Optimizing BEx Query Performance for SAP HANA

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In This Session

- If you are implementing a fresh SAP BW on SAP HANA system, or after you have finished upgrading to SAP BW on SAP HANA, the key design philosophy to keep in mind is LSA++
- LSA++ architecture results in reduction of layers, but along with that it is important to understand a few other query settings that can have a great impact on query performance in your SAP BW on SAP HANA system
- This session brings you practical tips to optimize the performance of your existing BEx queries and more on related topics

What We'll Cover

- Introducing SAP BW 7.4 SP11 on SAP HANA
- Learning to evaluate query performance and tuning BEx queries to run better on SAP HANA
- Evaluating the new query design tool available in SAP BW 7.4 and getting best practices for designing SAP HANA optimized queries
- Understanding the SAP HANA analytic process and learning to leverage analytic manager to enable advanced analytic capabilities
- Wrap-up

Introduction to SAP BW 7.4 powered by SAP HANA SP11

- Why the combination of SAP BW 7.4 and SAP HANA is so fascinating
- Overview of new technical capability
- Converting new features into your advantages

What Is New with SAP BW 7.4

- Enhanced Data Modeling
  - Common Eclipse-based modeling tools
  - SAP BW/HANA Smart Data Access providing the logical EDW
  - Easy integration of external data models with Open ODS Layer
  - Further reduce data layers in SAP BW via Operational Data Provisioning
  - New Composite Provider
- Push down further processing logic to SAP HANA
  - SAP BW Analytic Manager
  - SAP HANA Analysis Processes
  - SAP BW Transformations
  - PAK (Planning Application Kit) – Pushing down more planning semantics

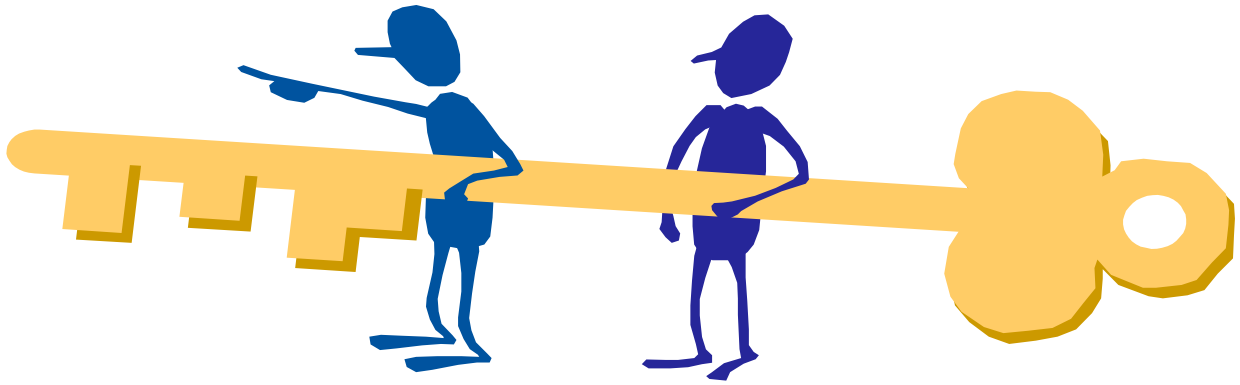
SAP BW 7.3 vs. SAP BW 7.4

Features	BW 7.3	BW 7.4 SP5
BEx 3.x	Supported	Not Supported
Character Length	60 Characters	250 Characters
Long Text	60 Characters	1333 Characters
Open ODS layer	n/a	New feature
Eclipse-based modeling tool	n/a	New feature
Mobile Enablement	Limited	Enhanced
Converged planning solutions (i.e., BPC unified)	n/a	New feature
PSA layer	Required	Optional

SAP BW 7.4 and SAP HANA: A Power Couple

Let's look at the greatest drivers for enterprise synergy resulting from the combination:

- **Speed (from SAP HANA)**
  - Without having to design a classic star schema



- **Simplification (from SAP HANA)**
  - Eliminates the necessity for multi-staged persisted data processing

SAP BW 7.4 and SAP HANA: A Power Couple (cont.)

- **Available Content (from BW):** Over the years the business content for SAP BW has grown significantly – this can be used instantly by SAP HANA

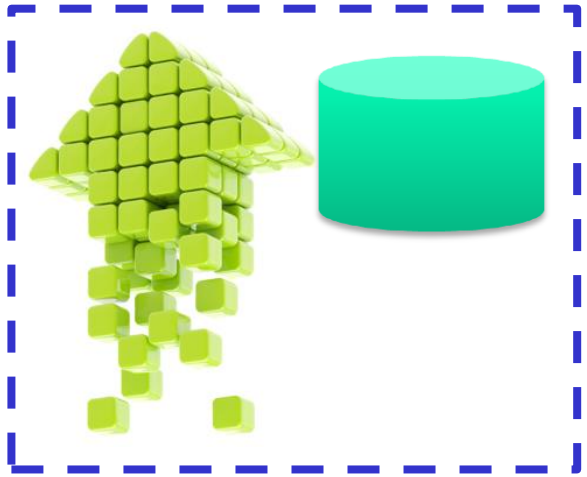
- **Governance (from SAP BW):** SAP BW has a strong foundation in terms of data and structure relationships. This can be used as an advantage in the SAP HANA environment too.

LSA++ Open ODS Layer

- Integrate data into the EDW with more
- Extensive and Flexible options …

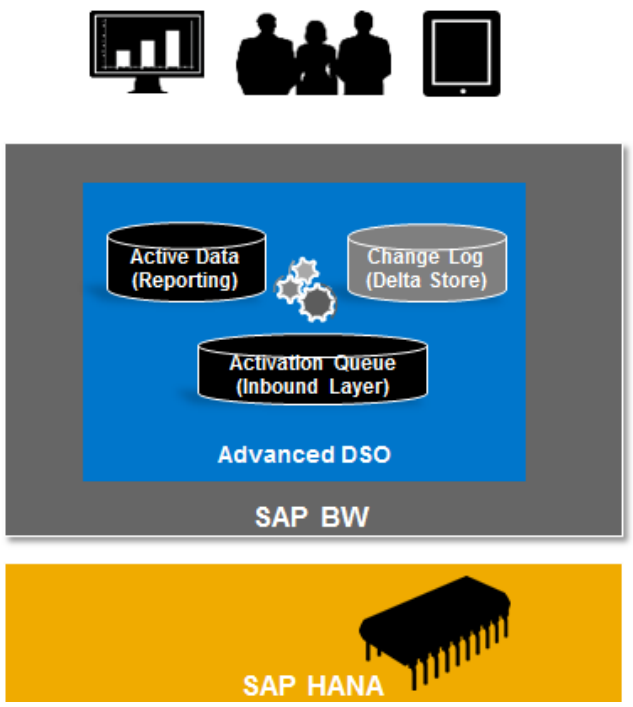
DataSources can be consumed virtually into an Open ODS View

Combined with BW InfoObjects or Models



Generate DataSource from the Open ODS View and ETL data into SAP BW

Advanced DataStore Object (DSO)



Source: SAP

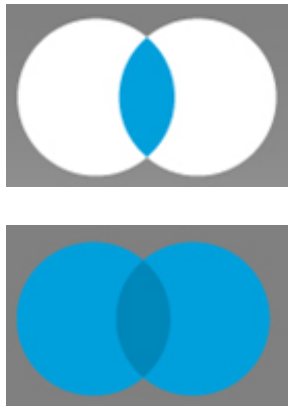
- The next generation of DataStore Object is Advanced DSO
  - Combines InfoObject and field-based modeling
  - One type of InfoProvider with different settings to consolidate DSO and InfoCubes
  - The fast, no activation requires loading of the Write Optimized DSO
  - The 3-table approach in standard DSOs
  - The "every characteristic is key" approach of the InfoCube: Supports up to 120 key fields

Advanced DSO can be used for data acquisition layer, corporate memory, data propagation, or reporting layer

The Power of Composite Providers

SAP HANA Tables/Views

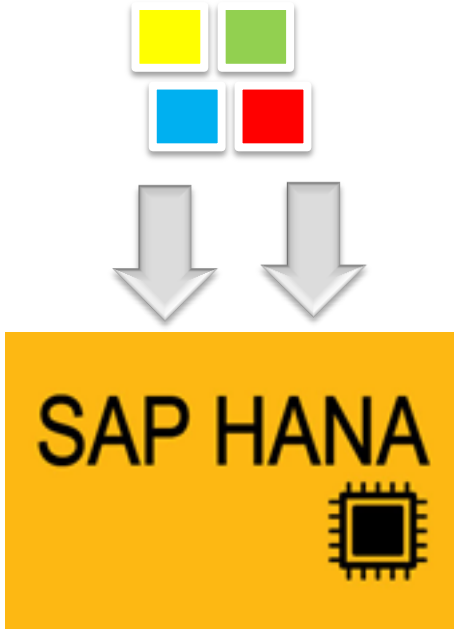
SAP BW InfoProviders



Union
and
Join

MultiProvider
InfoSet
Transient Provider
Virtual Provider

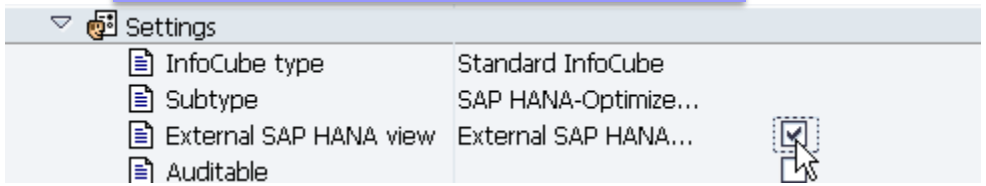
Composite
Provider



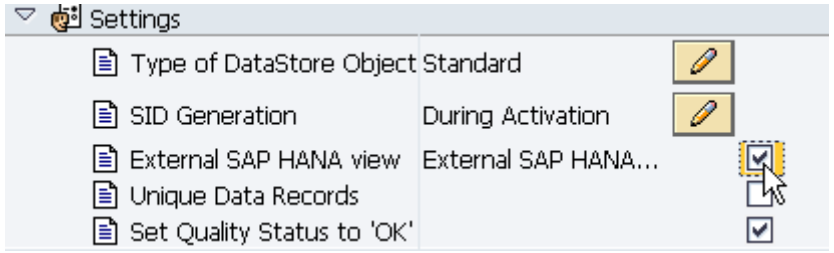
Composite
Provider
is fully
processed
in SAP HANA

