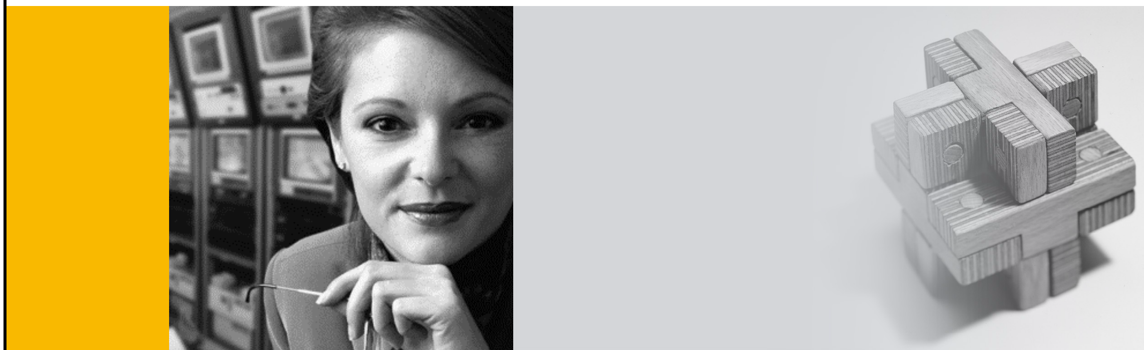

BW330

Business Information Warehouse – BW Modeling

THE BEST-RUN E-BUSINESSES RUN SAP

- R/3 System, Release 3.0B
- 2003/Q1
- Material number 50060097

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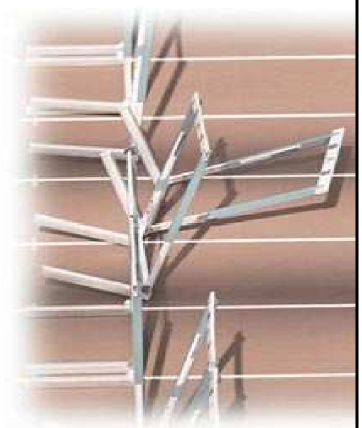
Prerequisites

Essential:

- Knowledge of the subject matter covered by BW210 (Business Information Workbench (BW)-Configuration)
  or
  BW310 (BW Warehouse Management) dealing with the BW Administrator Workbench

Recommended:

- -



Target Audience

Participants

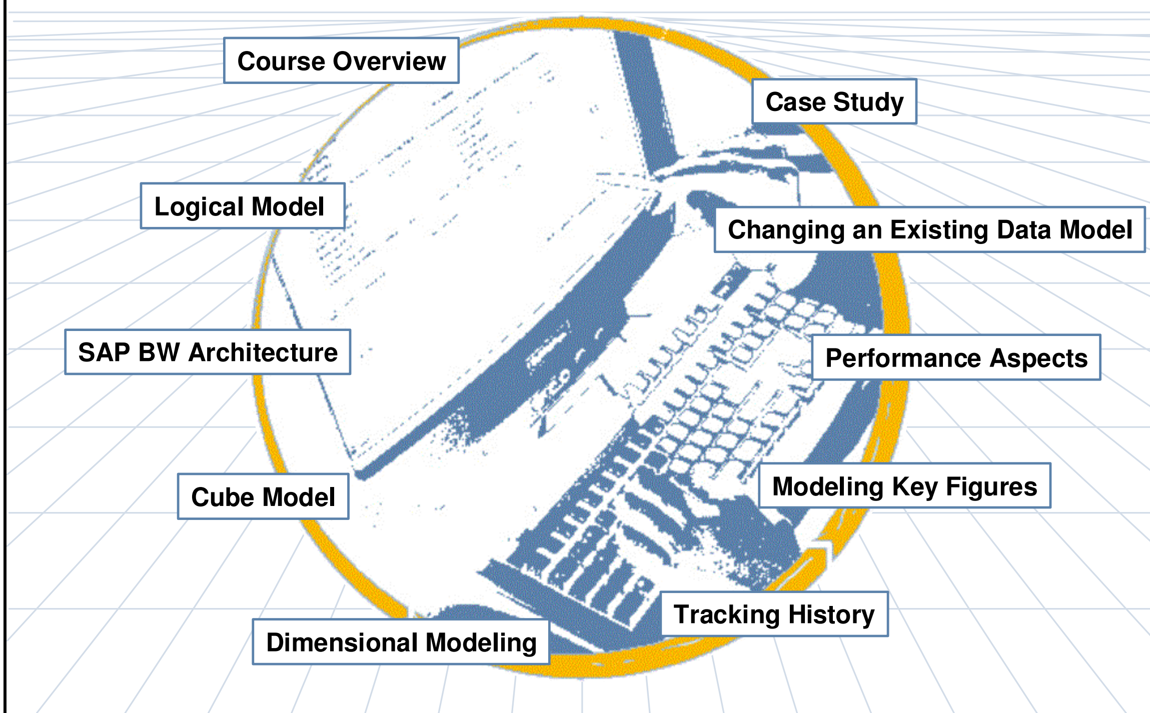
- Participants gain the knowledge and skills they need for a deeper understanding of data modeling in BW

Duration: 3 days

User notes

- These training materials are **not a teach-yourself program**. They complement the explanations provided by your course instructor. Space is provided on each page for you to note down additional information.
- There may not be sufficient time during the course to complete all the exercises. The exercises provide additional examples that are covered during the course. You can also work through these examples in your own time to increase your understanding of the topics.

BW330 Course Content



Course Goals

This course will prepare you to:

- Create a data model and implement it in SAP BW

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Course Objectives

After completing this course, you will be able to:

- structure your information needs
- develop a logical data model
- implement the data model in SAP BW

Main Business Scenario

Your company has decided to migrate the existing sales reporting function from SAP R/3 to BW.

In addition, new analysis requirements have to be integrated into the new reporting architecture.

Course Overview

Contents

- Introduction
- Requirements Analysis
- Logical Model
- Business Content Check
- Cube Model
- Modeling Dimensions
- Tracking History & Modeling Hierarchies
- Modeling Key Figures
- Performance Implications
- Changing an existing Data Model

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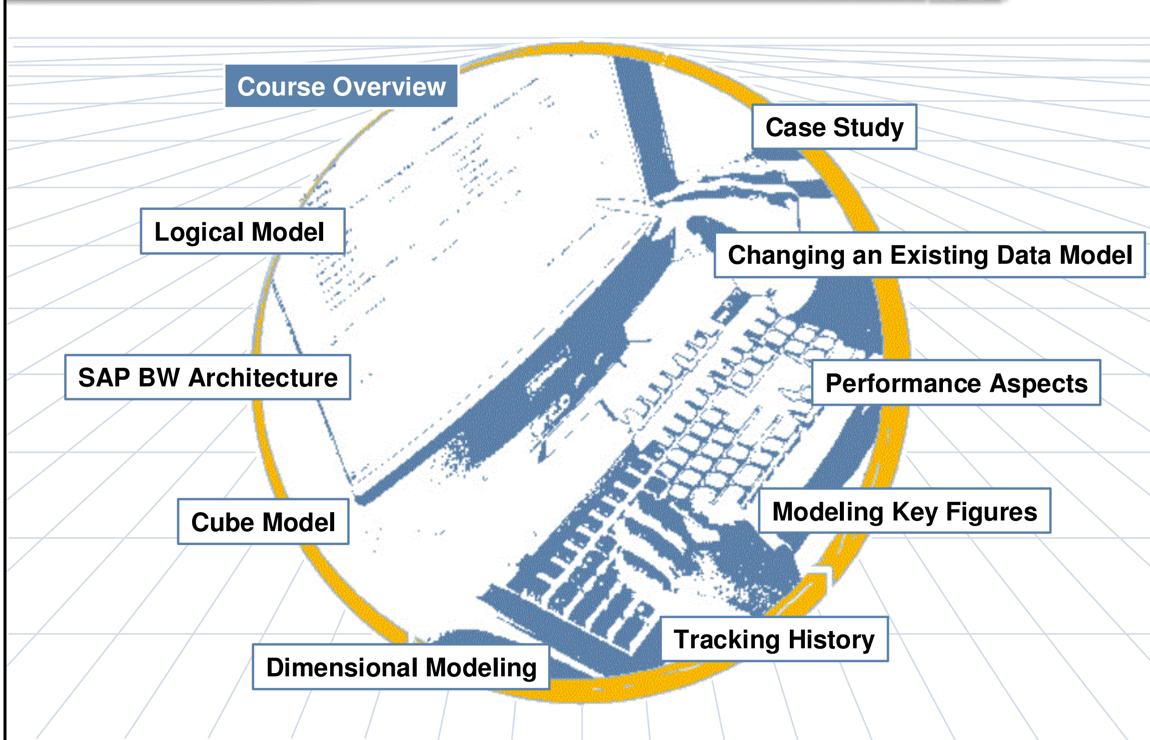
Course Overview: Unit Objectives

At the conclusion of this unit, you will be able to:

- Explain the goals of the modeling process
- Structure the modeling goals

Course Overview: Overview Diagram



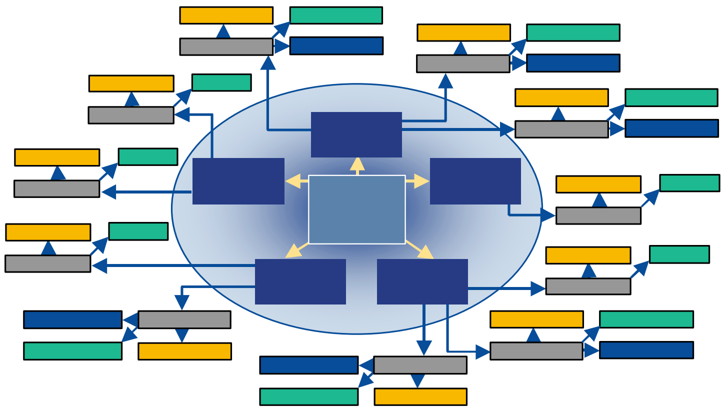
Course Overview: Business Scenario

As the person responsible for data modeling in your company's SAP BW implementation project, you first want to identify the goals and structure of the modeling process.

Introduction: Why Data Modeling?

Goals for SAP BW

- Structure and visualize all company information
- Easy, single access with central point of entry
- Self-service reporting
- Quick success



- To understand the importance of data modeling, it is necessary to remember the goals of a data warehouse.
- Structuring and visualizing all company information:
  - Ensured by putting the right content into SAP BW
  - Assumption: coverage requirement/expectations-> realization
- Easy, single access with central point of entry:
  - Tools
  - Data Model
- Self-service reporting:
  - Reporting instruments
- Quick success:
  - The system will be responsive to both users and those responsible for refreshing the data.
  - The data model will represent the company‘s data in an accurate and meaningful way.

