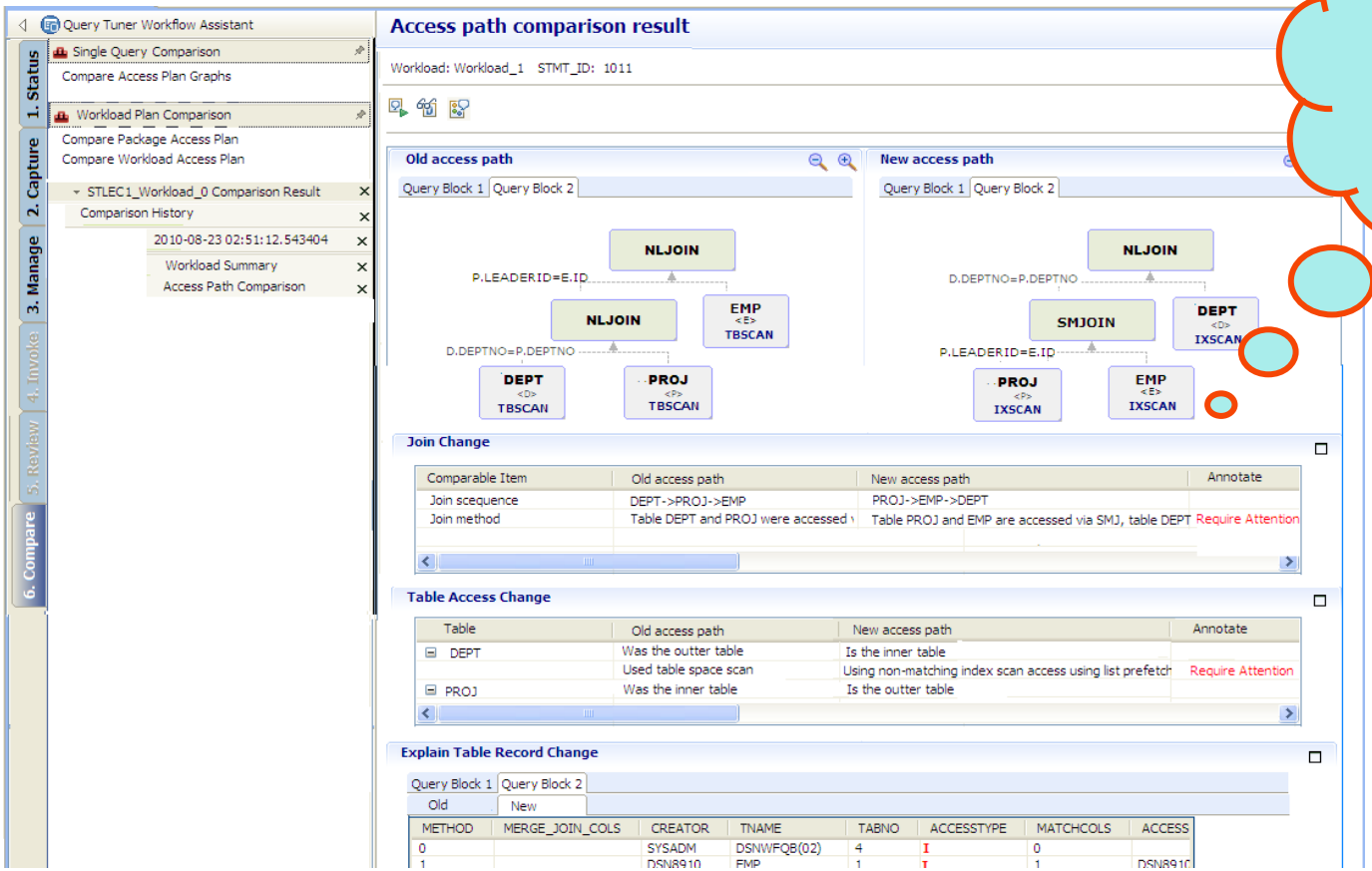
- Exposed to access path changes
  - Where access path gets changed ?
  - Changed for better or worse performance ?
  - It’s a nontrivial task

- How to manage access path stability efficiently ?

A Hypothetic Solution – Compare and Report



A Hypothetic Solution – Assess and Resolve



To Be Continued in IOD 2012!

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OQT Helps Implement Best Practices of SQL Tuning

- Collect statistics properly and diligently
  - Avoid collecting useless stats
  - Detecting conflicting stats
  - Collecting critical distribution stats and column group stats
- Design efficient indexes
  - To support efficient access with local predicates
  - To support efficient access the inner of joins
  - To support sort avoidance and index only access
- Design efficient predicates and queries
  - Predicate application (indexability and stage-1)
  - Predicate transformation and localization
  - Query rewrites which are not supported yet by optimizer
- Expert tuning methodology built in the product
- Learn and implement best practices for SQL tuning with Optim Query Workload Tuner

Resources

- Tuning SQL with Optim Query Tuner
  - http://www.ibm.com/developerworks/data/library/techarticle/dm-1006optimquerytuner1/
  - https://www.ibm.com/developerworks/data/library/techarticle/dm-1105optimquerytuner2/
- SQL Tuning, Not just for hardcore DBAs anymore
  - http://www.ibmdmmagazinedigital.com/dmmagazine/
- IBM Optim Query Workload Tuner web page
  - https://www-01.ibm.com/software/data/optim/query-workload-tuner-z/
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  - http://www.ibm.com/developerworks/spaces/optim

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