Automatic HANA View Generation

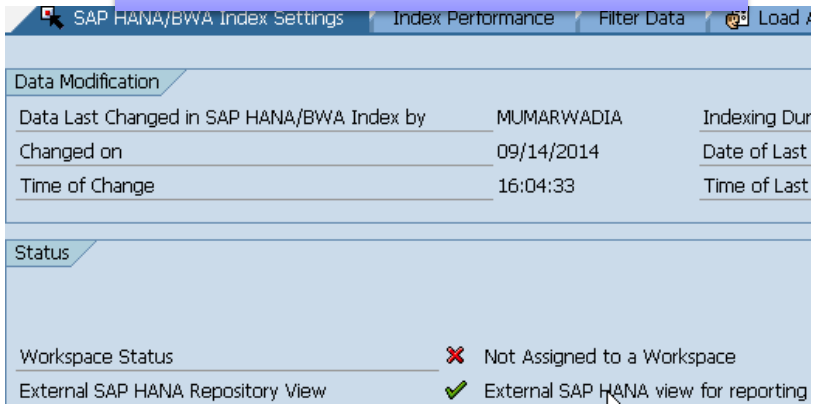
InfoCube



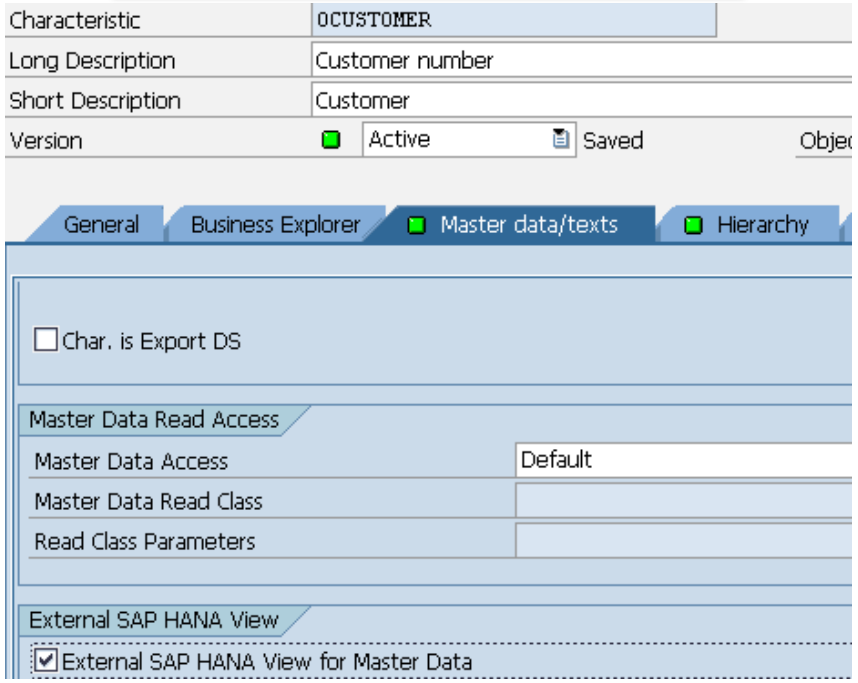
DSO



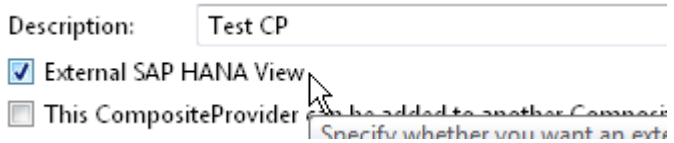
Query



InfoObjects

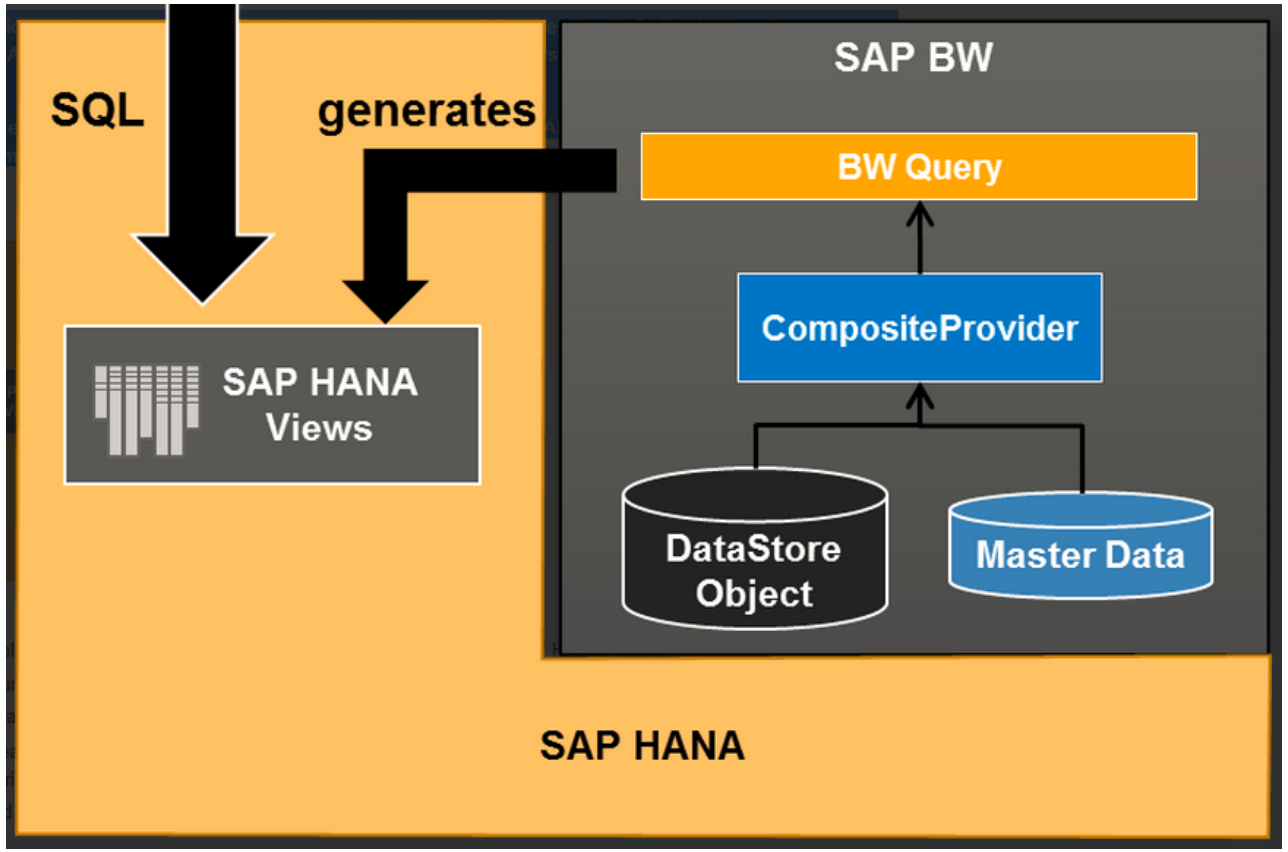


Composite Provider



SAP HANA Views from Queries

- If a query definition can be expressed as a flat view the calculation can fully take place in SAP HANA and a corresponding SAP HANA view can be generated. To do so the query in Eclipse offers a flag to create an "External SAP HANA view."
- This will generate an SAP HANA view based on the query definition into a separate SAP HANA schema which allows consuming the data, for example, via SQL or further modeling with native SAP HANA views



Source: SAP

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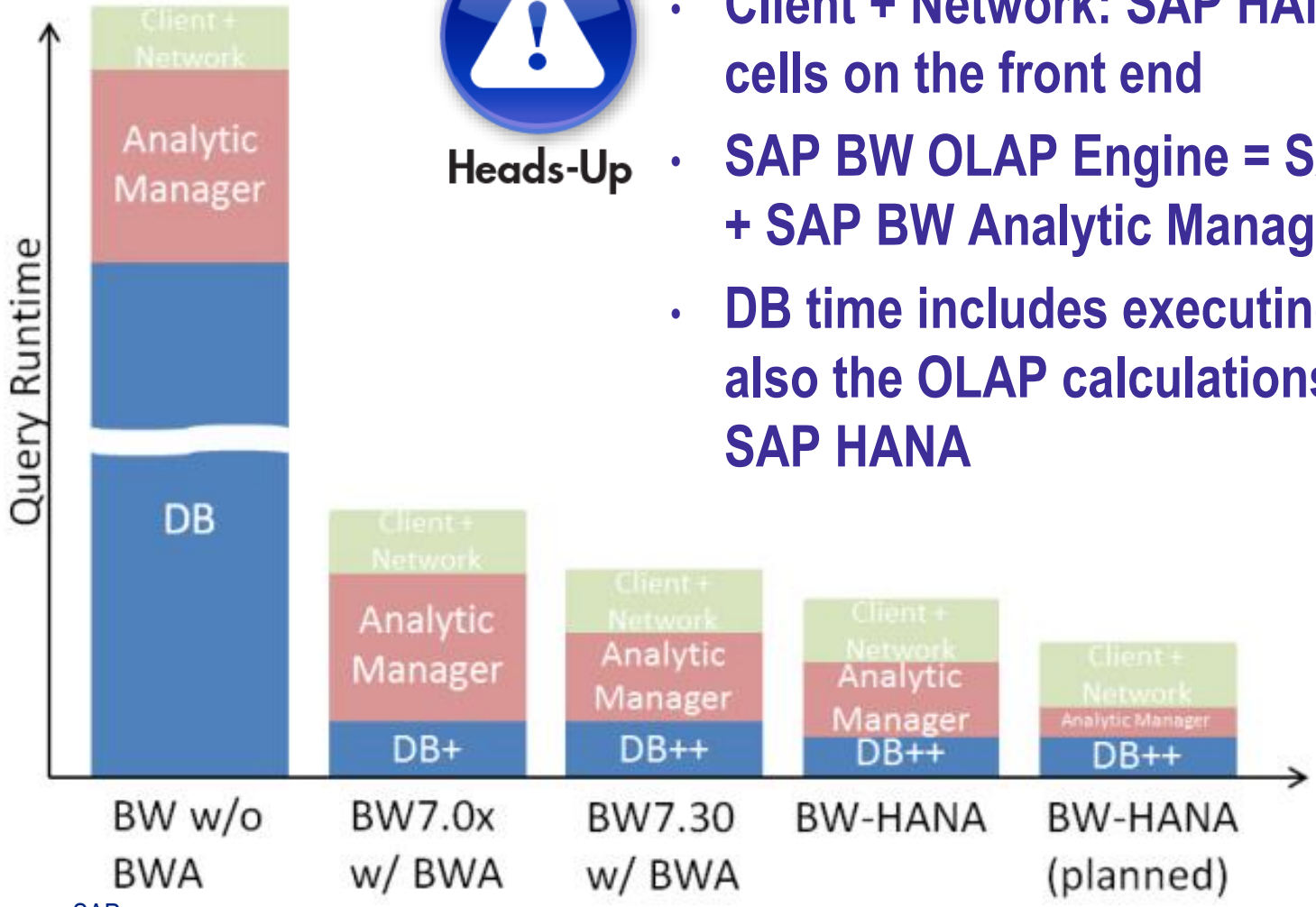
Understanding Query Runtime



Source: SAP

Heads-Up

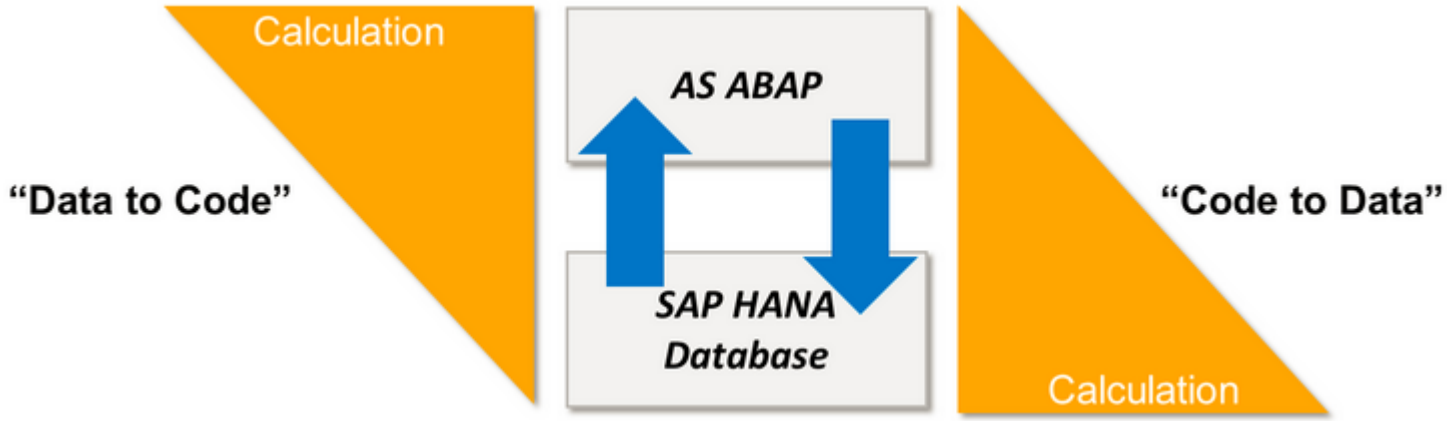
- Client + Network: SAP HANA cannot speed up rendering cells on the front end
- SAP BW OLAP Engine = SAP HANA Calculation Engine + SAP BW Analytic Manager
- DB time includes executing the SQL statement and also the OLAP calculations that are pushed down to SAP HANA

So Where Are the Improvements for the Query?

- Scenarios with very large master data tables (>100 million rows)
- Query execution plan: SAP HANA has a rule-based optimizer. The rules are continuously improved. E.g., inversion of the JOIN direction for certain accesses and table sizes.
- Materialization of intermediate results – Overcomes memory problems on smaller BWA blades

How to Check for "Push Down" to SAP HANA

- Check for the OLAP functions that can be processed by SAP HANA
- Understand how the push down works … through BW Statistics
- Is an SAP HANA Calculation Scenario generated and used?
- Is an Exception Aggregation a candidate for push down?



Source: SAP

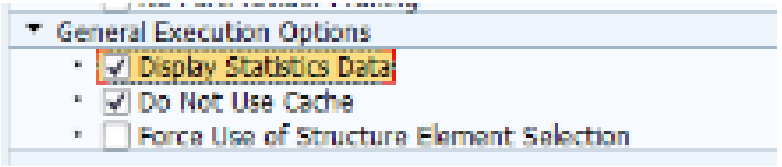
Query Features and Their Handling

Analytic Manager operation	Release*
Aggregation	BW 7.0 + BWA 7.00
Cell-based calculations (FEMS)	BW 7.0 + BWA 7.00
Hierarchy-processing (part 1)	BW 7.0 + BWA 7.00
MultiProvider-UNION	BW 7.3 + BWA 7.20
Exception aggregation COUNT	BW 7.3 + BWA 7.20
Exception aggregation for keyfigures w/o currency/unit conversion	BW 7.3 + BWA 7.20
Exception aggregation for keyfigures w/ currency conversion	BW 7.3 + BWA 7.20
Exception aggregation for keyfigures w/ unit conversion without reference InfoObject	BW 7.3 + BWA 7.20
Time-dependent currency conversion	BW 7.3 (SP10) on HANA
Avoid intermediate result set materialization (Layer "Q" virtualization)	BW 7.4 (SP05) on HANA
"Current member" calculation	BW 7.4 (SP05)
CompositeProvider (e.g. JOIN between fact data)	BW 7.4 (SP05) on HANA
Stock coverage keyfigures	BW 7.4 (SP06)
Unit conversion with Reference InfoObjects (see SAP Note 2001947 to switch off)	BW 7.4 (SP08) on HANA
Parts of Handling of inventory keyfigures (see SAP Note 2001947 to switch on)	BW 7.4 (SP08) on HANA
Leverage HANA hierarchy processing	planned with BW 7.5(SP00) on HANA
List-based calculations (like conditions)	under discussion
Time-Series calculations	under discussion
Temporal Hierarchy JOIN	planned
Internal Business Volume elimination	under discussion
Formula exception aggregation for non-dimensional keyfigures	planned
Formula exception aggregation	planned

Keep checking SAP Note 2063449 | BWA functionality is fully covered by SAP HANA, not vice versa

Checking BW Statistics

- Run the query with RSRT settings as shown
- Review the steps and timing through the various layers, including the SAP HANA Calculation Engine layer
- Change the Query Execution Modes and repeat to review differences in execution, steps, and performance



Source: SAP

Statistics Data for Query Runtime

Frontend/Calculation Layer | Aggregation Layer | Aggregation Layer Cluster Info | HANA Calculation Engine Layer