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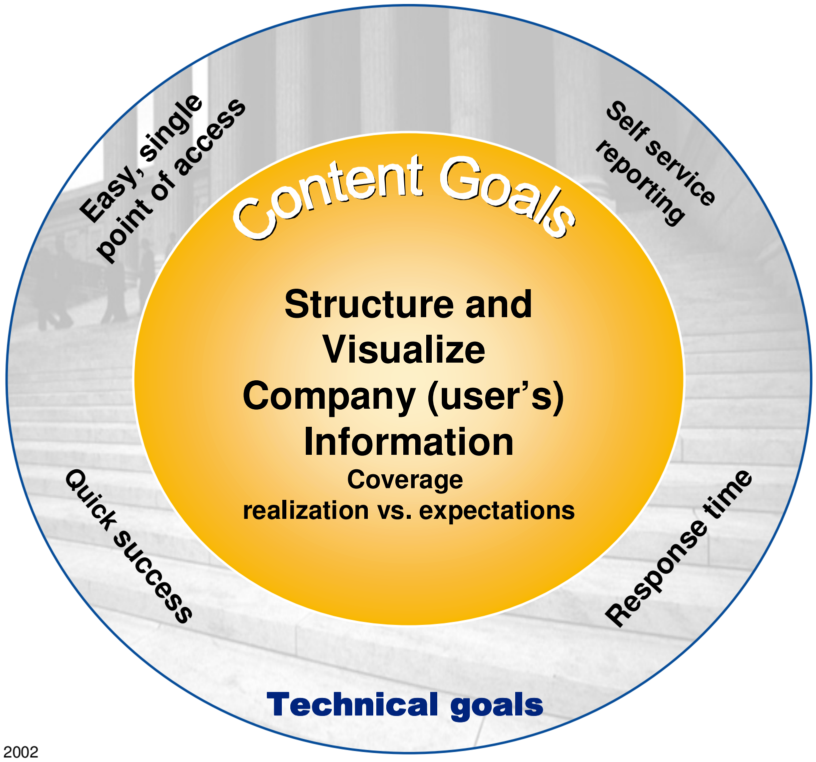
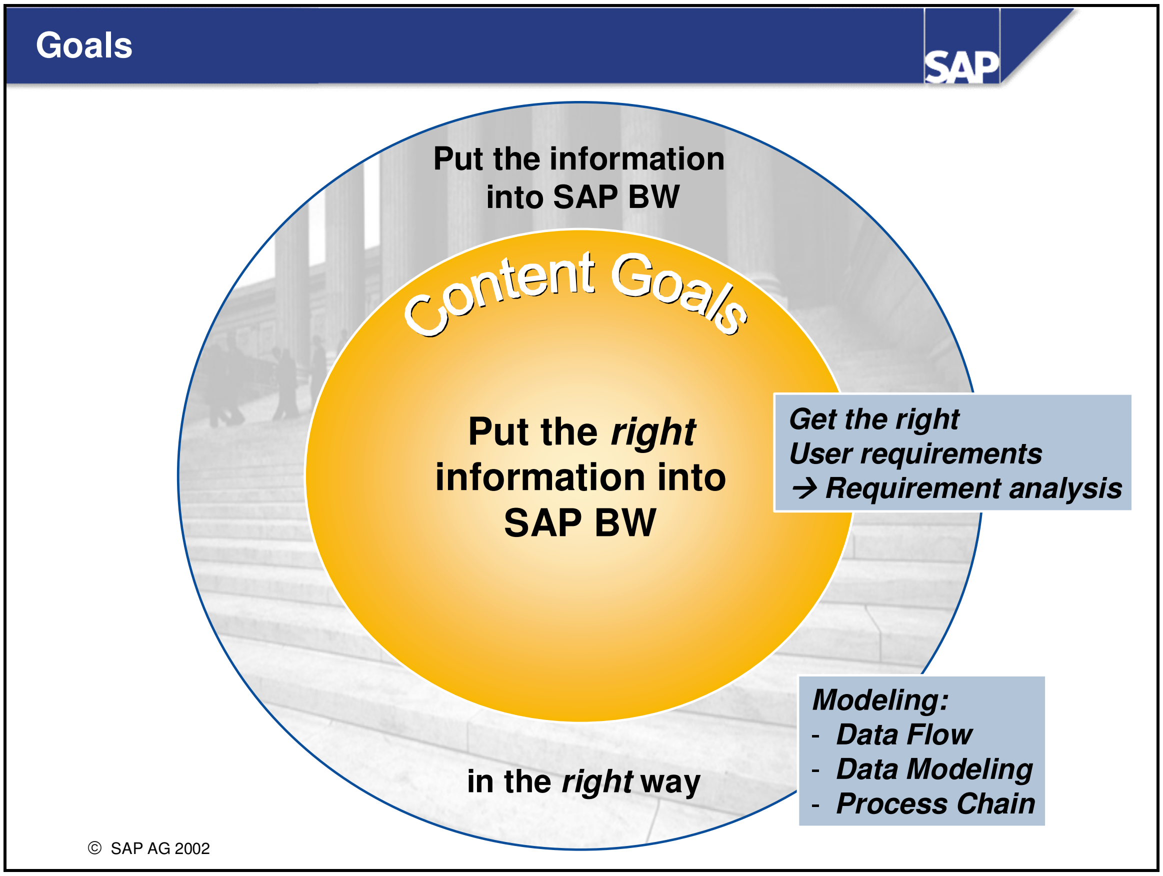
Structure Your Goals

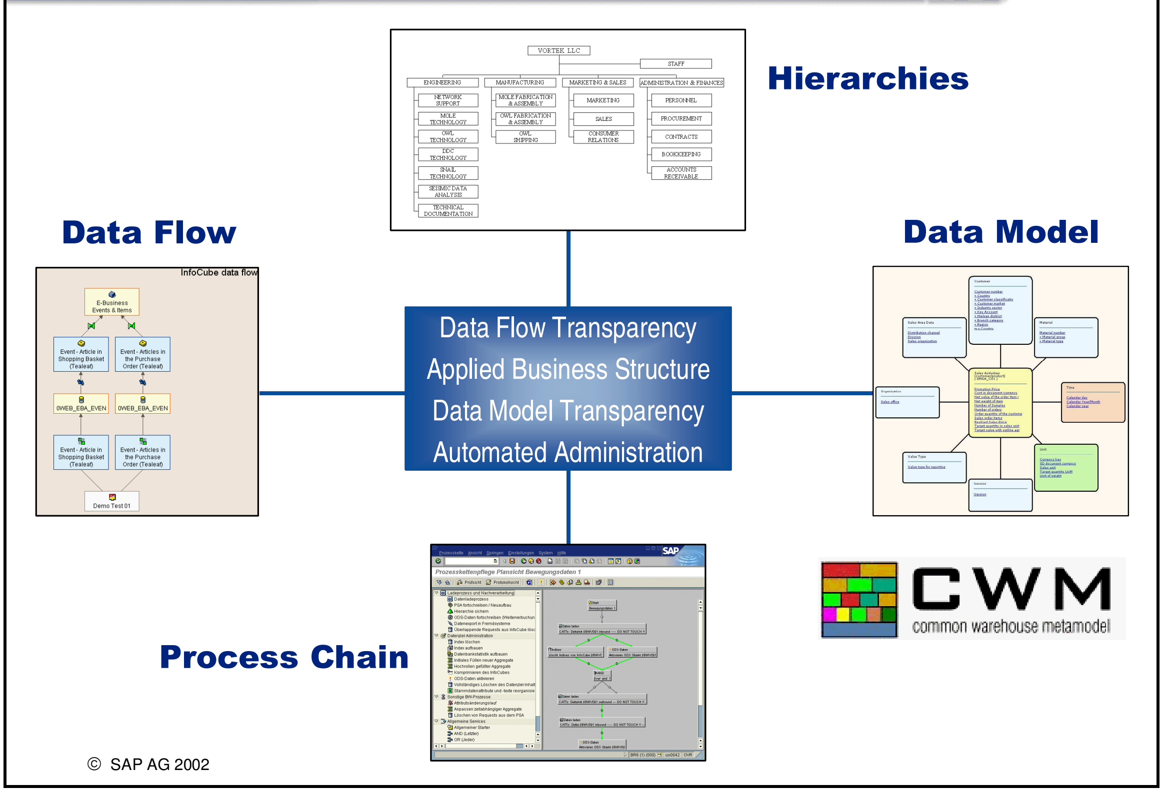


- As there are several goals which impact the modeling process, the first step is to structure the goals by priority.
- The central content goal is to provide all necessary information for the end user: “The user wants to report on specific fields“.
- Goals like “Easy and quick access” or “Flexible reporting”, etc. can be summed up as technical goals.



- The first goal is the content goal. This means to put the right information into SAP BW.
- In order to put the right information into SAP BW, there must be a detailed analysis of the user's requirements. This analysis will determine the information demand.
- The second goal is to put the information into SAP BW in the right way.
- To put the information into SAP BW in the right way is the task of data modeling.

Data Modeling as a Component of Business Modeling



- Modeling means to define the right data flow and the right data modeling, but also the right process chains. This is critical because if a user wants to have daily updated information about sales revenue, it requires the right scheduling of the data extraction.
- The overview shows modeling tasks for the Business Modeling. The main focus lies on the data modeling, especially the multidimensional modeling. Nevertheless, it also involves the modeling of data flows and process chains, since decisions in data modeling produces consequences in these areas.

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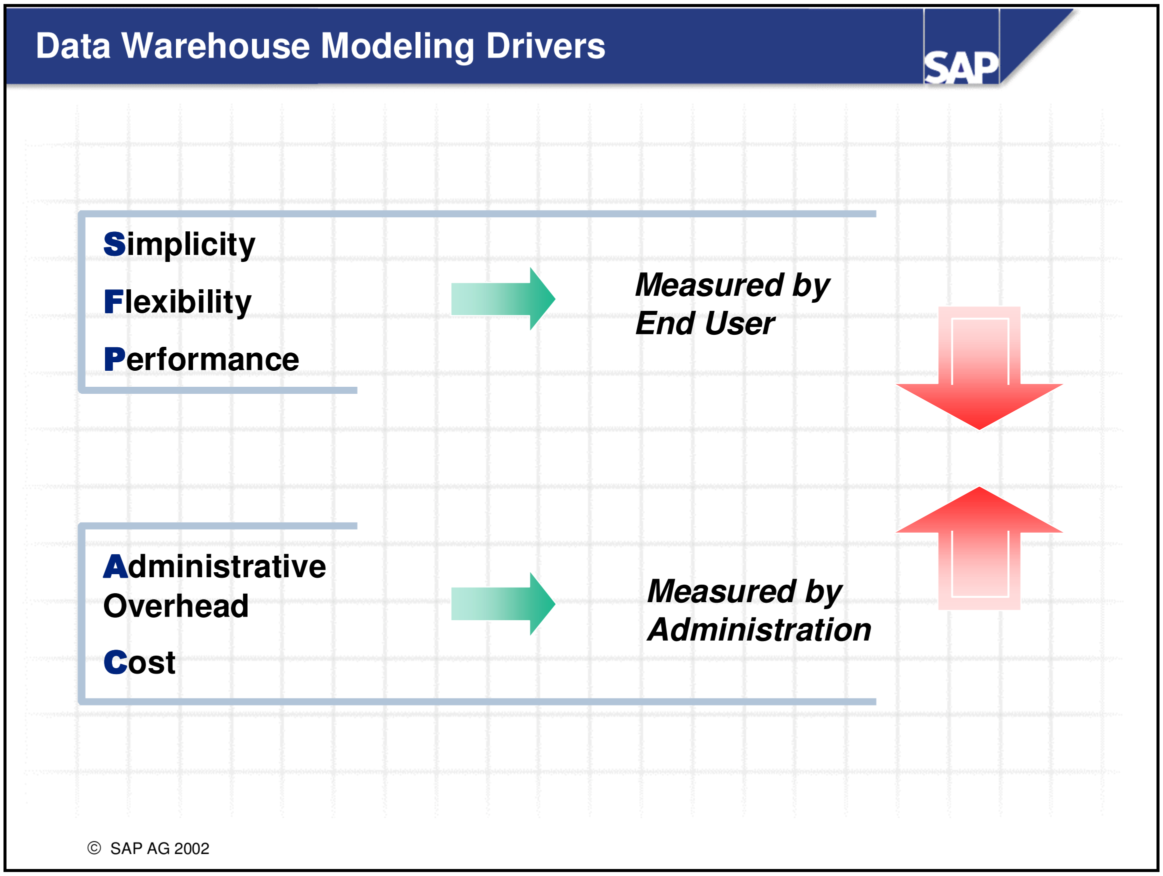

- The content and technical goals constitute the business drivers of simplicity, flexibility and performance.
- But there are also additional drivers, in part opposed to the drivers from the user side. A quick and flexible system could produce immense administrative overhead and cost. That is why the administrative drivers must also be considered.

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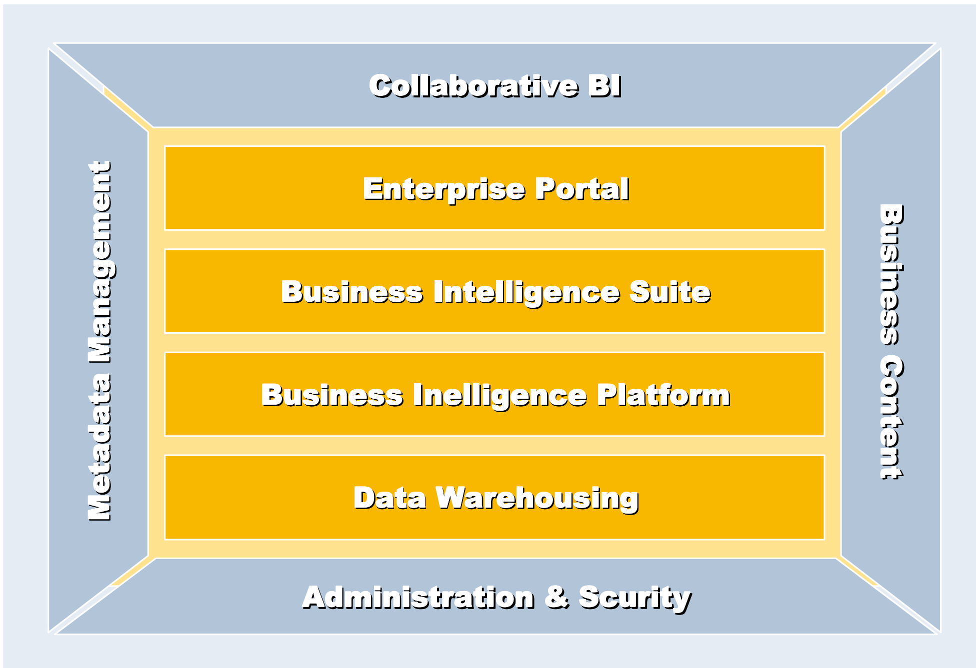
mySAP Business Intelligence



- In the previous versions of BW, most customers equate BW with just InfoCubes. mySAP Business Intelligence is more than that. To understand the focus of this course, the various layers and scope of mySAP Business Intelligence should be kept in mind.