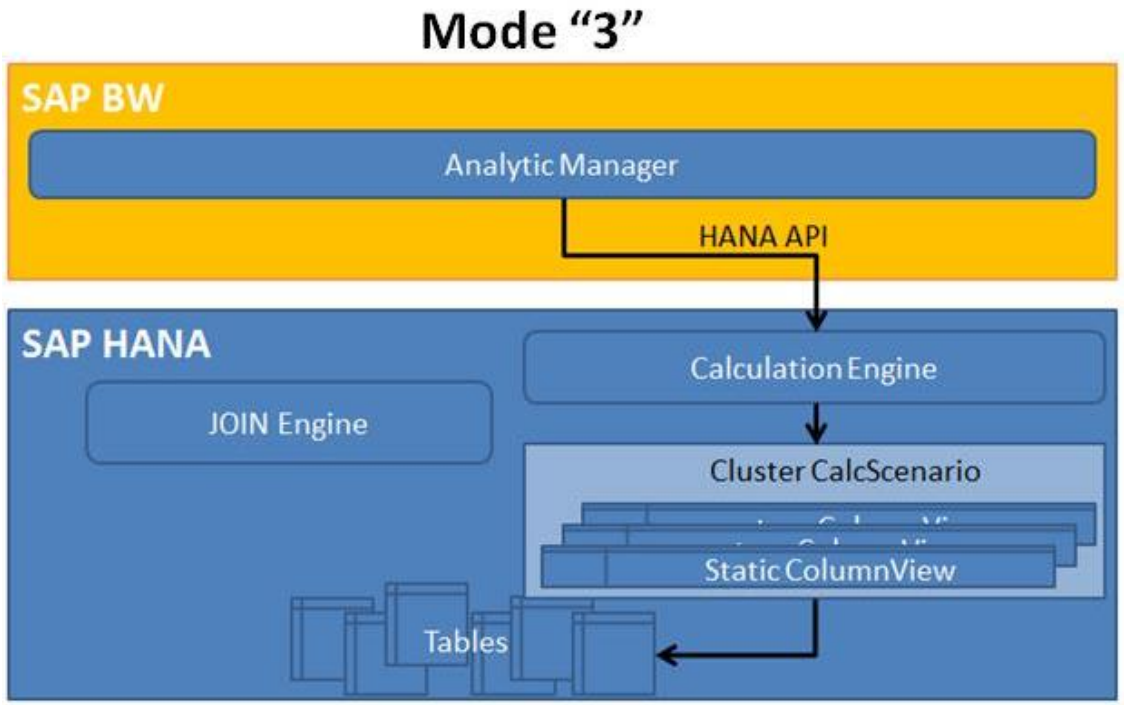
Data Manager UID	Host Name	Internal ...	Scenario Name	Calculation Node Name	Statement ID	Ta...	Column Names	Table Size	Execution Timestamp
00A0185ZPDRZ5WP1IMUP3D5HP	lt5006	31.003	SAPHBW:0BW:BIA:BI0_...	$REQUEST$	0		BNR_0002@sum@	1	20150608113314312
00A0185ZPDRZ5WP1IMUP3D5HP	lt5006	31.003	SAPHBW:0BW:BIA:BI0_...	NORMAL_0001_CC	0		0D_NW_SO_SID;BNR_0002	1.344.130	20150608113314312
00A0185ZPDRZ5WP1IMUP3D5HP	lt5006	31.003	SAPHBW:0BW:BIA:BI0_...	NORMAL_0001_NO	0		0D_NW_SO_SID;S____2360_CU;RBNR_0002_SUM_0001;RBN...	5.376.546	20150608113314312
00A0185ZPDRZ5WP1IMUP3D5HP	lt5006	31.003	SAPHBW:0BW:BIA:BI0_...	NORMAL_LQHF	0		0D_NW_SO_SID;0D_NW_PCURR_SID;RBNR_0002	5.376.546	20150608113314312
00A0185ZPDRZ5WP1IMUP3BX8T	lt5006	31.003	SAPHBW:0BW:BIA:_CS...	$REQUEST$	0		0D_NW_BP_SID;0D_NW_PCURR_SID;D_NW_NAMT@sum@;__...	573	20150608113312946
00A0185ZPDRZ5WP1IMUP3BX8T	lt5006	31.003	SAPHBW:0BW:BIA:_CS...	0EPM_MP02	0		0D_NW_BP_SID;0D_NW_PCURR_SID;D_NW_NAMT;__numoff...	573	20150608113312946

Query Execution Mode in Transaction RSRT

- SAP BW can access data in SAP HANA in two different ways:
  - Standard SQL
  - Using SAP HANA API against the Calculation Engine. This supports the OLAP/Calculation features.

- By default all queries use Mode “3.” A Calculation Scenario is created in SAP HANA at runtime combining the Column Views of the InfoProviders. Then, a single statement is executed via the HANA-API for this cluster. The other InfoProviders are accessed independently, but in parallel.

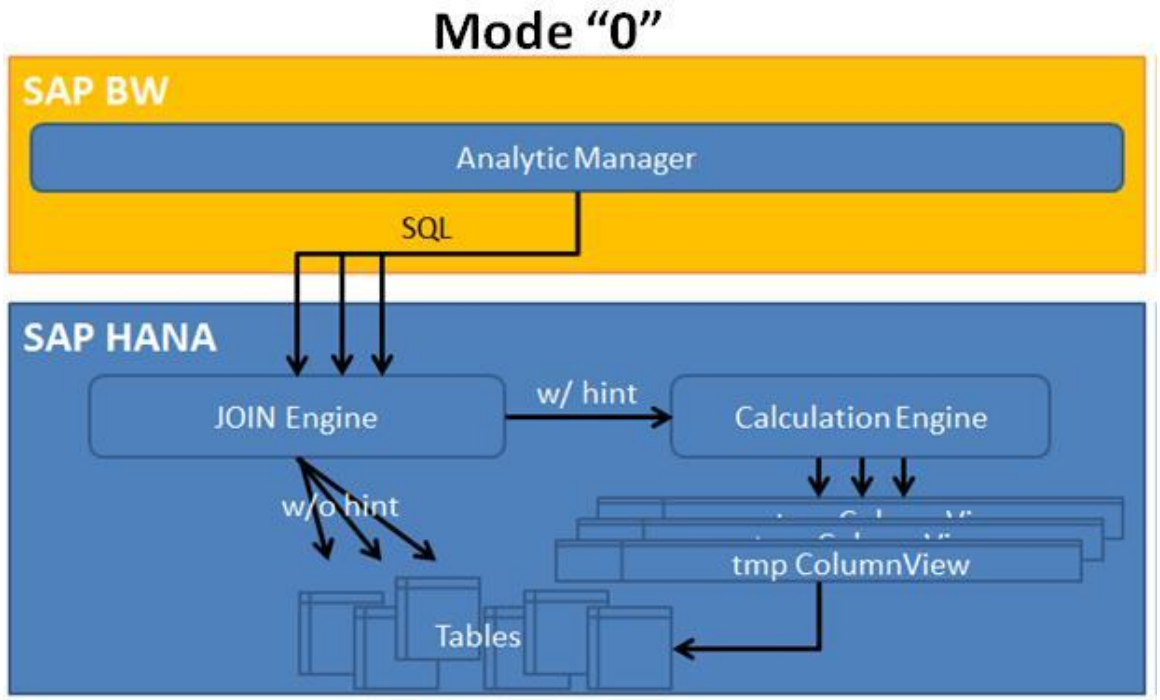
Query Execution Mode “3”



Source: SAP

- Pushes the UNION operation to SAP HANA
- Decreases the amount of data that has to be transferred from the database to the application server
- SAP HANA can also reuse the result of certain operations that have to be performed for each single InfoProvider in the cluster (e.g., a JOIN between the SID-table and a master data [X-/Y-] table)

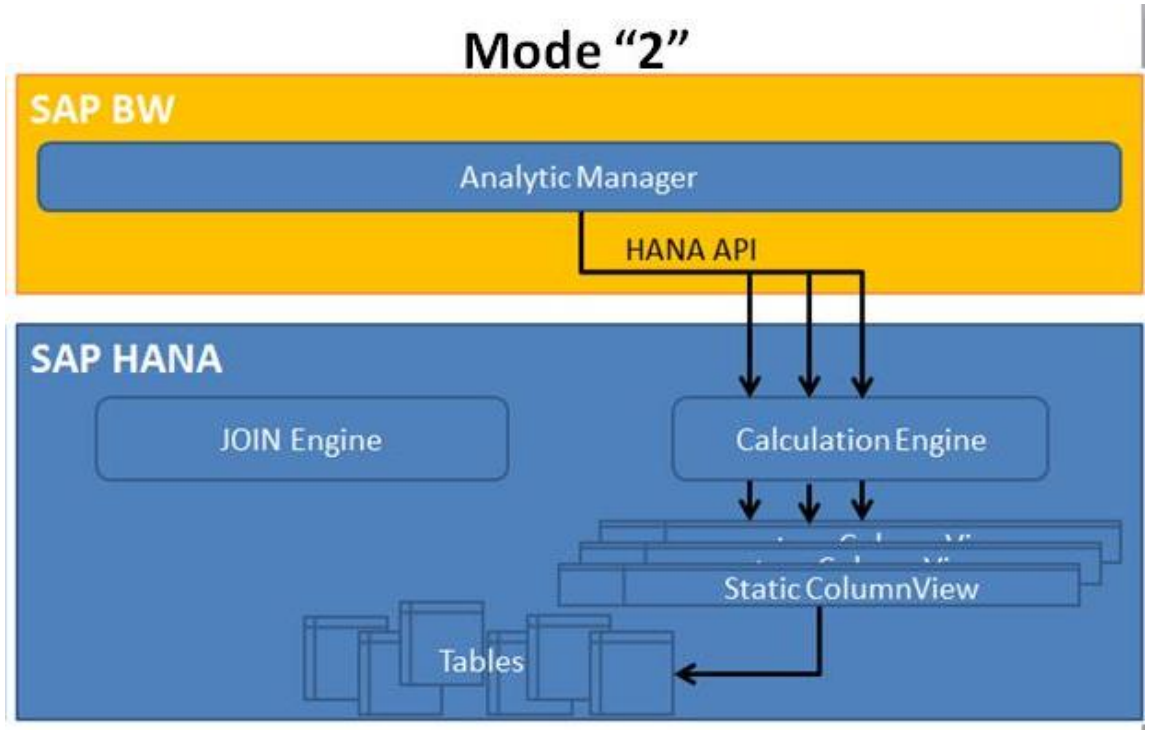
Query Execution Mode “0”



Source: SAP

- Mode “0” means no operations in SAP HANA
- Each single InfoProvider is accessed via the generated SQL statement
- May be used in debugging situations when you want to force the usage of the JOIN engine
- SAP Note 1858333 – Query Execution Mode "2/3" reads more data than "0" has more details on unique situations when Mode “0” may be the fastest

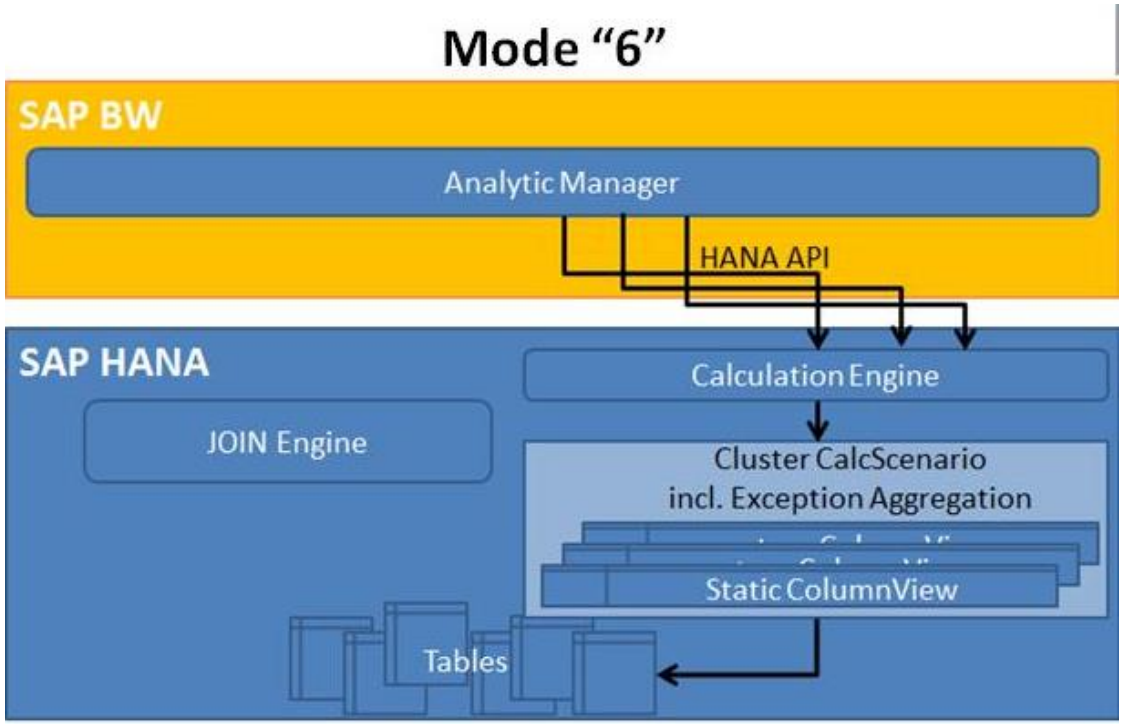
Query Execution Mode “2”



Source: SAP

- Mode “2” means no operations in SAP HANA
- Each single InfoProvider is accessed via the generated SQL statement
- May be used in debugging situations when you want to force the usage of the JOIN Engine

Query Execution Mode “6”

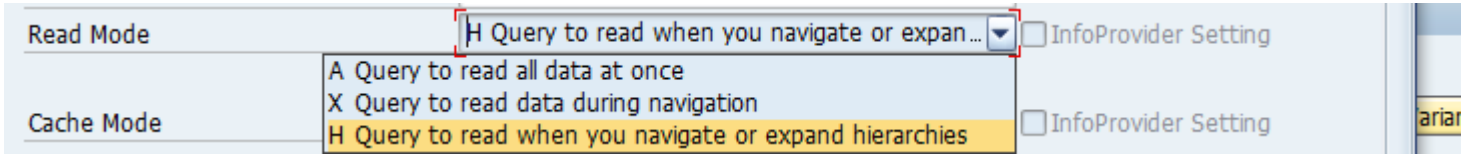


Source: SAP

- Mode “6” is specifically to deal with exception aggregation in SAP HANA
- Check the query runtime statistics, especially the “records transferred” value, to give an indication of the level of performance gain by the push down

Read Mode

- The read mode determines how the OLAP processor gets data during navigation. Three alternatives are supported:



  - H = You can improve the performance of queries with large presentation hierarchies by creating aggregates in a middle hierarchy level that is greater than or equal to the start level
  - X = When accessing the database, the system uses the most suitable aggregate table and, if possible, aggregates in the database itself
  - A = The "Read when navigating" setting, in contrast to "Read when navigating/expanding the hierarchy," only has a better performance for queries with presentation hierarchies

Query Cache Mode

- The cache mode defines whether and how the query results and navigational states calculated by the OLAP processor should be saved as highly compressed data in a cache
- Can be defined at InfoProvider and query level
- Caching is a means of improving query performance.
  But you need to balance:
  - Benefits: Caching improves the response time for queries
  - Costs: Expenditure involved in organizing and retaining data in the cache

Different Cache Modes: Local and Database

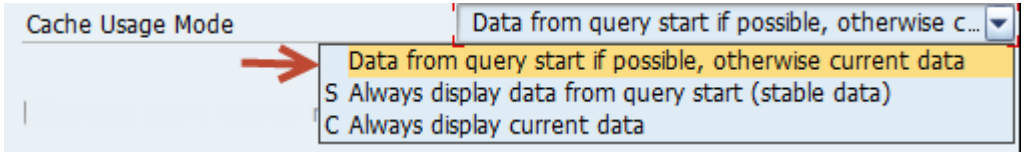
- Cache Mode I: Cache is inactive
  - New data is read during every single navigation step
- Cache Mode 0: Local cache
  - The database cache is deactivated. In this case, the system works exclusively with the local cache.
- Cache Mode D: Cache in database
  - The cache data is persistent in database tables. In this mode, no data is displaced, and the memory size is unlimited. The database instance for the table carries the load. More space is required, but this method also saves time.
- Cache Mode P: Every provider as set in the InfoProvider definition
  - This mode is only available for queries on MultiProviders and CompositeProviders. It makes it possible to cache the data from the contained InfoProviders in accordance with the cache made set in the definition of each individual InfoProvider.

Cache Usage Mode

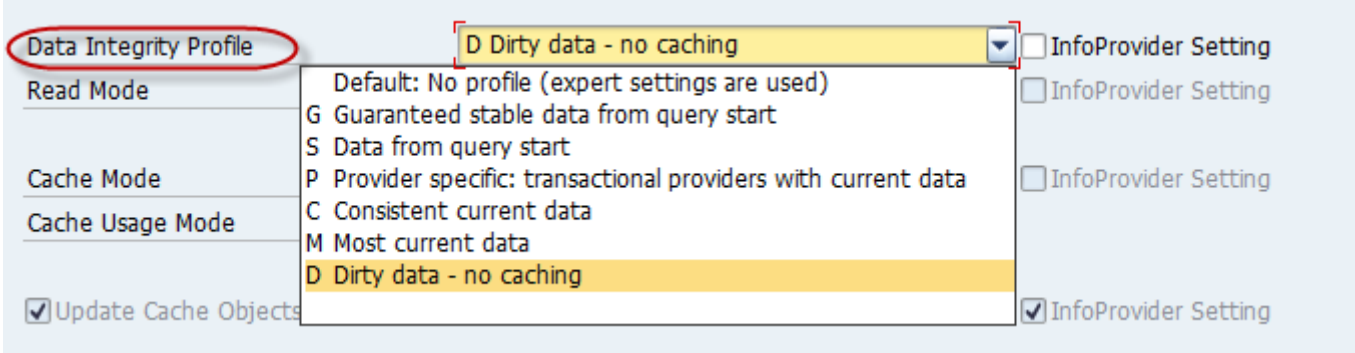
- The cache usage mode is an expert extension to the cache mode. It defines in which situation cache entries can be used for answering a query, and in which cases data needs to be read anew.
- “S” Always display data from query start (Stable Data)

- “C” Always display Current Data

- “ ” Data from query start if possible, otherwise current data (default behavior)



Data Integrity Profile



- The data integrity profile offers a simple way to control the data integrity of a query without the need to understand all the expert settings of data integrity, cache mode, read mode, InfoProvider grouping, and cache usage mode

Key Feature

- Use: By using the data integrity profile, the system automatically uses correct settings for other individual technical query settings. This prevents contradictory settings of the expert settings, which might not produce the required query behavior.

Use Selection of Structure Elements

- The "Use Selection of Structure Elements" option affects system performance. This function should therefore normally be activated.
  - Example: Query with the restricted key figures (Sales 2013) and (Sales 2014): A drilldown by year in the rows would show the years 2013 and 2014 in the rows. If the query is filtered by the key figure (Sales 2013), then only the row for 2013 would be shown if the flag is switched on. If the flag is switched off, still the two rows for 2013 and 2014 would be shown but the cell (Sales 2014) for the year 2014 would be empty.

Process Key Figures with High Precision

- Defining a certain calculation accuracy decides which number format will be used internally for calculating key figures
  - The level of calculation accuracy can be set in the InfoObject maintenance transaction for each key figure, and in the query monitor for all key figures of a query

- There are two levels of precision:
  - Decimal floating point numbers with 16 places (#short decfloat#)
  - Decimal floating point numbers with 34 places (#long decfloat#)

- Short decfloats are used by default in the Analytic Engine for numerical data to minimize the memory requirements for the main memory and the OLAP cache

No Parallel Processing

- Parallel processing can be deactivated for an individual query. This can be beneficial because the query then uses fewer system resources if you use non-parallel processing.
- In the case of queries with very fast response times, the effort required for parallel processing can be greater than the achievable time gain
  - In this case, it may also make sense to turn off parallel processing
    - The query contains cells with a constant selection

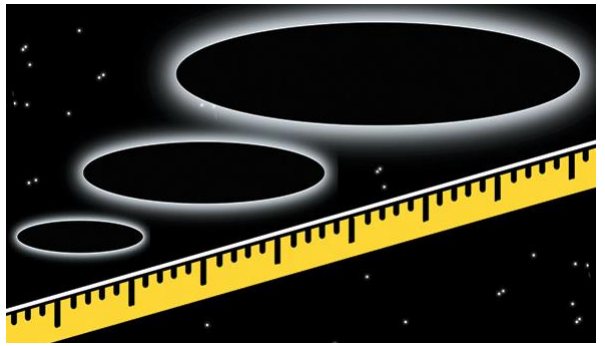
Operations in SAP HANA

- If you are using the SAP HANA database, the system always checks whether optimized operations in the SAP HANA DB are possible for the InfoProvider that the selected query is based on. You can choose one of the following options:
  1. No optimized operations in SAP HANA: If there are virtual chars/key figures, the system sets the No Optimized Operations in SAP HANA
  2. Individual access for each InfoProvider: A separate access is made for each participating InfoProvider

Materialize Intermediate Query Result

- If the query property “Operations in SAP HANA” is set to “Exception Aggregation” or higher, a major part of query processing takes place in SAP HANA

- Normally it is faster to recalculate the intermediate results each time, because in this case subtotal level specific optimizations can be used
  - In some exceptional cases it is faster to materialize the intermediate result sets
- These cases involve a combination of the following:
  - A large number of characteristics in drill, each with subtotals
  - A huge reduction of data by standard aggregation
  - Nearly no reduction of data based on filters



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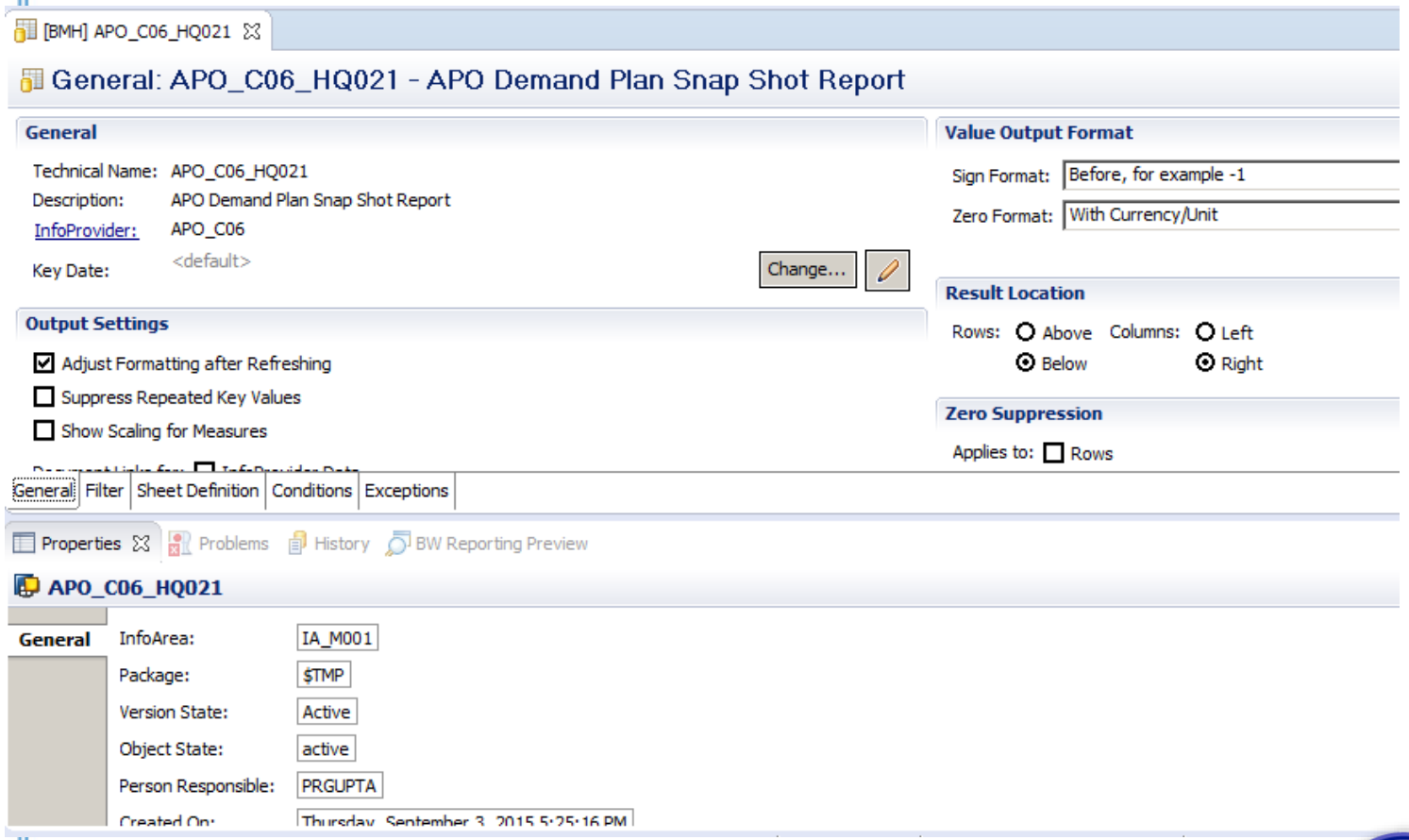
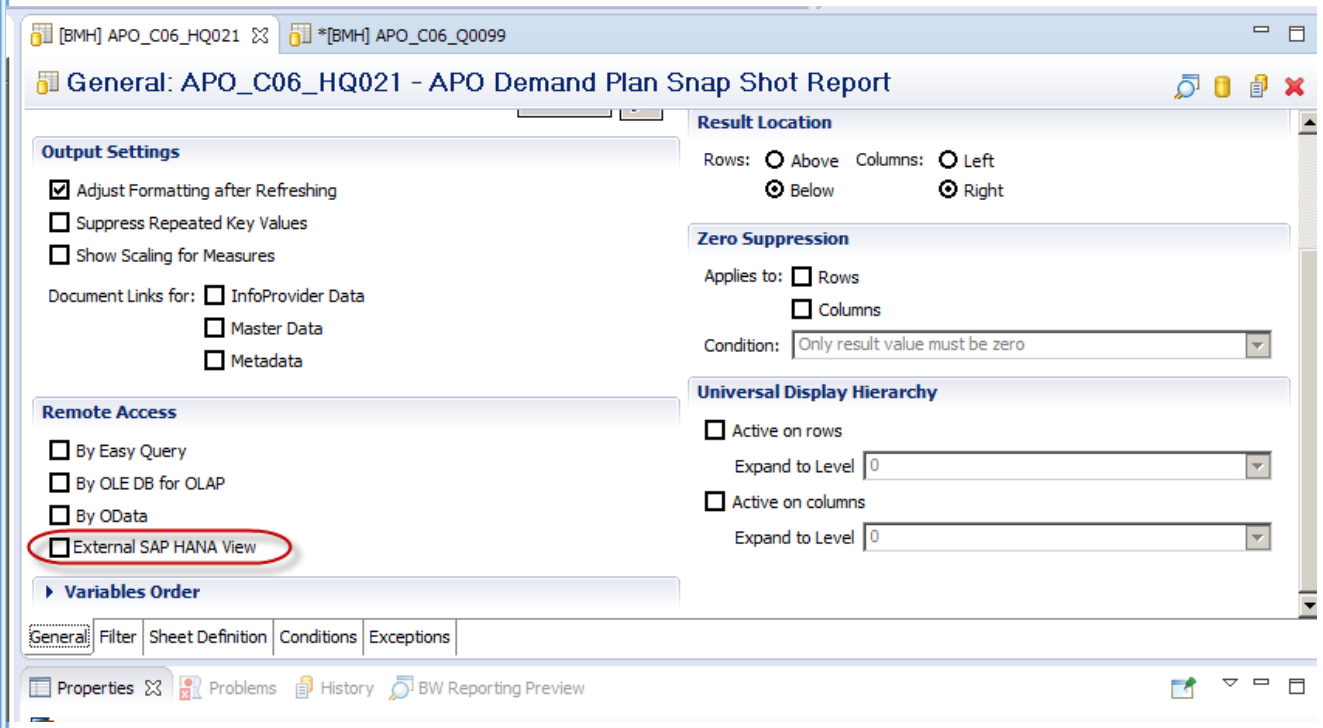
Eclipse-Based Query with BW Modeling Tool (BW-MT)



- **Create simple queries in Eclipse**
  - **BW-MT 1.6 required**
  - **A subset of query functionality can be created directly in Eclipse**
- **Choose between various functions**
  - **Create structures in row and columns area of the query**
  - **Conditions and exceptions**
  - **Currency and unit conversion**
  - **CANNOT create reusable restricted and calculated key figures and variables**