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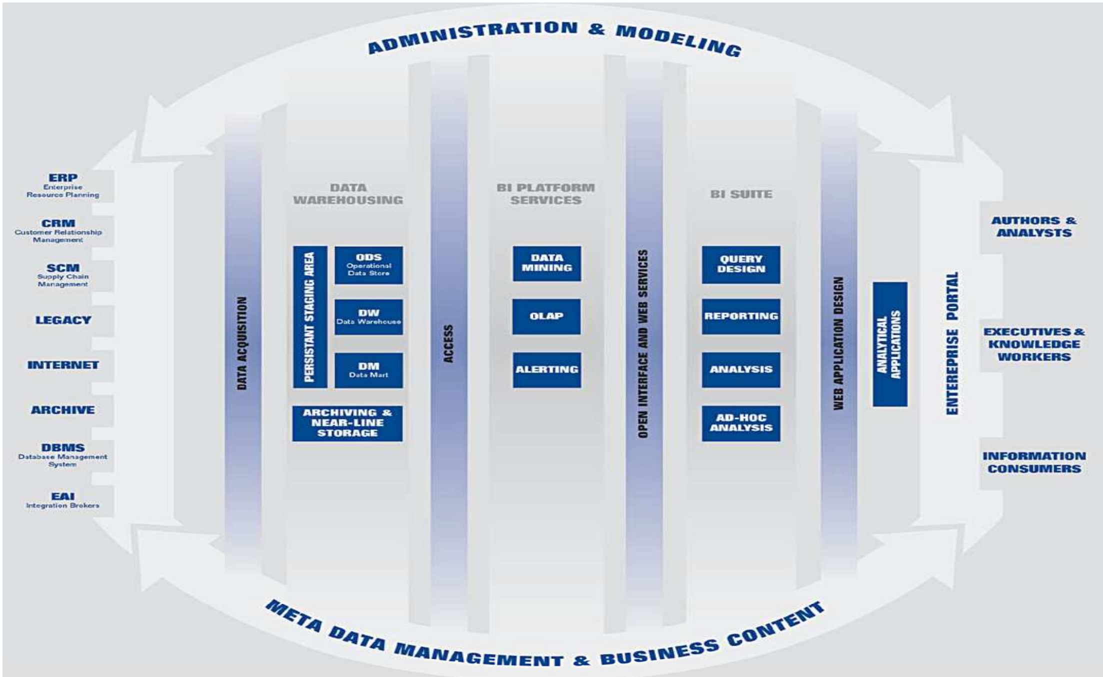
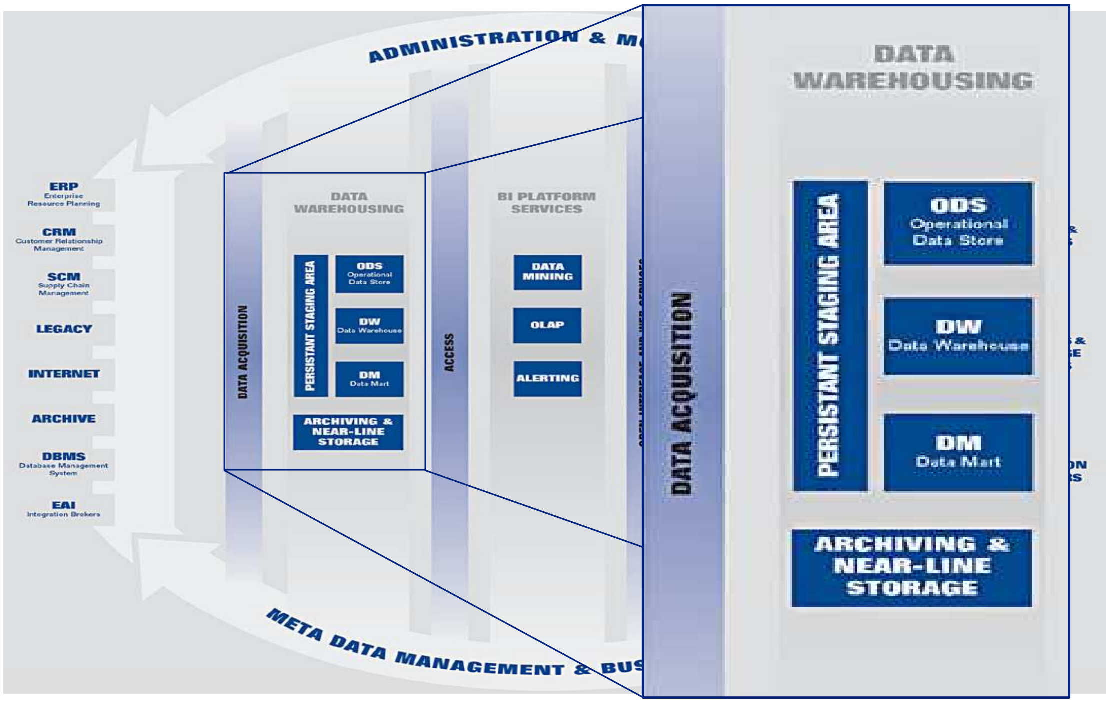
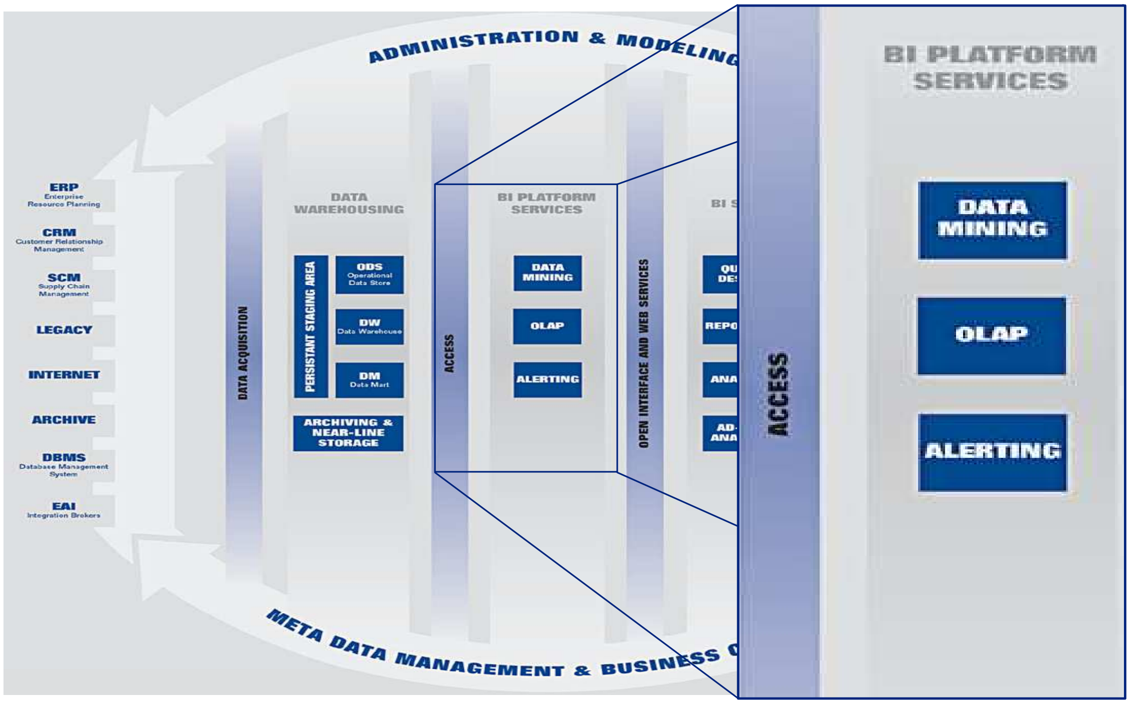
Comprehensive, End-to-End BI Solution



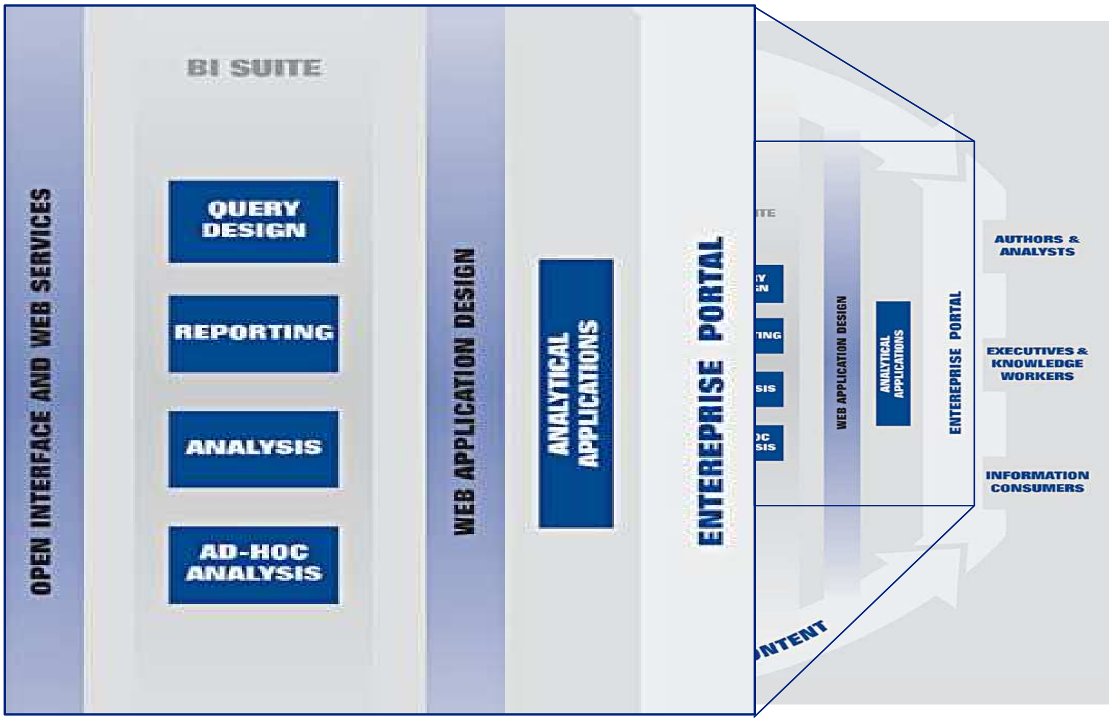
Data Warehousing



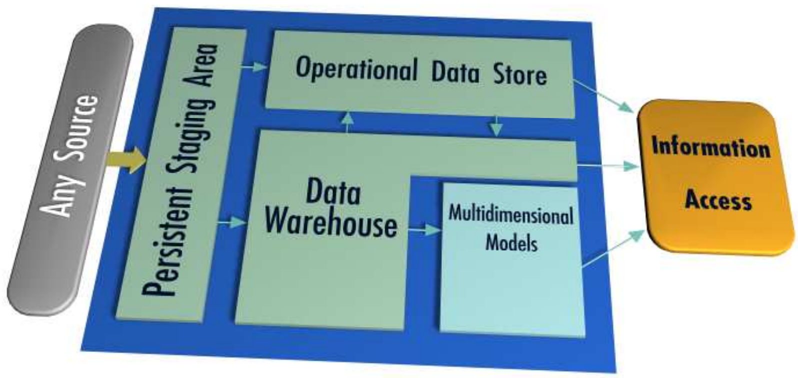
BI Platform Services



BI Suite and Enterprise Portal



BW Layer



Data Warehouse
- Non volatile
- Granular
- Integrated
- Historical foundation
- Built with ODS Objects