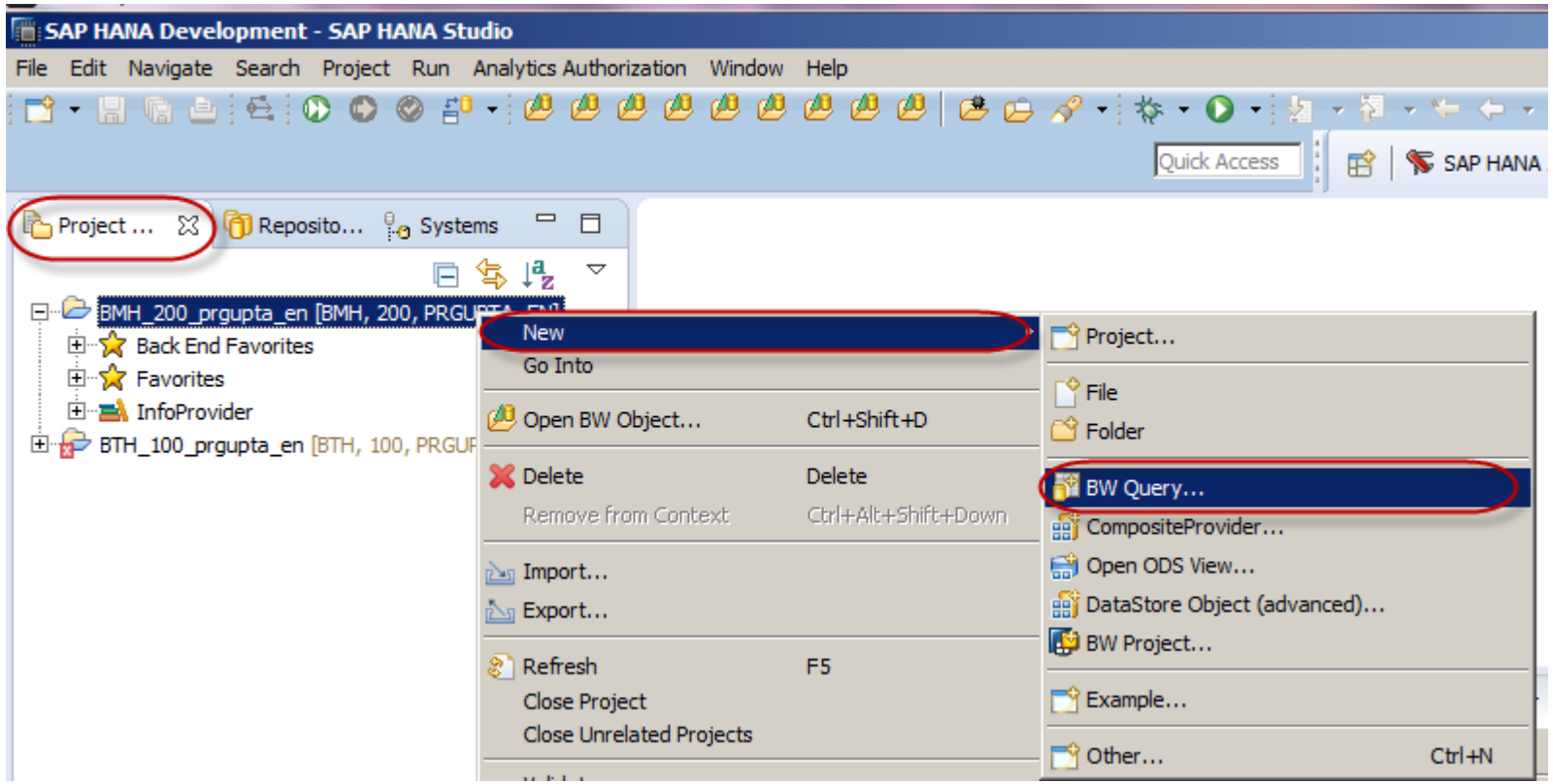
Generate SAP HANA Views Based on BW Queries SP09+



- If a query definition can be expressed as a flat view, the calculation can fully take place in SAP HANA and corresponding HANA views can be generated
- Generate an SAP HANA model for a simple BW query including security
- Supported features: Currency/Unit conversion, variable, restricted key figures, global restrictions, and inventory key figure (closing balance)
- Generated SAP HANA model is also able to read the data from NearLine Storage

Create a Query Using Eclipse-Based Query Designer

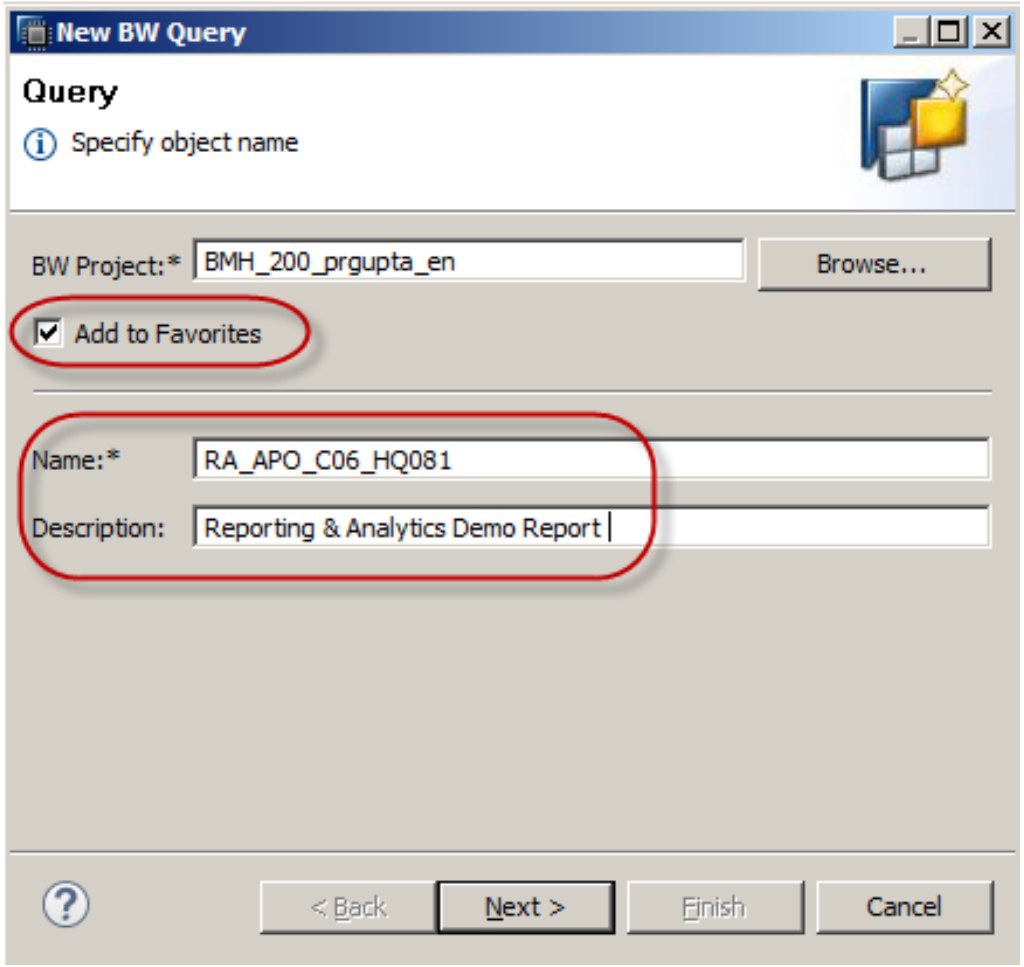
- Invoke the context menu on an SAP BW project and select New ➞ BW Query



Create a Query Using Eclipse-Based Query Designer (cont.)

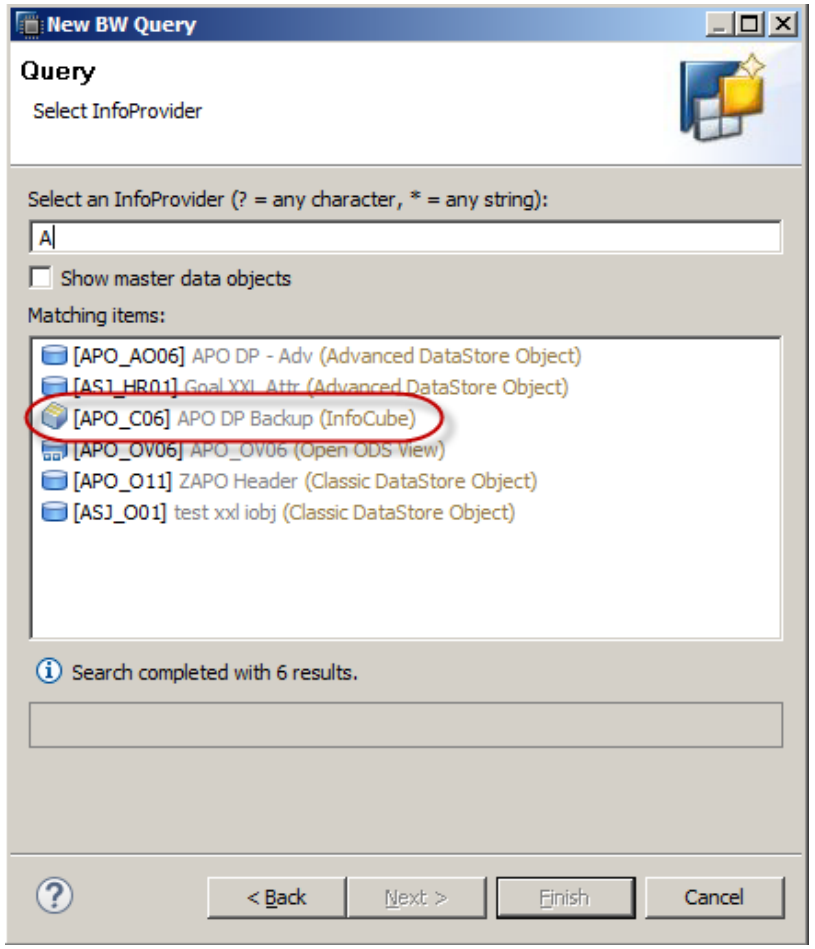
- New BW Query dialog box comes up, where we can give the name and description of the query

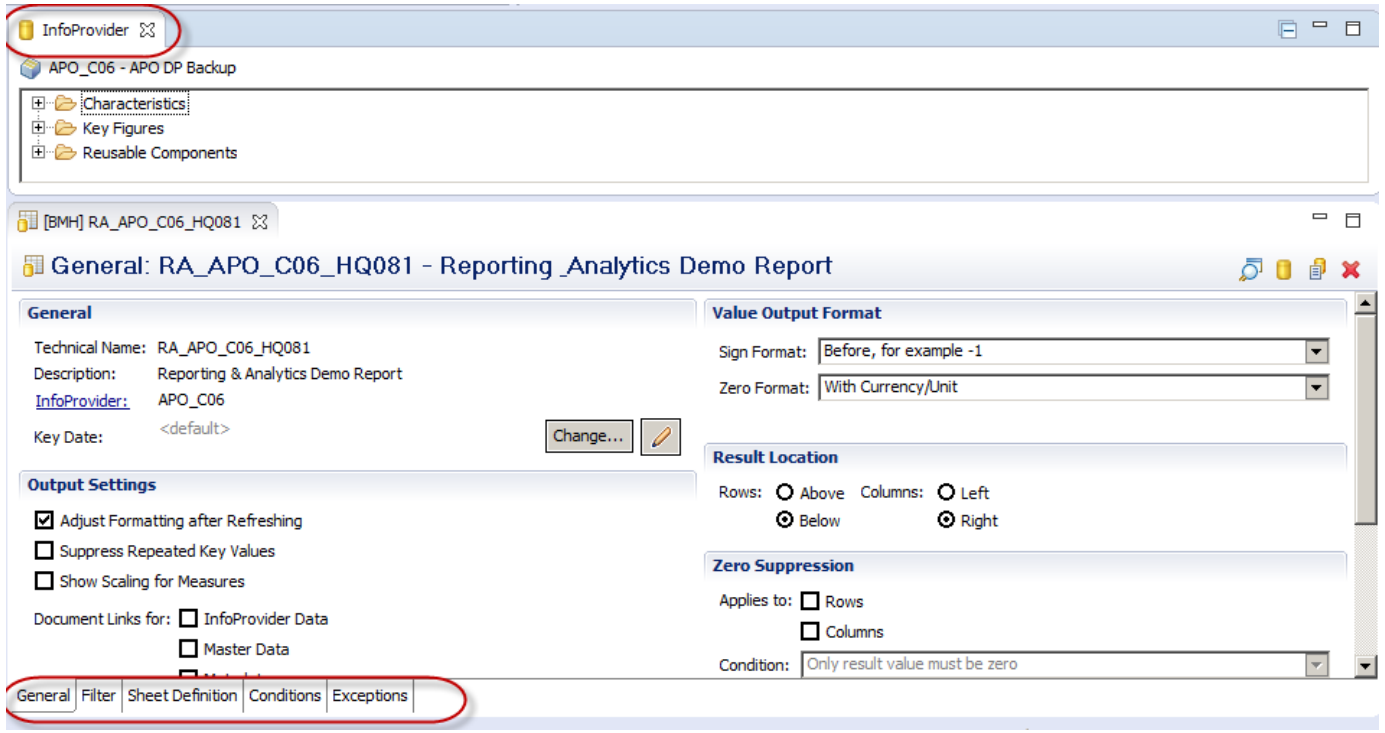
Note: When creating the query itself, it's possible to have the query in the Project Explorer "Favorites," for the SAP BW project, by selecting the "Add to Favorites" option



Select the InfoProvider for Query

Select the desired InfoProvider and select "Finish" in the New BW Query dialog box