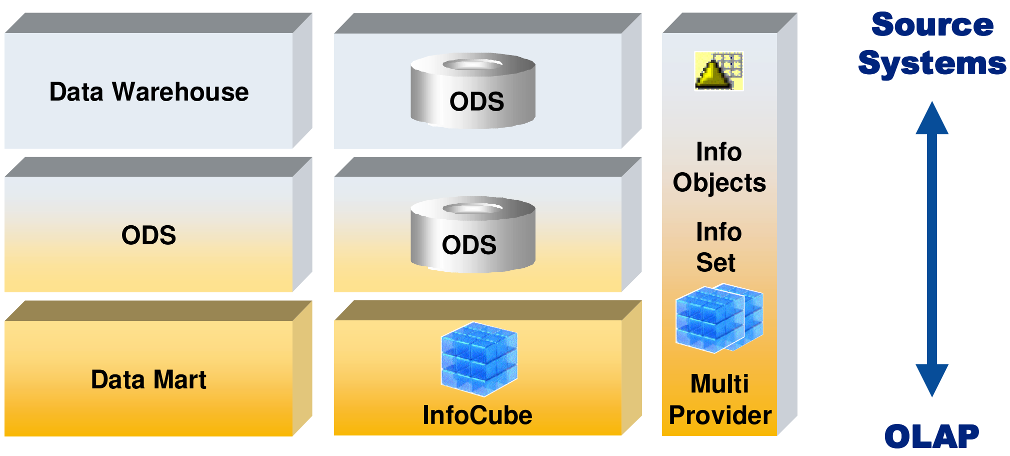
Operational Data Store
- Operational Reporting
- Near Real-Time / Volatile
- Granular
- Built with ODS Objects

Multidimensional Models
- Multidimensional analysis
- Aggregated view
- Integrated
- Built with InfoCubes

... to provide the right information for all users

- This overview of SAP BW layers is more detailed. The Persistent Staging Area is the first layer for data from different sources and application areas. The Persistent Staging Area has no rules for converting or harmonizing the incoming data.
- The Data Warehouse layer is also a pure staging area without reporting purposes. The data warehouse layer contains rules for harmonizing data from different sources. The Data Warehouse layer has also the complete history which is not available in the source system or the reporting layer anymore.
- The Operational Data Store is the layer for operational reporting, which typically means reporting on the item level and on a daily basis.
- The Multidimensional Models layer is designed for analytical reporting on an aggregated view of the data with ‘slice and dice’ functionality.

InfoProviders and Their Layers



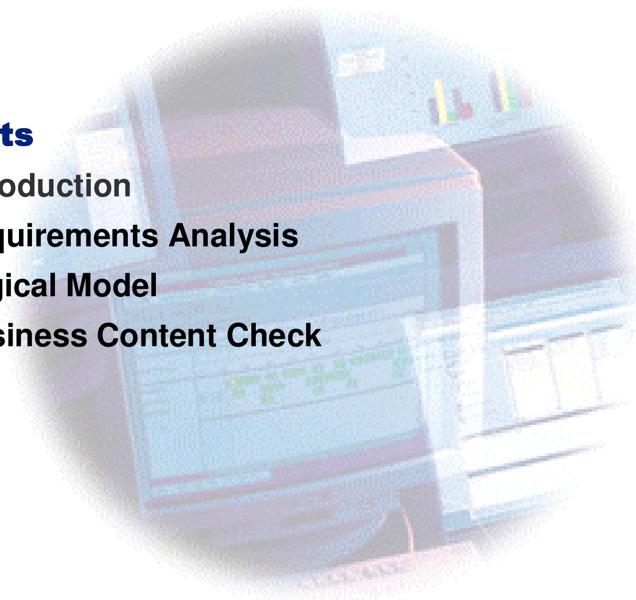
- The SAP BW InfoProviders are relevant to the different layers of the BW architecture. The PSA layer uses the PSA tables. The ODS and Data Warehouse layers need updating and change log functions, so this layer mostly consists of ODS objects. The Multidimensional layer needs multidimensional objects, therefore it is based on InfoCubes and MultiProviders.
- So InfoCubes are the central objects for (analytical) reporting. This course focuses on correctly modeling the InfoCube models. ODS objects are not as complex and are already explained in the BW310 course. Therefore, InfoCube modeling is the central objective of this course.

Course Overview: Unit Summary

Now you will be able to:

- Explain the goals of the modeling process
- Structure the modeling goals

Logical Model



Contents

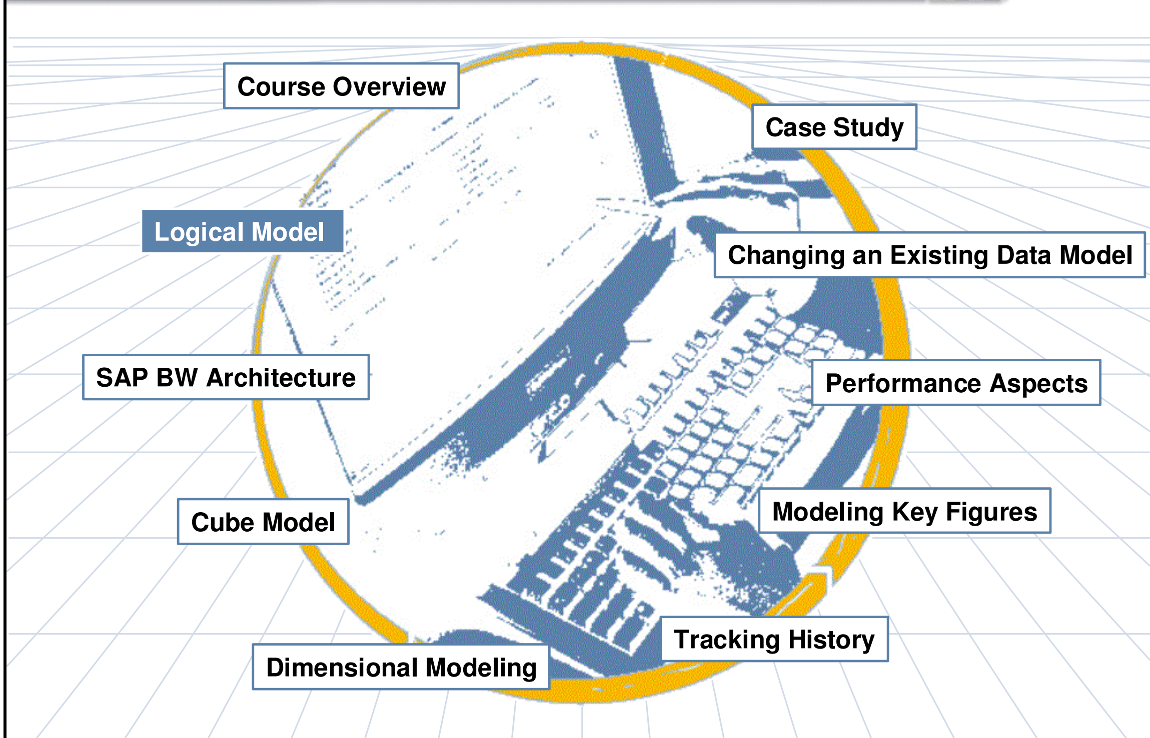
- Introduction
- Requirements Analysis
- Logical Model
- Business Content Check

Logical Model: Unit Objectives

At the conclusion of this unit, you will be able to:

- Identify the steps of the requirements analysis
- Setup a logical model based on the requirements analysis
- Analyze the Business Content
- Identify gaps between your requirements and delivered objects

Logical Model: Overview Diagram



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Logical Model: Business Scenario

- Your company has done an initial requirements analysis in a workshop. Your task is to identify additional information needed to complete the requirements analysis.
- Based on the requirements analysis, you will setup the initial logical data model.
- You want to check the Business Content in BW to identify any gaps that exist between your requirements and the delivered objects.

Steps to Define a Data Model

Information Gathering

- Get the information needed
- Get the relevant processes

Structure the Information Need

- Multidimensional structure
- Logical model

Transfer into a Physical Model

- BW data model

Business Content

- Explore use of existing models

- As stated in the introduction, getting the right information demands from the user is an essential point in the process of modeling. The information demand has to be structured and transformed step-by-step into a multidimensional model.
- BW already contains complete business logic: The BW Business Content.

Information Gathering

Gather requirements and expections of the users

- Which processes should be reported?
- Which perspectives should be reported?

Get decision points in design

- Grain, history

Get process know-how

Correct expectations

- One of the goals of the information gathering is to find out which reporting processes should be modeled. In addition, we may uncover differing perspectives of the same process and these differences need to be resolved.
- Part of the resolution process is to define specific decision points on design aspects such as the level of granularity of the data and how history will be tracked.
- The information we get from the interviewing process is the base of knowledge we have to use in the design process.
- During the information gathering process, you can begin to set the correct expectations of those you interview.

Checklist for Information Gathering

- **Interviews or small workshops**
- **Short duration**
- **Get the right requirements**
  - Speak business, not technical, language
  - Interview every role twice
  - Consider:
    - Executive level
    - Corporate and field
    - Technical and business side
    - Technical side provides a realistic view on available data: a “reality check”
    - Overview system landscape / source systems
- **Prototyping**
- **Example reports**

- Here are various points which should be considered during the interviewing process.
- A parallel prototyping is helpful, to find a common understanding of the modeled process. The Business Content can help to build a quick, but concrete, prototype.
- It is important to define the proper coverage for personnel interviews. This means to consider the field (e.g. Sales in every country), the corporate departments and the executive level to find out management demands.
- The business side can help to enhance the existing reporting to find a higher level of benefit.
- The technical departments (IT) can help identify the sources of information that the business side needs. This gives a more realistic view of available information. It also helps identify which authorization issues must be considered.

Key Points for Information Gathering

Requirements

Grain

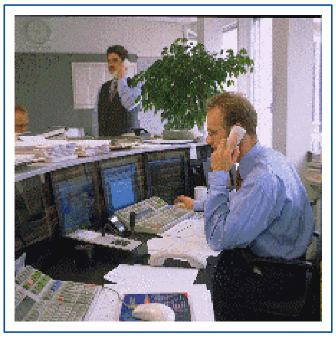
Historical duration

Urgency

Speed

- These are the issues which must be considered during the concept phase for any data modeling project.

Requirements



Understand the users' process

- Mission of your team / group / department / division
- How do you measure your business?
- Business Driver

Analytical needs

- Analysis needs for the job

- Understanding the users' business process and which analytical parts have to be reported in BW is definitely a requirement for correct modeling. Often the user cannot express his needs in a technical way, so sometimes the transforming of his needs into technical language is necessary, often with help from the technical application side.
- However, this depends on whether the BW project is a porting of the reporting function from one system to another or a complete new beginning, often parallel with a introduction of a new application and processes.

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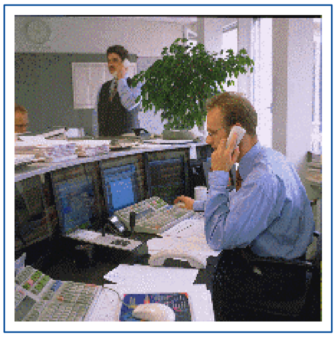
Requirements



Sources

- Where do you get this information?
- Realistic requirement
- Internal data
- External data

Grain

- Daily/Monthly/Yearly based
- Snapshot vs. Inventory vs. transactional
- Freezing necessary
  - Finance
  - HR

- Simply having a list of fields available is not sufficient to build a model.
- It is also necessary to know which sources should be used for a particular piece of information since, for example, revenue differs based on its source (Finance, Controlling, Sales view).
- The question of which sources will be used is also a criteria in determining if the information requirement is realistic.
- Grain means how granular or detailed the information should be. On one hand, you may ask if a realtime overview of sales volume necessary or if a monthly snapshot of the sales data is sufficient. In some cases, a frozen view of the data is needed, to ensure that a view of the data for a point in time is always available.