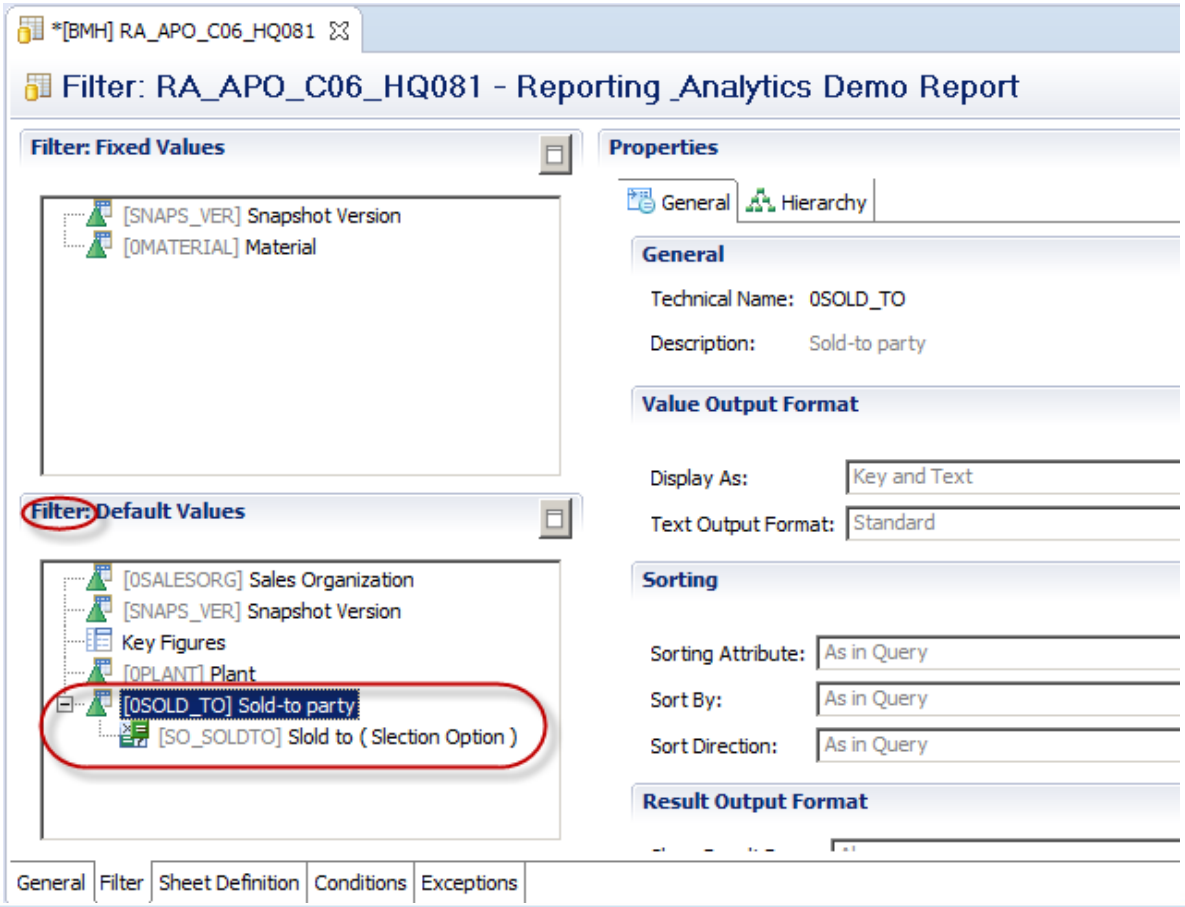


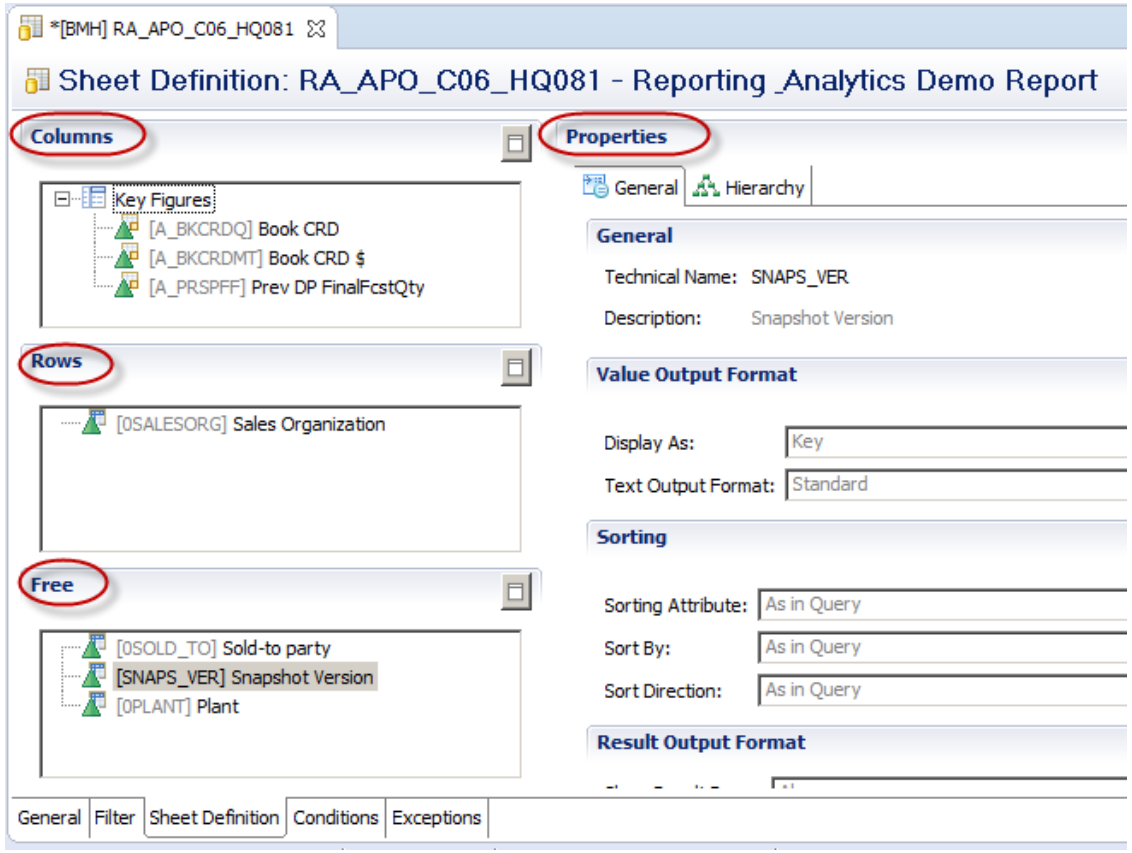
InfoProvider – Which has the characteristics, key figures, and reusable components

Five tabs – General, Filter, Sheet Definition, Conditions, and Exceptions

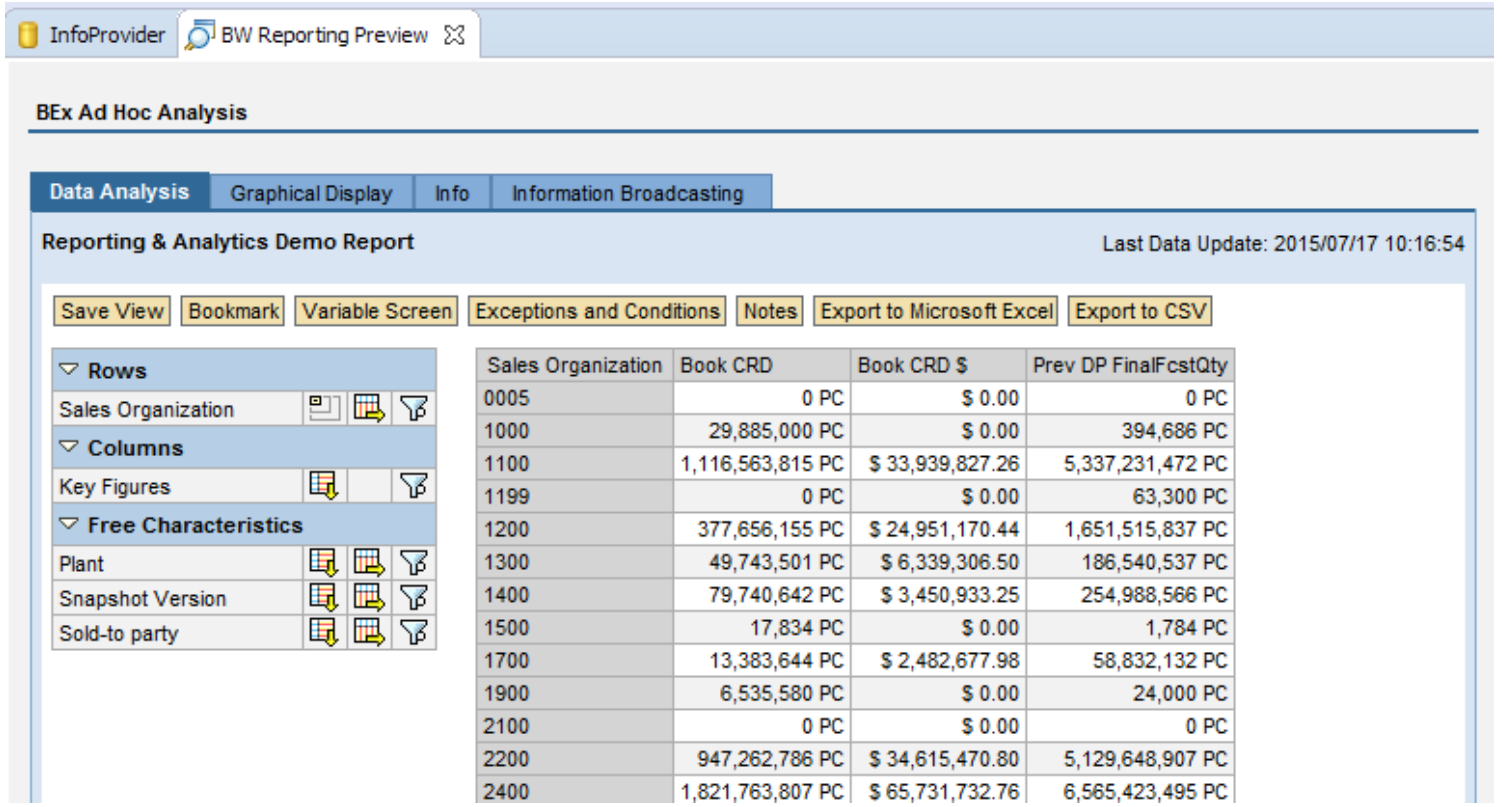
Define the Query: Filters and Sheet Definition

- Navigate to the Sheet Definition and Filter tabs and drag and drop the desired characteristics and key figures from the InfoProvider. You can also use Variable for Dynamic filters.





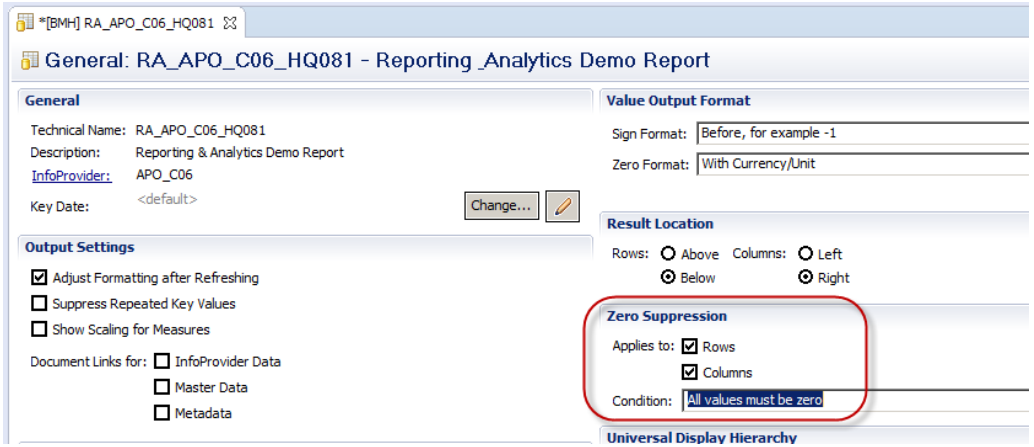
Preview of the Query Using the “Show Preview” Button



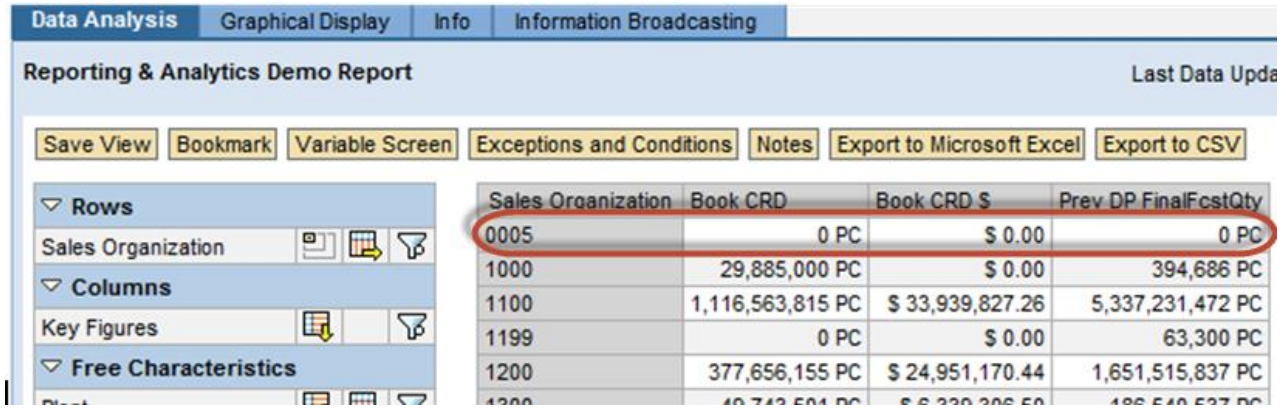
Sales Organization	Book CRD	Book CRD $	Prev DP FinalFcstQty
0005	0 PC	$ 0.00	0 PC
1000	29,885,000 PC	$ 0.00	394,686 PC
1100	1,116,563,815 PC	$ 33,939,827.26	5,337,231,472 PC
1199	0 PC	$ 0.00	63,300 PC
1200	377,656,155 PC	$ 24,951,170.44	1,651,515,837 PC
1300	49,743,501 PC	$ 6,339,306.50	186,540,537 PC
1400	79,740,642 PC	$ 3,450,933.25	254,988,566 PC
1500	17,834 PC	$ 0.00	1,784 PC
1700	13,383,644 PC	$ 2,482,677.98	58,832,132 PC
1900	6,535,580 PC	$ 0.00	24,000 PC
2100	0 PC	$ 0.00	0 PC
2200	947,262,786 PC	$ 34,615,470.80	5,129,648,907 PC
2400	1,821,763,807 PC	$ 65,731,732.76	6,565,423,495 PC