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Types of Granularity

Transaction Granularity

- Point in time, most dimensional
- Best for capturing event detail

Periodic Snapshot

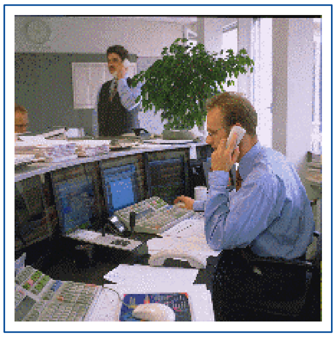
- Span of time regulary repeated
- Best for long continous processes

Accumulating Snapshot

- All of history from beginning to present
- Best for short processes and workflows

- The term granularity describes the detail of a database in a data warehouse. "Highly granular data" is data that is highly detailed. For the InfoCube, this means that there are many Characteristics which describe the key figures. For example, "by customer" level granularity is less granular than "by customer, by material."
- Granularity affects the size of the database. Data stored "by customer, by month" is much more summarized than "by customer, by material, by day." Therefore, a year's worth of data for the first case would be much smaller than for the second case. However, reducing granularity means losing information. For instance, a customer buys the same product 2 to 3 times a month. A time granularity of Day may produce 2 or 3 Fact table entries. A time granularity of Month will produce 1 record in the Fact table, but with a loss of information (I.e., number of orders on different weekdays).
- The decision on granularity has the biggest impact on space and performance. Large Dimension tables (many characteristics) have a negative impact on performance and size.
- Granularity is the fundamental determinant of how far you can drill down on the data.
- Thus, the decision as to locate a Characteristic in either a Dimension table of an InfoCube or in the Master Data attribute table is one made on:
  - The degree of desired granularity (more dimension table characteristics = more granularity),
  - The reporting requirement of drill-down frequency by the Characteristic, and
  - The balance between data load time versus query performance (query run time).

Requirements



Volume

- How many customers?
- How many line items?
- How many products?

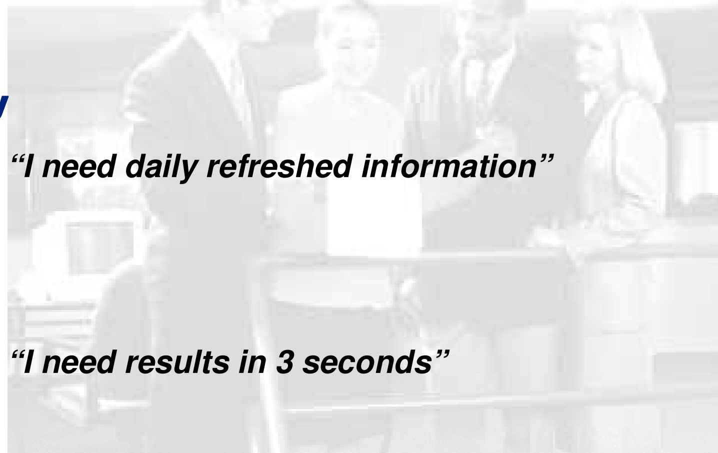
- Information about data volumes is a basic issue, since having millions of customer records can make it necessary to make other design decisions (e.g. line item dimensions, mixed dimensions – described in later chapters).

Staging Issues

use

History Duration

"I need monthly comparison of the last 3 years"



Urgency

"I need daily refreshed information"

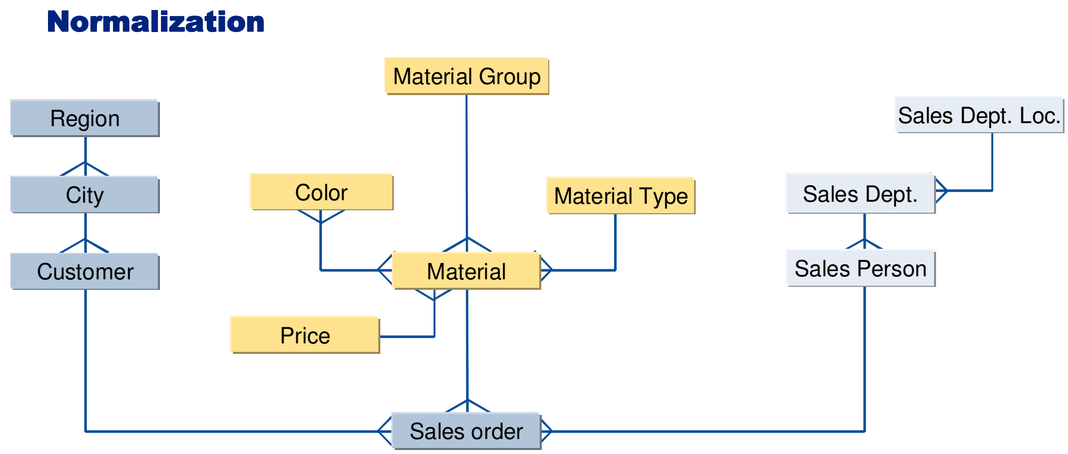
Speed

"I need results in 3 seconds"

cost

- Time related staging issues must be addressed. To do so, you will make decisions about:
  - How much historical information should be supplied?
  - How recent is the information that is supplied?
  - How quickly can the information be retrieved?

The Role of Entity Relationship Model



Pros

- **Exact understanding of process and relationships between KPIs, Entities and Attributes**

Cons

- **Model may be overly complex for data warehouse modeling**

- The Entity Relationship Model describes the process very precisely and provides a good base for building a multidimensional model. It shows if relationships between entities are 1:n or n:m, which is very important for decisions in multidimensional modeling.
- On the other hand, often the business refuses to build such a model because of its complexity (at first sight).

Transform Information Need into Data Model

Information gathering ✓

- Get the information needed ✓
- Get the processes ✓

Structure the information need

- Logical model
- Multidimensional structure

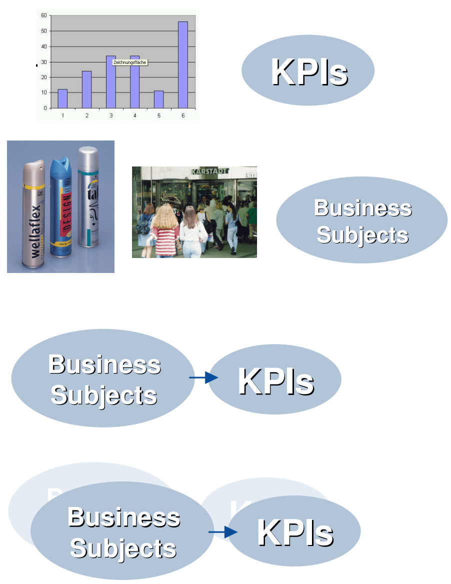
Transfer into physical model

- BW data model

Business Content

- Use of existing models

Steps: Structure, Transform and Check Model



Step 1: Analyze KPIs

- Get relevant KPIs from interviews
- Get basic key figures

Step 2: Analyze Business Subjects & Related Attributes

- Characteristics, which describes the KPIs
- Business subjects / Big Entities
- Additional attributes

Step 3: Assign Business Subjects to KPIs

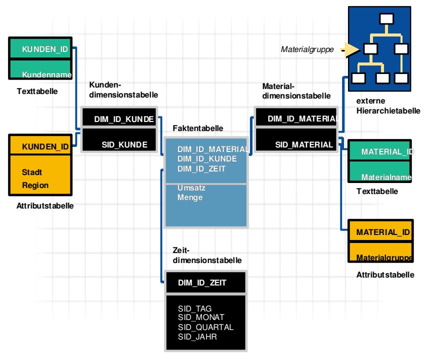
- Time View

Step 4: Cluster Key Figure Structure

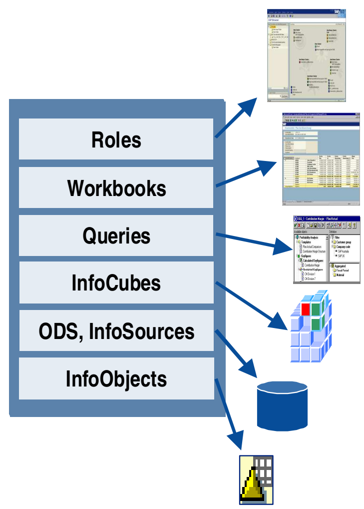
- This slide shows a formal way to structure the gathered information needs. The first step in this process is to find out the things which should be measured, like volumes, order entry and costs.
- The second step is to find the main business subjects of the reporting area. Typical subjects are customer, product or organizational objects like sales organization. These subjects have additional attributes, which describe these subjects. For example, grouping attributes like customer group, account group or product class. The customer often contains attributes like address data.
- Often the KPIs already contain Business Subjects, e.g. revenue in certain product groups.
- The third step assigns the business subjects to the key figures.
- The fourth step is to cluster key figures with similar structure, which is the initial basis for a basic cube.

Steps: Structure, Transform and Check Model

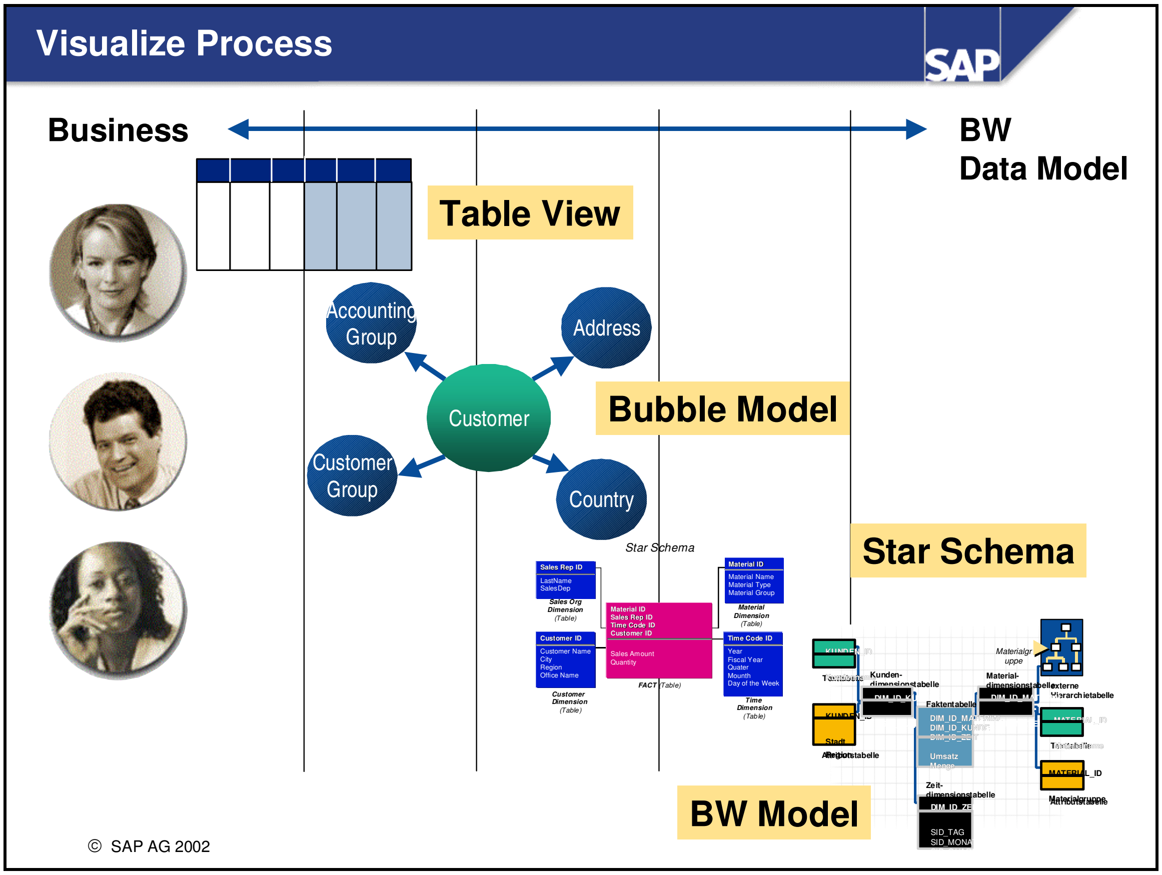
Step 5: Transform into Physical Model



Step 6: Business Content Check



- Step 5 transforms the logical model into a physical model.
- Step 6 checks the model against the Business Content. The Business Content check is usually made during the complete process from information gathering to the physical model. In the first steps, the Business Content can give ideas for reporting demands (e.g. Prototype), because often the business cannot exactly describe its demand. The Business Content also helps in building a logical model.



- As you progress through the requirements analysis, you will be able to create representations of your model that are increasingly concrete.
- The earlier models, such as the table view and Bubble Model, allow for discussion and thought about business process representation without having to become too restricted by technical details.
- These models will be described in the following slides.

Table View

Characteristics

Key Figures

Key figure	*Product*	*Sales Org*	*Customer*	*Material*	*Account*	*Country*
Order Entry (Vol)	X	X	X	X		X
Sales	X	X	X	X		X
Order Inventory	X		X	X		X
Revenue	X	X	X	X		X
Sales Quantity	X	X	X	X		X
Volume	X	X	X	X		X
Return	X	X	X	X		X
Product Cost	X			X		
License Cost					X	
Accounts Rec.					X	

Assignments

■ The table view, shown here, is a good technique to structure the information demand.