For Further Tuning You Can Set Query Properties

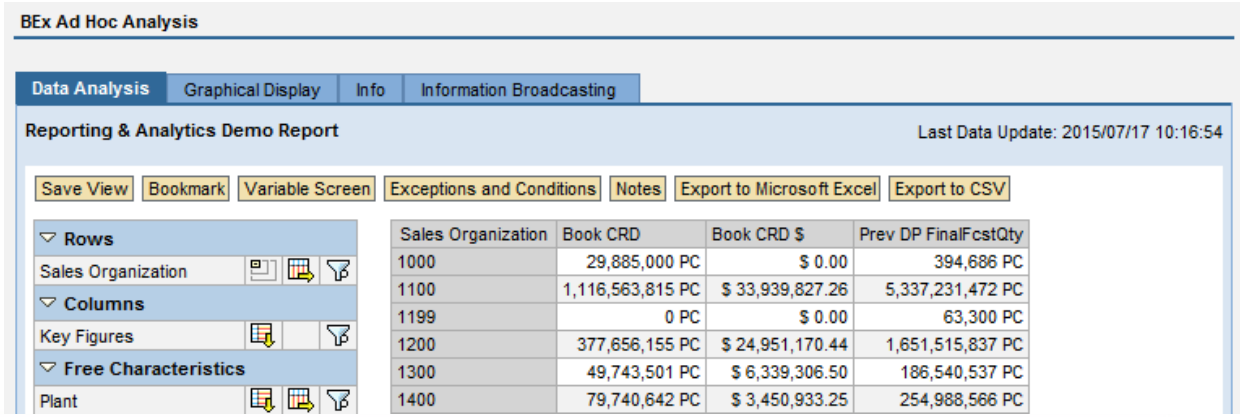
- For example, you would like to suppress the ZERO Values



Before Zero Suppression



After Zero Suppression



What We'll Cover

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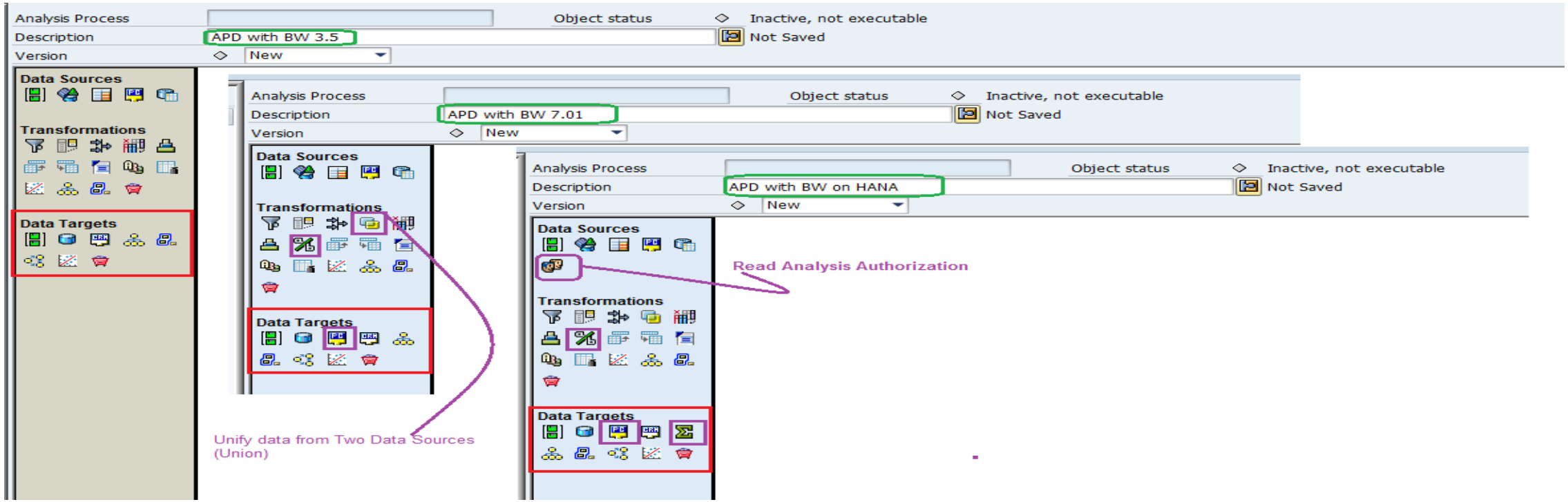
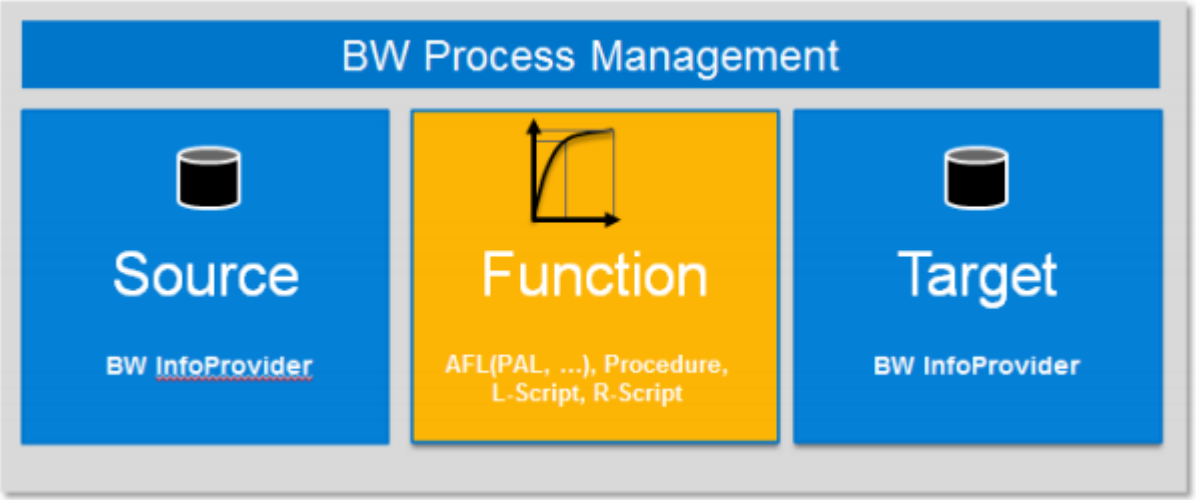
Analysis Process Designer

SAP BW 3.x	SAP BW 7.01	SAP BW on SAP HANA
5 DataSources	5 DataSources	6 DataSources
14 Transformations	16 Transformations	16 Transformations
8 Data Targets	9 Data Targets	10 Data Targets



What Is an SAP HANA Analysis Process (HAP)

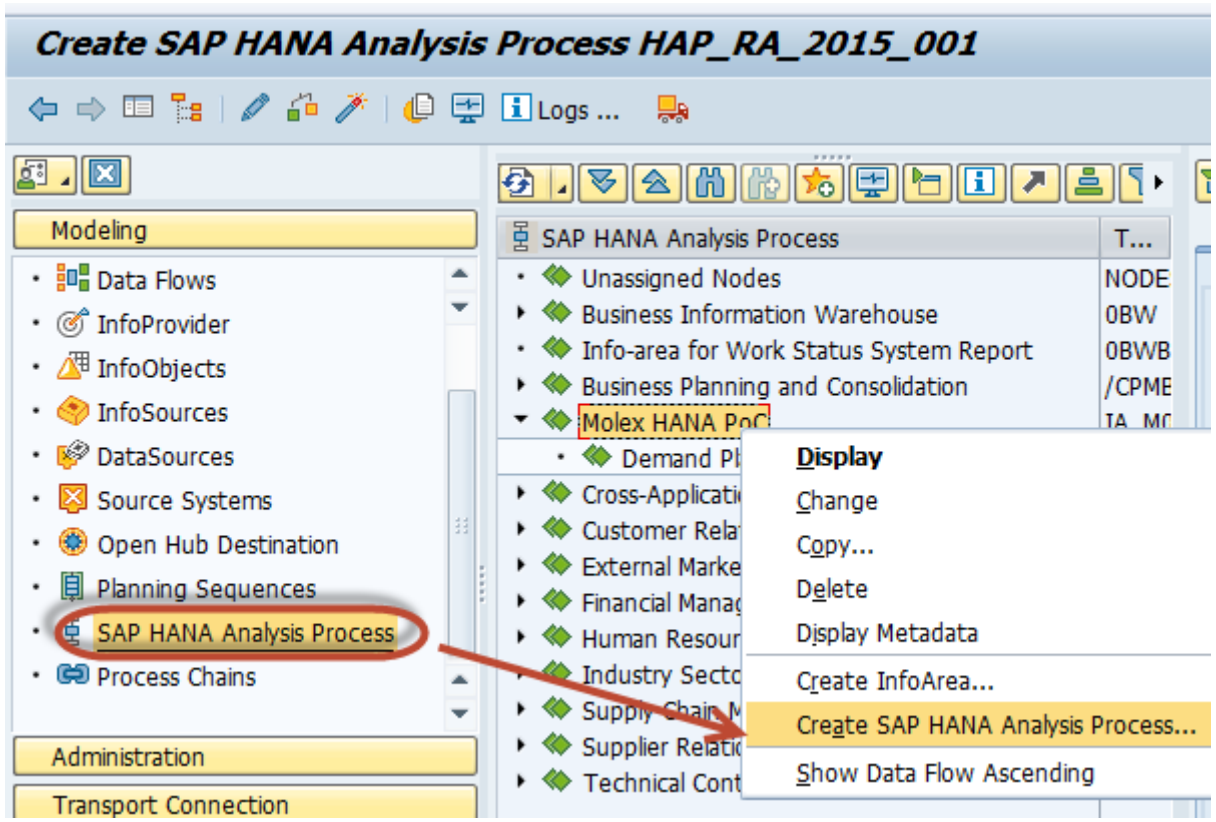
- Using SAP HANA analysis process, functions of the SAP HANA database and functions in the SAP BW systems can be combined
- Always made up of exactly one data source, a function for data analysis, and data target
- SAP recommends to use SAP HANA analysis process instead of Analysis Process Designer (APD) to take advantage of improved performance
- It is possible to execute SAP HANA functions from different libraries (e.g., PAL, AFL, R) directly on SAP BW InfoProvider data such as clustering, association algorithms, regression analysis, weighted score, exponential smoothing, etc.

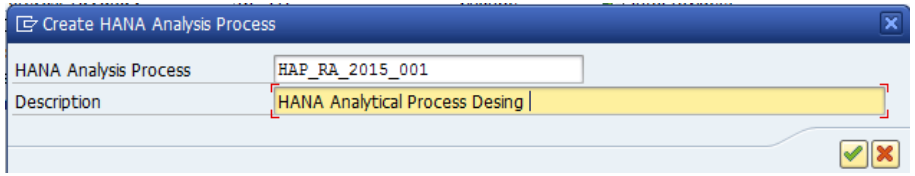


Source: SAP

Steps to Create an SAP HANA Analysis Process

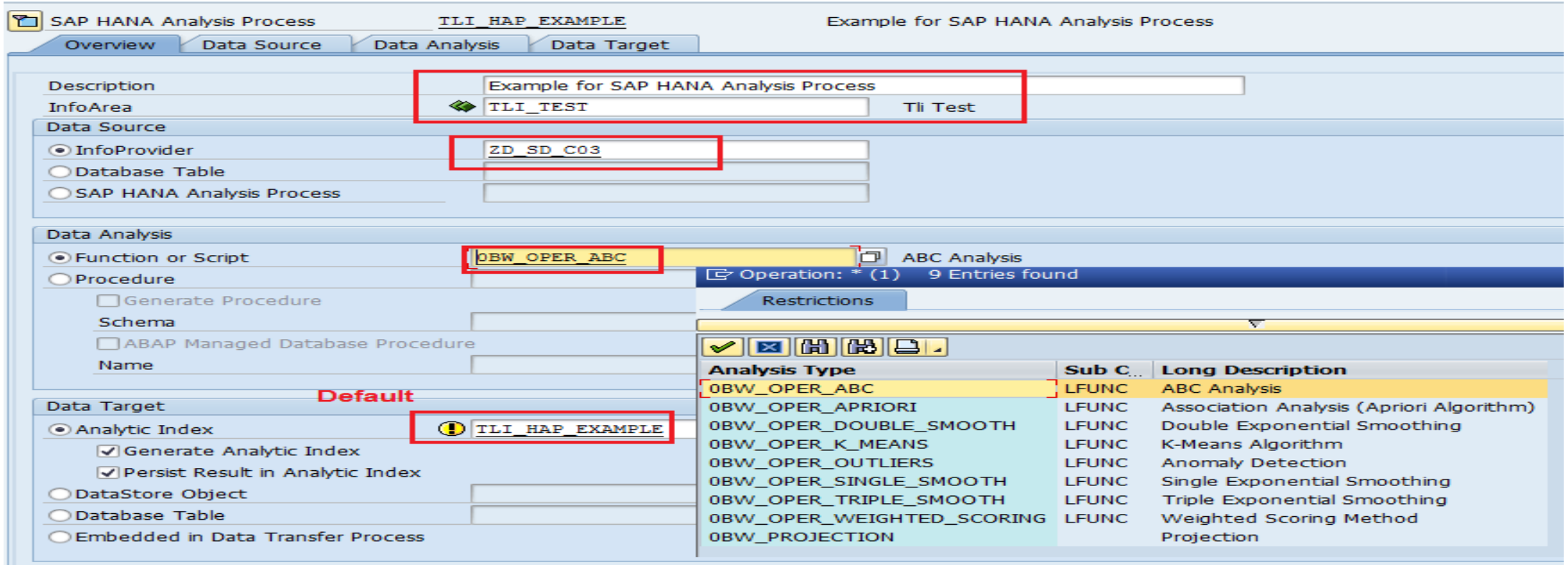
- In the Modeling Workbench (RSA1), choose SAP HANA Analysis Process under Modeling





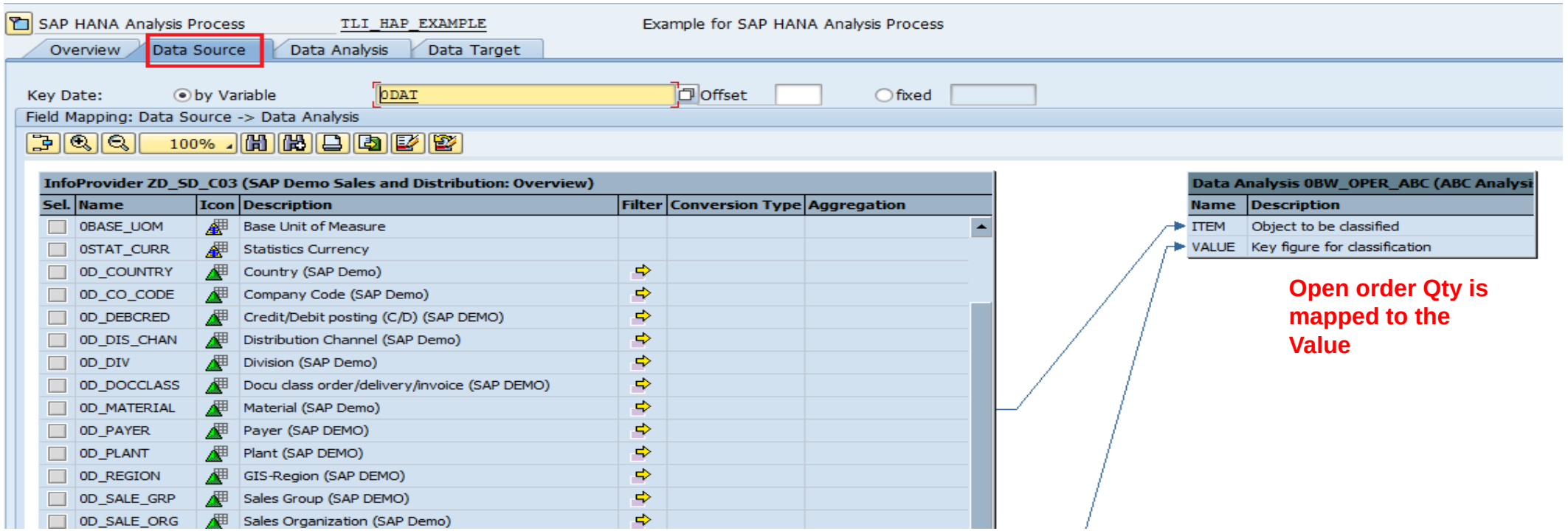
Steps to Create an SAP HANA Analysis Process (cont.)