Table View

SAP

Step 2
Gather Characteristics

Characteristics

Step 1
Gather
Key Figures

Key Figures

Key Figure	*Product*	*Sales Org*	*Customer*	*Material*	*Account*	*Country*
Order Entry (Vol)	X	X	X	X		X
Sales	X	X	X	X		X
Order Inventory	X			X		X
Revenue	X			X		X
Sales Quantity	X			X		X
Volume	X			X		X
Return	X	X	X	X		X
Product Cost	X			X		
License Cost					X	
Accounts Rec.					X	

Step 3
Assign
Business Subjects
To key Figures

Step 4
Sort
Key Figures
=
Cluster
Key Figure
structure

Assignments

- Remembering the steps of structuring the demand, the first step is to gather key figures in the rows. The characteristics are gathered in the columns (Step 2). The assignment is done by checking, if the characteristic makes sense (or should be reported) related to the key figure.

Extended Table View

Business Content

Grain

Key Figures

Key Figure	*Type Keyf. Basic*	*Calc*	*Source*	*Grain Time*	*BC*	*Product*	*Profit Center*	*Customer*	*Material*	*Account*	*Country*
Order Entry (Vol)		X	SIS	Month	SD	X		X	X		X
Sales		X	SIS	Month	SD	X		X	X		X
Order Inventory		X	SIS	Month	SD	X		X	X		X
Revenue		X	SIS	Month	SD	X		X	X		X
Sales Quantity	X		SIS	Month	SD	X		X	X		X
Volume	X		SIS	Month	SD	X		X	X		X
Return			SIS	Month	SD	X		X	X		X
Product Cost	X	X	SIS	Month	SD	X	X	X	X		
License Cost	X	X	SIS	Month	SD					X	
Accounts Rec.		X	SIS	Month	SD					X	

Source

Calculated / Basic Key Figure

Characteristics

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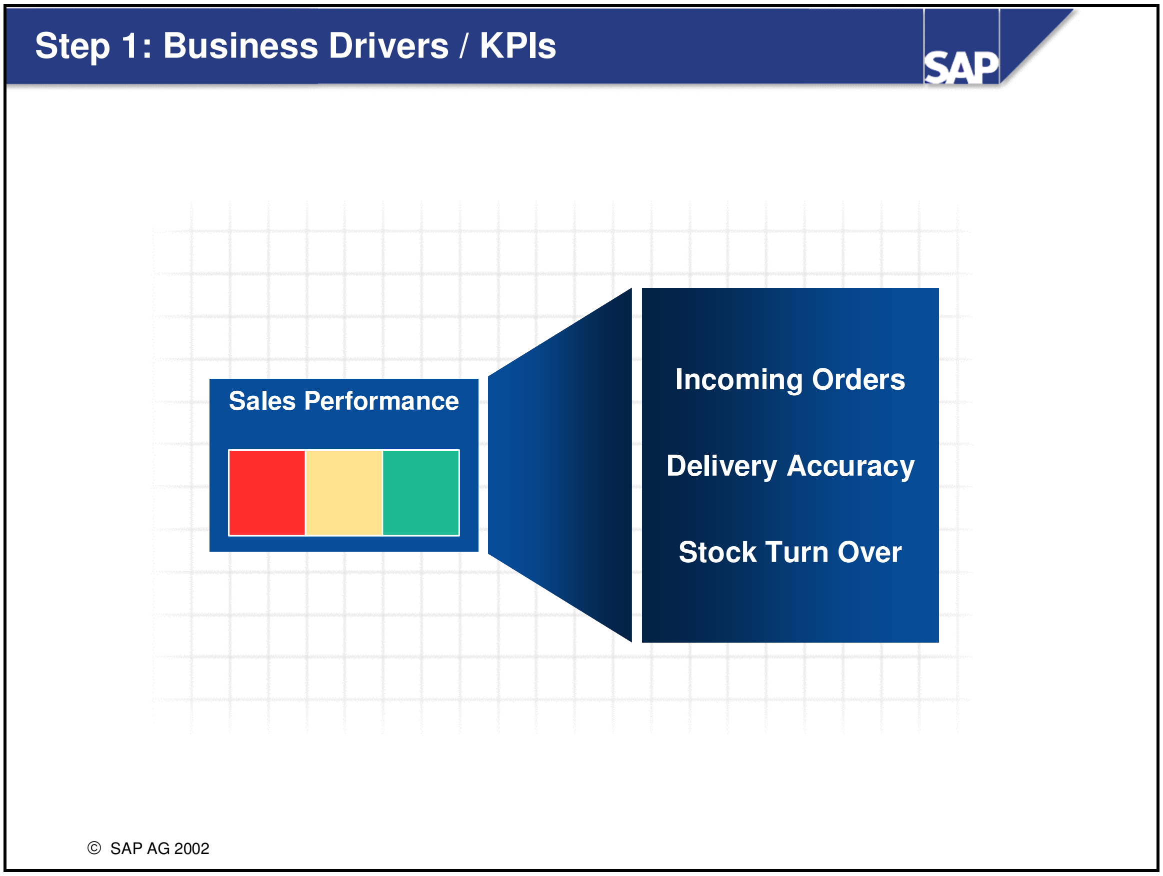
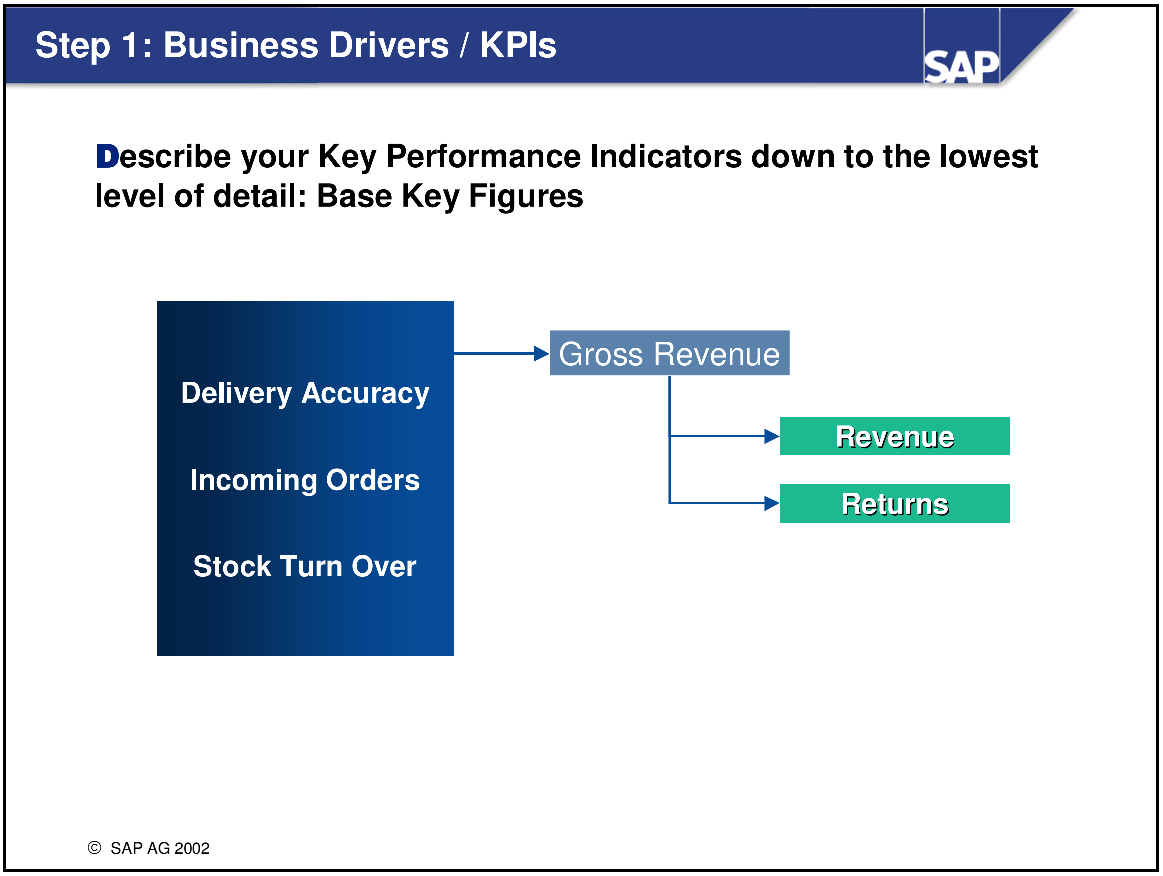
- The extended table view shows enhanced information about
  - the required grain of the key figures
  - the source of this information / Business Content area (which is often the same)
- The table model does not show the relationships between the single characteristics. This relationship is important in defining the right dimensions.



- This slide show the derivation from the reporting process to the individual reporting issues. From this point the single key figure is to be determined.
- This is the first step in the process from structuring the information demand to the logical and physical model.

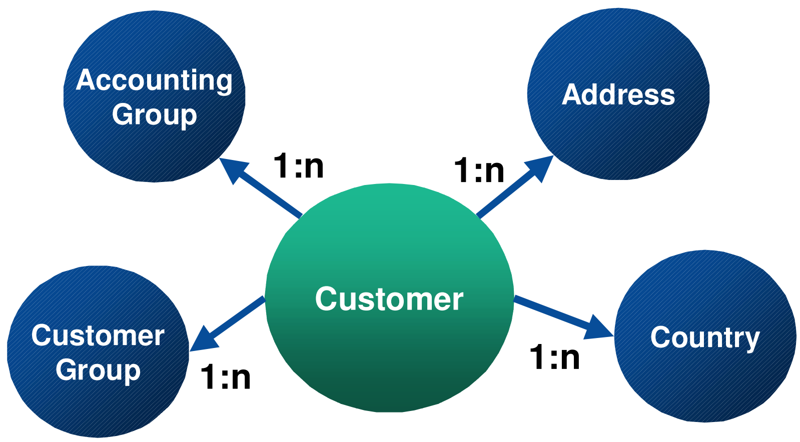


- The first step is to gather the key figure, which should be measured.
- In this process it should also be considered if these key figures are basic or calculated.

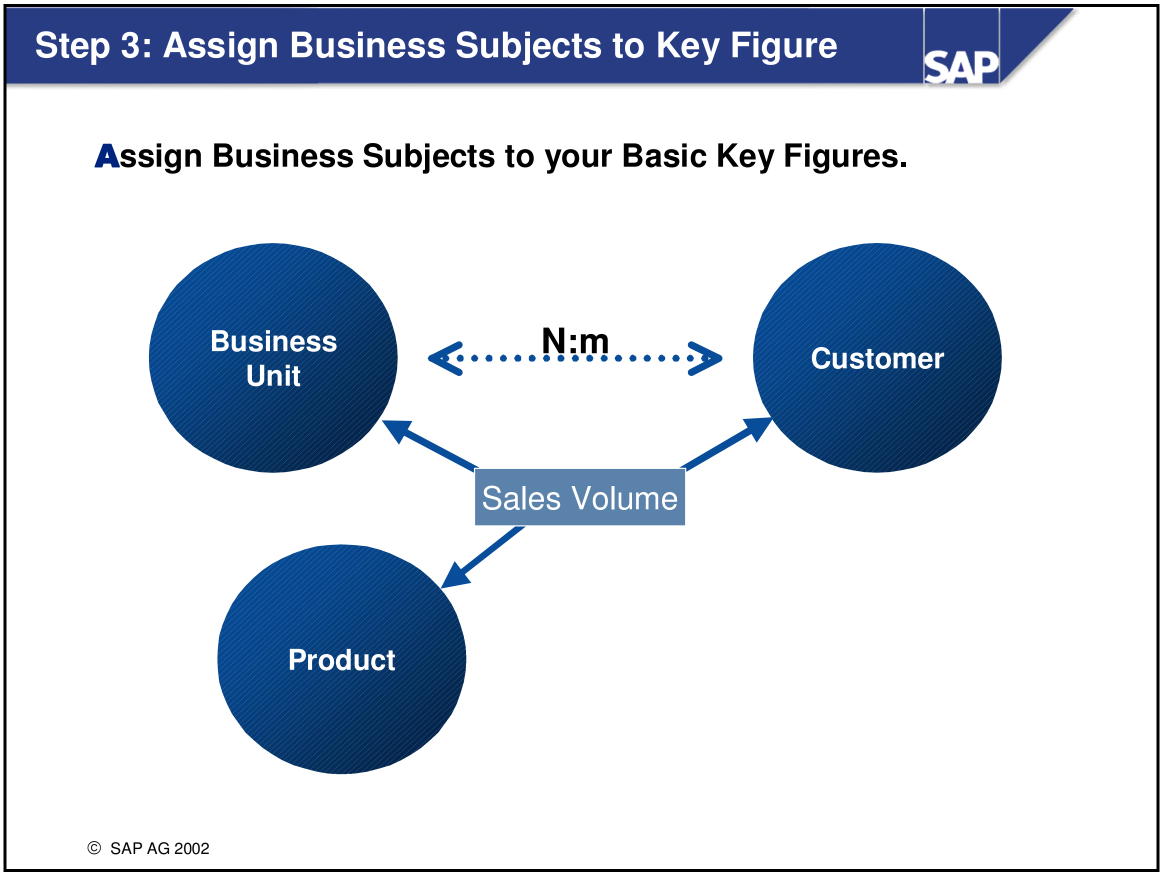
Step 2: Business Subjects

Find your main business subjects like customer, product, organization and describe them by their important properties