- On the Overview tab, select a data source
- Select the Function or Script or Procedure for the data analysis
- Select the data target



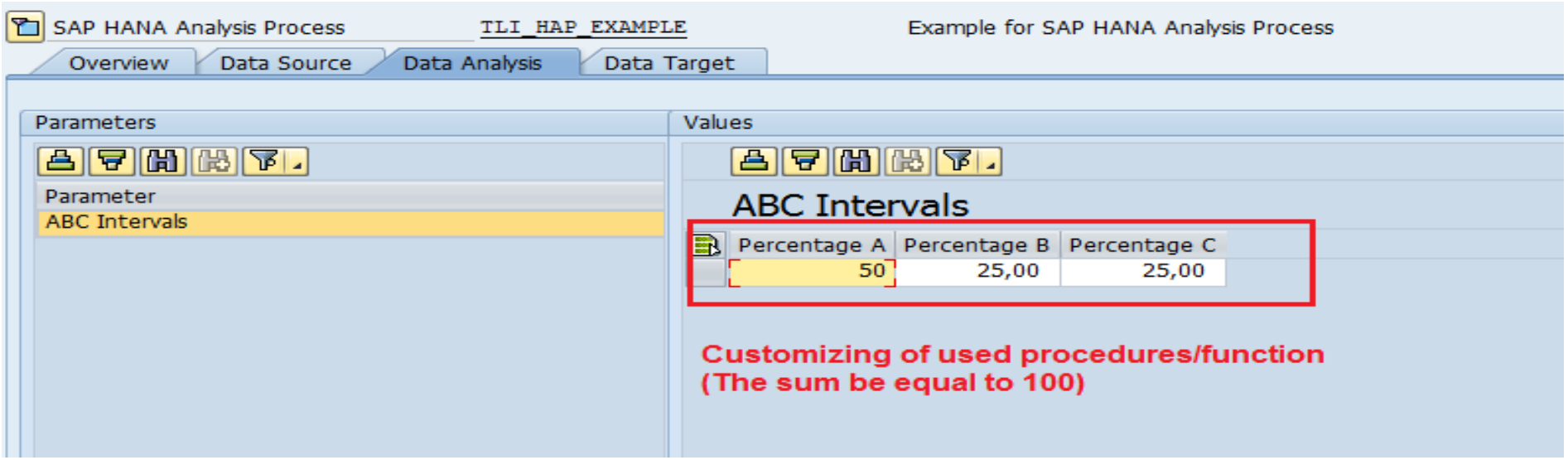
Steps to Create an SAP HANA Analysis Process (cont.)

- **Data Source Tab: Make assignments between the fields of the data source and the entry table of a function or procedure, and create filters and calculations**



Steps to Create an SAP HANA Analysis Process (cont.)

- Data Analysis Tab: You start by choosing a PAL (Predictive Analysis Library) function
- On this tab you can change the parameters of the function selected. This tab is only visible if you choose **Function or Script** in the Overview tab.



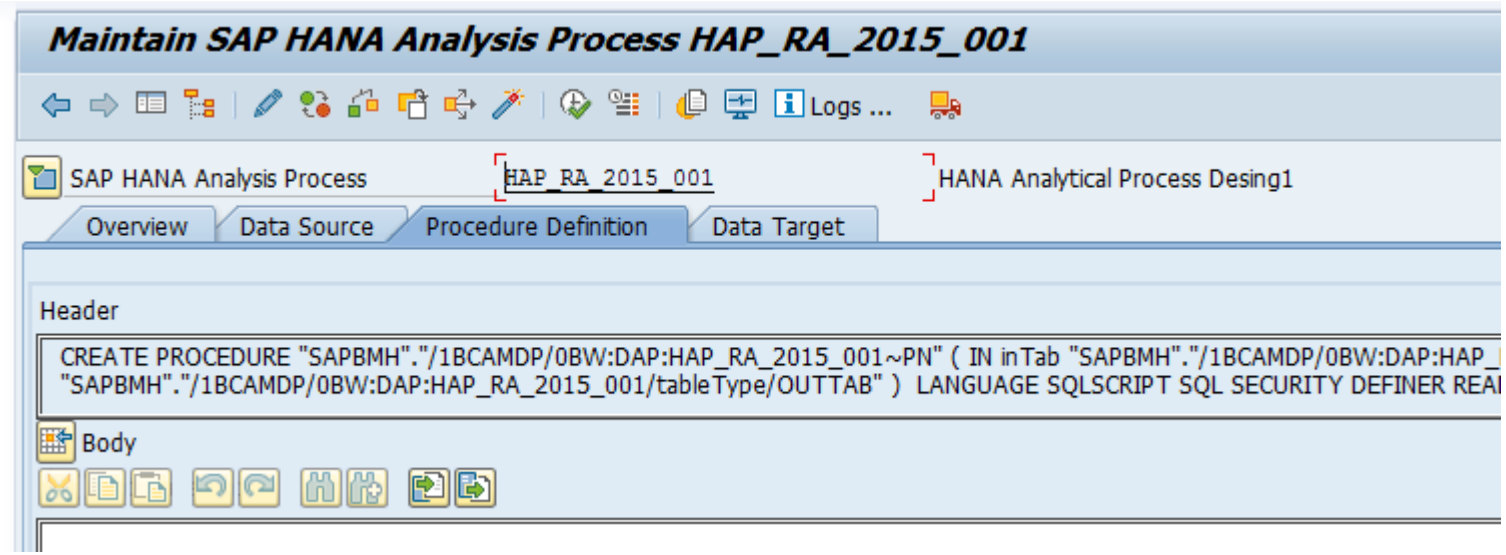
Note

You can find details on PAL functions here:

http://help.sap.com/hana/SAP_HANA_Predictive_Analysis_Library_PAL_en.pdf

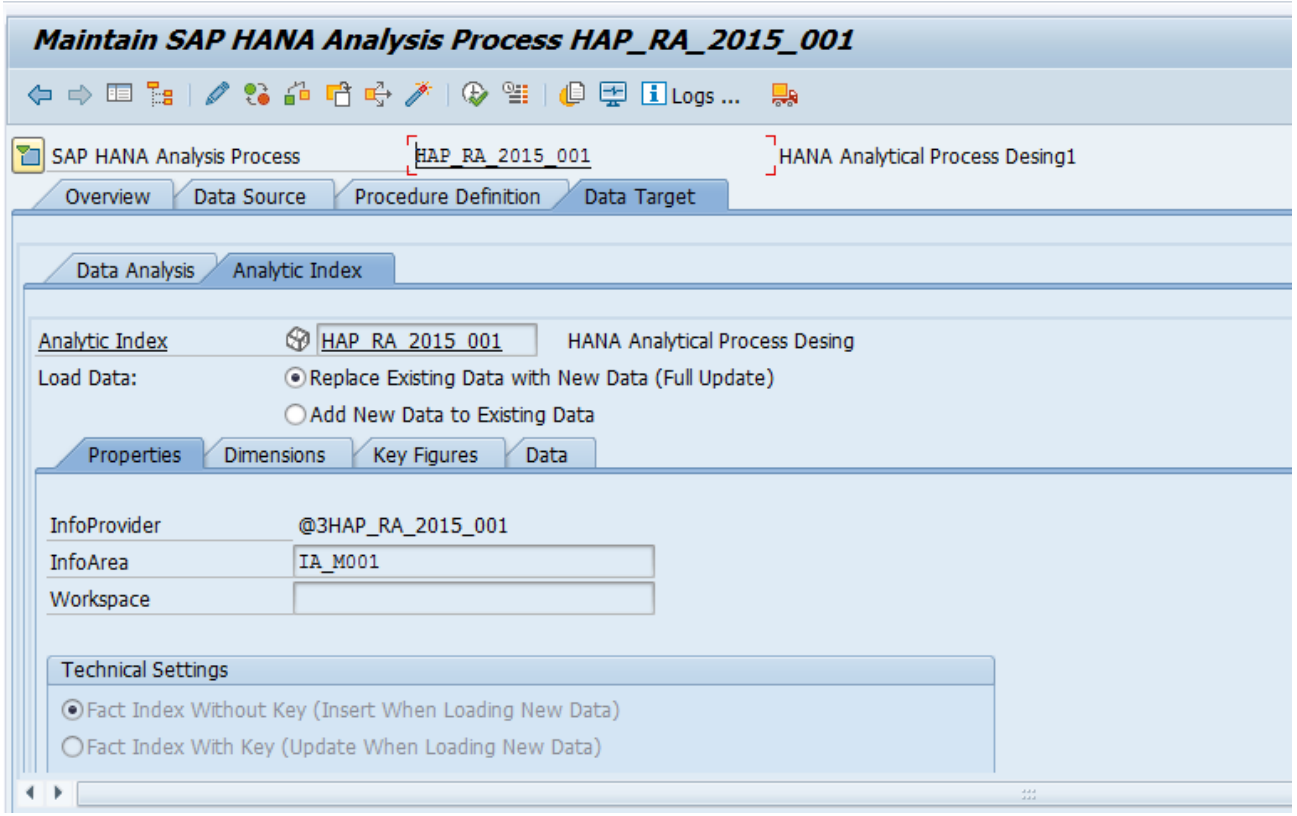
Steps to Create an SAP HANA Analysis Process (cont.)

- Procedure Tab: You start by choosing a PAL (Predictive Analysis Library) function
- On this tab you can change the parameters of the function selected. This tab is only visible if you choose **Procedure** in the Overview tab.
- You can enhance the default logic of the generated procedure



Steps to Create an SAP HANA Analysis Process (cont.)

- Data Target Tab: You can edit loading behavior settings here
- Depending on the selections in the first page, Data Analysis and Analytic Index tabs can be selected
- Analytic Indexes:
  - Cannot be transported
  - No backup and restore
  - Best used for ad hoc scenarios only
  - Is used to generate a Transient Provider



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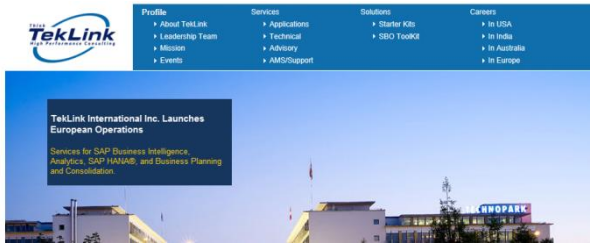
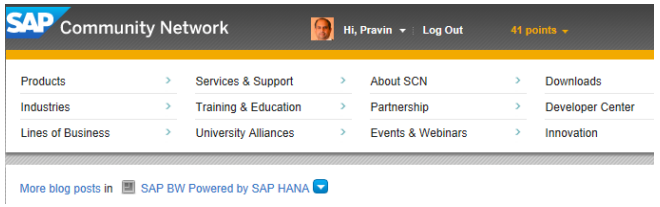
Where to Find More Information



- You can find articles and presentations on SAP HANA and SAP BW 7.4
  - www.teklink.com/site/binaries/content/assets/pdfs/conference-2014/bw-74-powered-by-sap-hana-use-it-to-your-advantage_v1-.pdf
  - www.teklink.com/site/binaries/content/assets/pdfs/conference-2014/asug-chicago-chapter-simple-models-in-hana-apr-2012---pravin.pdf
  - www.teklink.com/site/binaries/content/assets/pdfs/conference-2015/bi2241_extending_the_reach_of_lsa-v2.pdf

- Operations in SAP HANA/BWA on the SAP Help Portal
  - https://help.sap.com/saphelp_nw73/helpdata/en/4b/bda228a8b43c22e10000000a42189b/frameset.htm



- Marc Hartz, "How to check the SAP BW Query push down to SAP HANA?" (SAP Community Network, June 2015).
  - http://scn.sap.com/community/bw-hana/blog/2015/06/18/how-to-check-the-sap-bw-query-push-down-to-sap-hana

7 Key Points to Take Home

- SAP BW on SAP HANA does not mean that your queries are always rocket speed
- Take the time to understand the query execution plan, modes, and stats. This brings you insight into the steps at different layers.
- Keep check on new information from SAP as there is a lot of development going on with respect to query processing and feature push down
- Query performance improvements are just one of many improvements and enhancements that SAP HANA can bring to you
- SAP BW 7.4 coupled with SAP HANA brings an exciting range of new modeling capabilities and other features
- The new query design tool shows you a preview of the data in design mode
- HAP makes it possible to execute SAP HANA functions from different libraries (e.g., PAL, AFL, R) directly on SAP BW InfoProvider data

Your Turn!

Questions?

How to contact me:

Pravin Gupta

Director, Business Analytics
TekLink International

Pravin.Gupta@teklink.com

Please remember to complete your session evaluation

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