→ Building Subjects

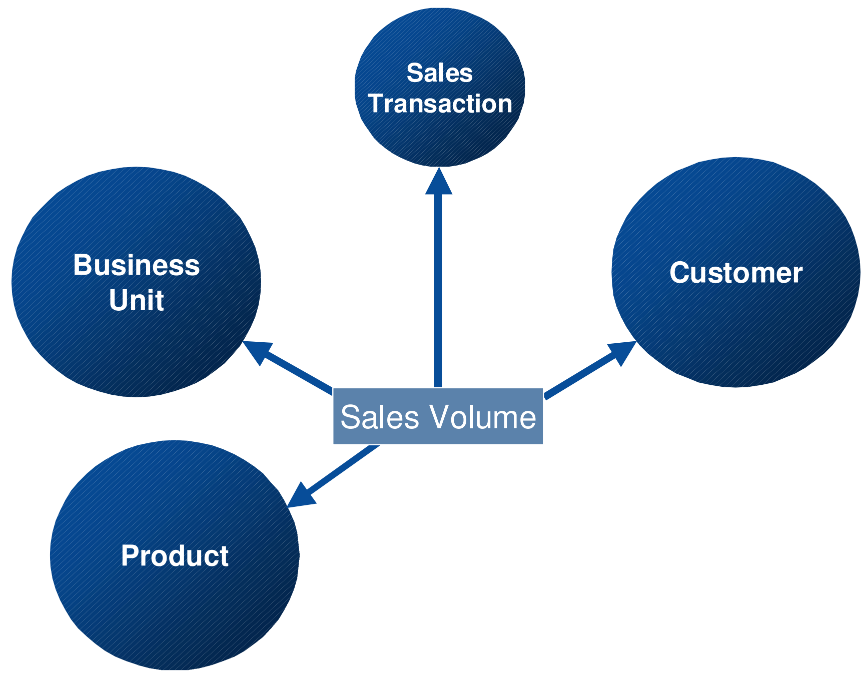


- The second step is to consider the business subjects, the main reporting perspectives. These business subjects are described by attributes, which are often grouping and categorizing subjects. These attributes are typical reporting objects in the analytical reporting. These attributes are regularly 1:n related to the main business subject, so the object customer is the most detailed information.
- In some cases there also n:m relations, e.g. one account can have more than one owner, a product can have more than one color. This issue is handled as a special modeling issue in the following chapter.

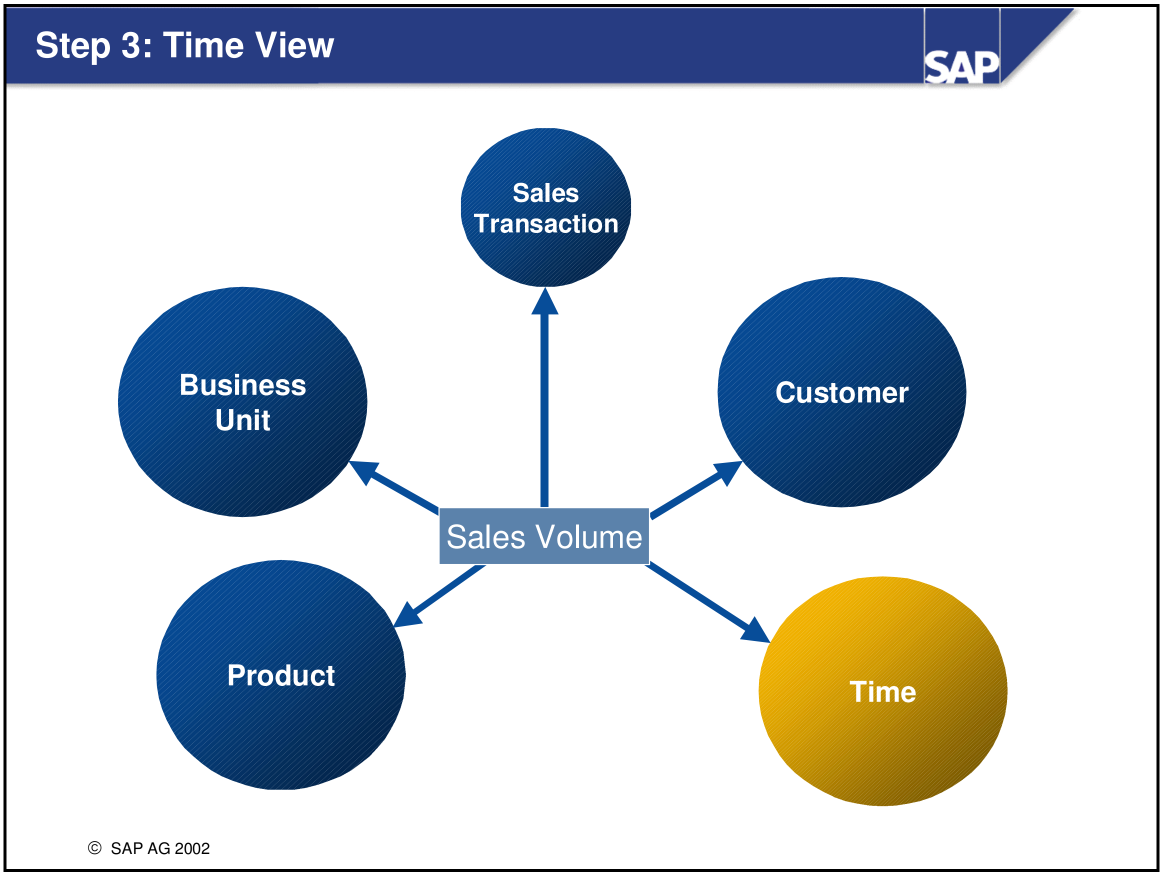


- In the third step, the business subject is assigned to the key figures.
- The business subjects are n:m related, e.g. one customer can buy several products, one product can be bought by several customers.
- Products are sold in several business units.

Step 3: Intersection Entities

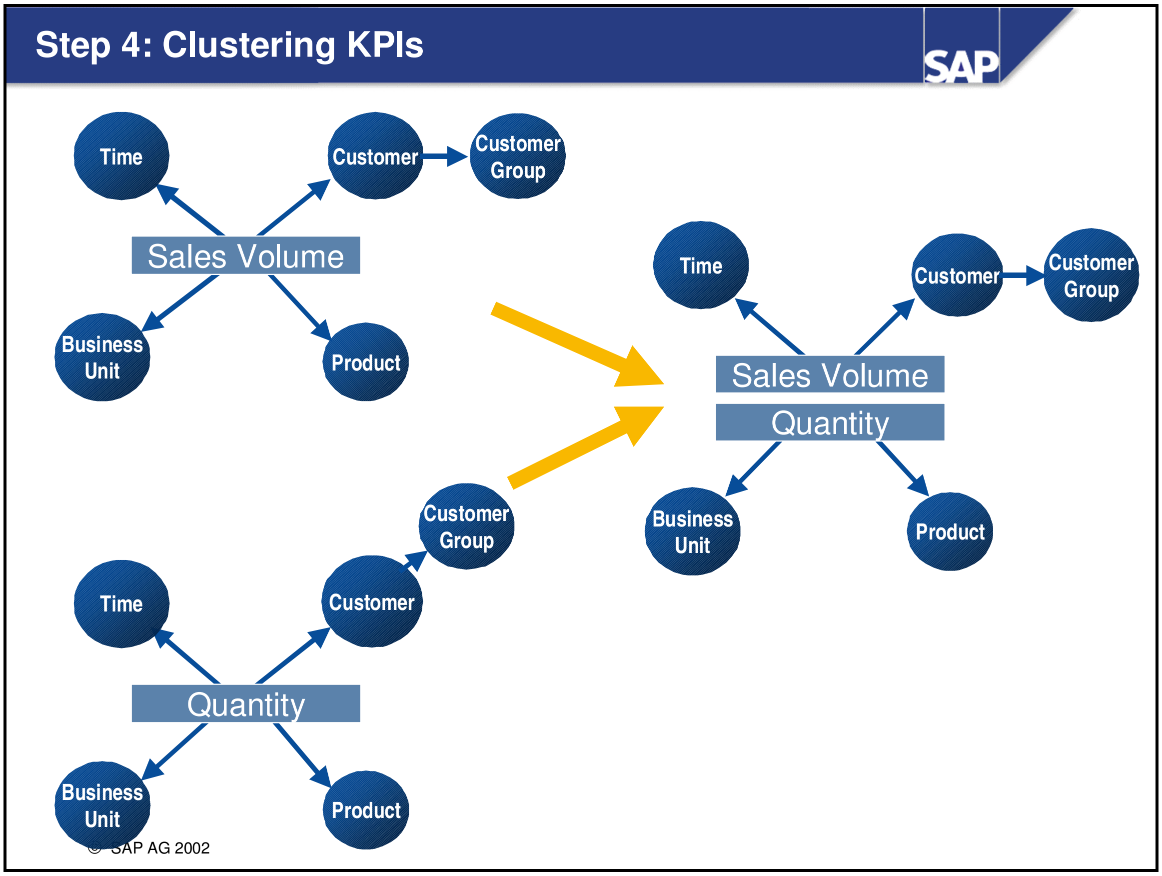


- Some subjects/entities are strongly related to the facts, e.g. document number.
- These subjects are called intersection entities and have to be an "unique" bubble because of its n:m relationship to the other objects.



■ The time view is also a separate object which has to be defined from its own perspective.

Step 3: Complete View



- Key figures with the same business subject and grain are summarized into one structure.

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Step 4: Complete View

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Transform into Physical Model

Information gathering ✓

- Get the information needed ✓
- Get the processes ✓

Structure the information need ✓

- Multidimensional structure ✓
- Logical model ✓

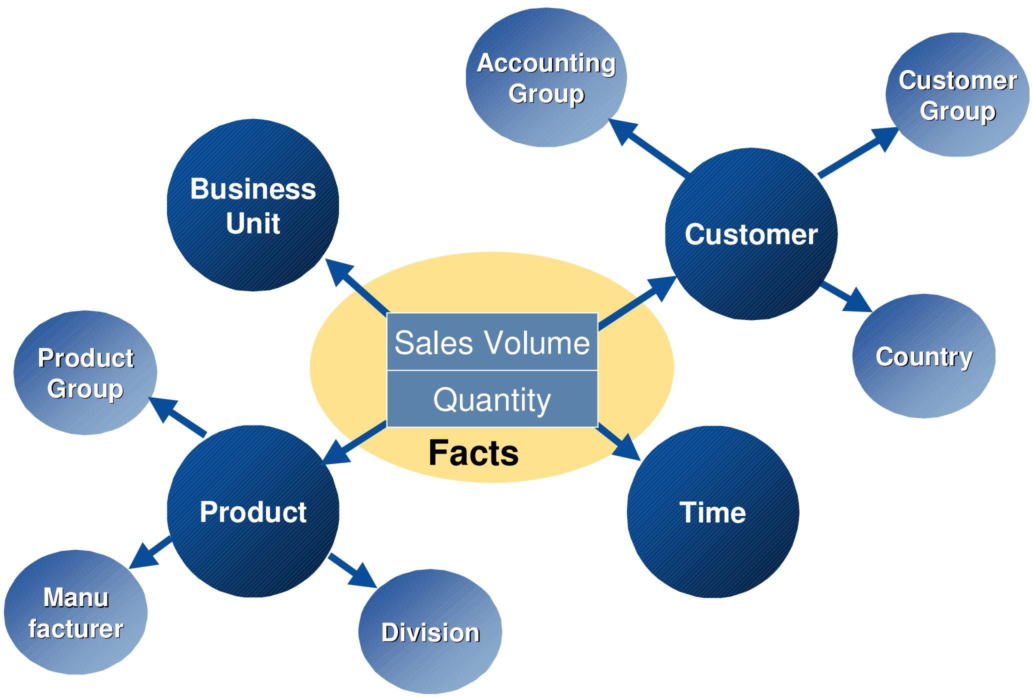
Transfer into physical model

- BW data model

Business Content

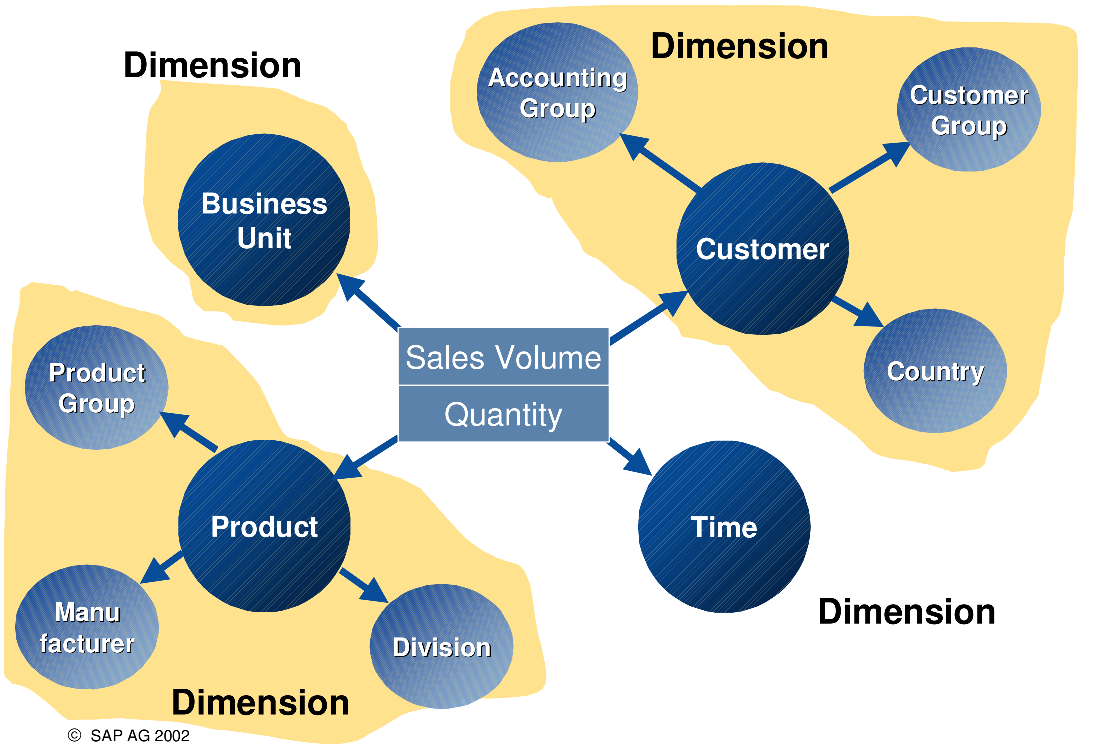
- Use of existing models

From Bubble Model to Star Schema



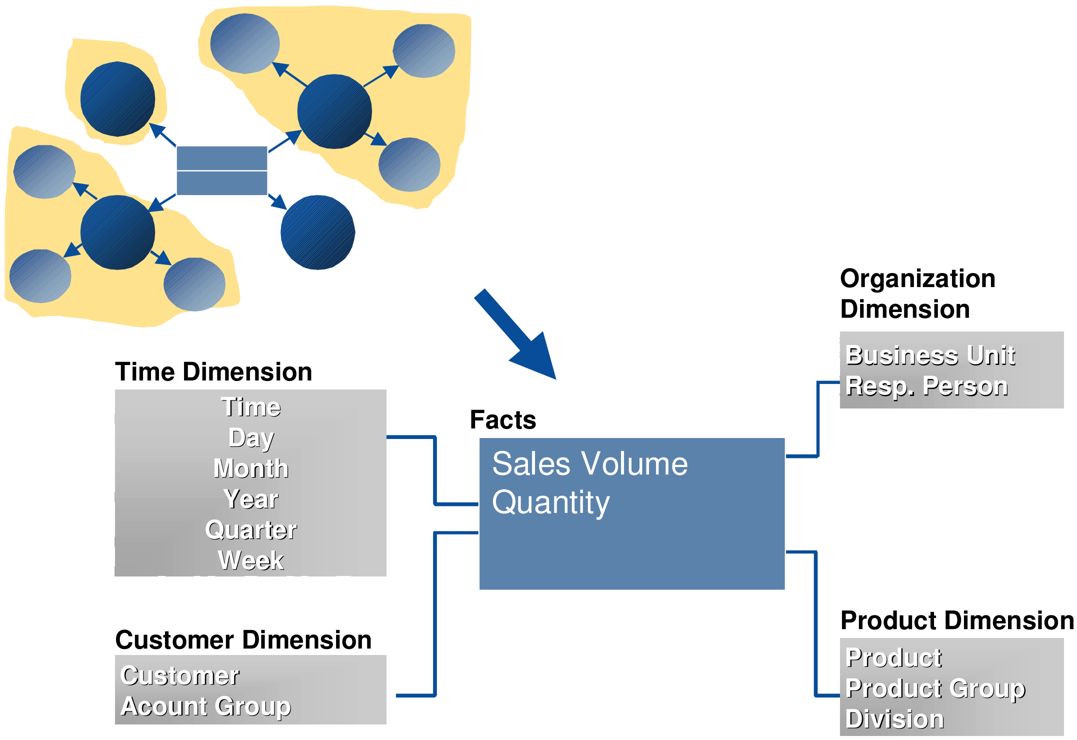
- When using the Bubble model the basic objects of a Multidimensional model, facts and dimensions, can easily be identified.
- The key figure structures are the facts in the center of the Bubble model.

From Bubble Model to Star Schema



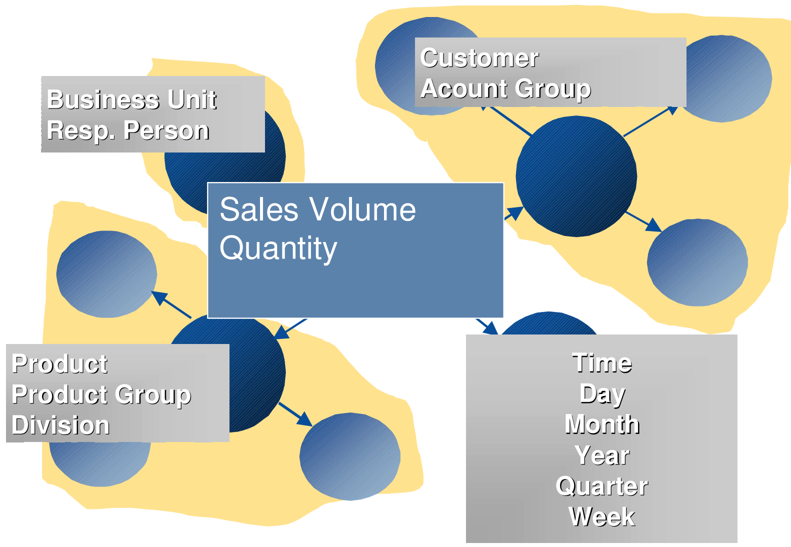
- The Dimensions are the Business Subjects with their attributes. Be careful that these attributes are 1:n to their "main" object, otherwise it is better to define an additional dimension.

From Bubble Model to Star Schema

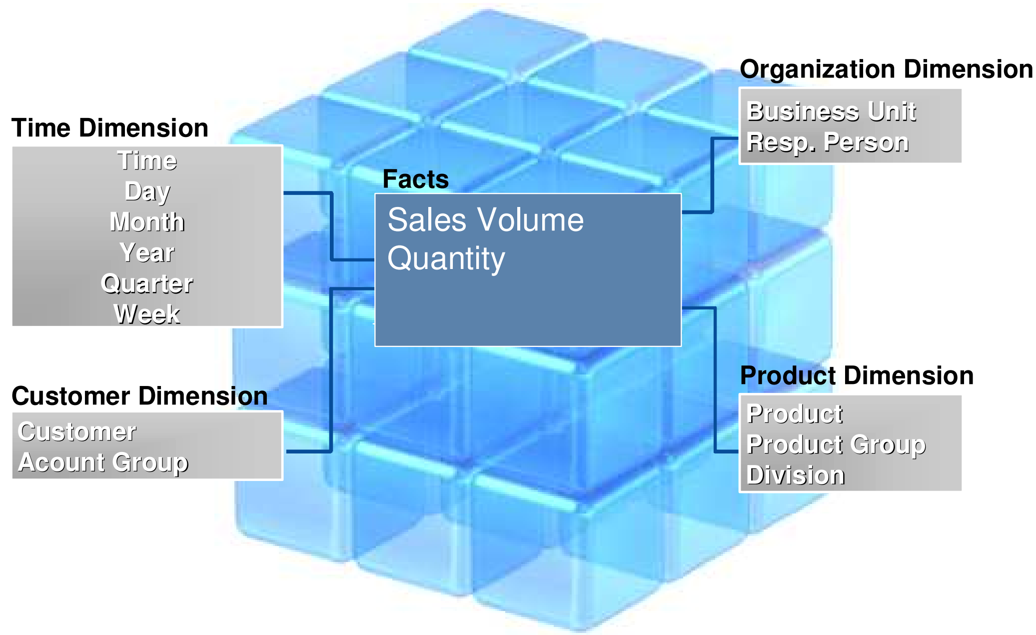


- The Dimensions are the Business Subjects with their attributes. Be careful that these attributes are 1:n to their “main” object, otherwise it is better to define an additional dimension.

From Bubble Model to Star Schema



From Star Schema to BW Data Model



How the Star Schema Works: Make a Query

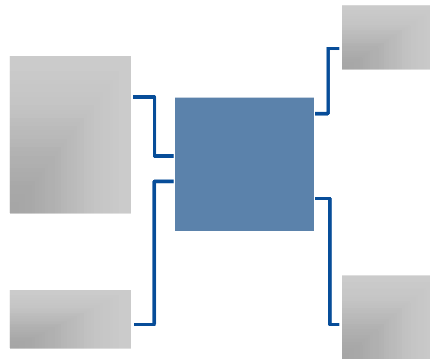
"Show me the revenue for customers located in New York with Product group 'telephones' in the Year 1997"

Step 1: Browse the dimension tables

- Access the Customer dimension table and select all records with city = 'New York'.
- Access the Product dimension and select all record with Material Group = 'telephones'.
- Access the Time dimension table and select all record with Year = '1997'.

Step 2: Accessing the Fact Table

- Using the key values evaluated during Browsing,
- Select all records in the Fact Table which have these values in common in the Fact Table record key.



- An example of how the star schema works is seen when executing a query.
- The first step is searching for characteristic values which are selected by the query definition.
- The second step is finding the corresponding facts for these dimension values.

How the Star Schema Works: Update into Cube

Customer Smith (4711) buys a telephone on 20.10.2002.

Time Dimension

TIMEID	DAY	MONTH	YEAR	QUARTER	WEEK
1	20.10.2002	200210	2002	20024	200247

Customer Dimension

CUSTOMER ID	CUSTOMER	ACCOUNT GROUP
1	Smith	12

Product Dimension

PRODUCT ID	PRODUCT	PRODUCT GROUP	DIVISION
1	4422	22	1

Fact Table

TIMEID	CUSTOMER ID	ORG ID	PRODUCT ID	REVENUE	ORDER ENTRY
1	1	1	1	1000	10

↑

DAY	*CUSTOMER*	*PRODUCT*	*REVENUE*	*ORDER ENTRY*
20.10.2002	4711	4422	1000	10

- Shown above is an example of writing the information into the InfoCube by selecting the proper dimension IDs based on the transaction data.

How the Star Schema Works: Update into Cube

Customer Smith (4711) buys a telephone on 20.10.2002.

Time

TIMEID	DAY	MONTH	YEAR	QUARTER	WEEK
1	20.12.2002	200210	2002	20024	200247

Customer

CUSTOMER ID	CUSTOMER	ACCOUNT GROUP
1	Smith	12

Product

PRODUCT ID	PRODUCT	PRODUCT GROUP	DIVISION
1	4422	22	1

Facts

TIMEID	CUSTOMER ID	ORG ID	PRODUCT ID	REVENUE	ORDER ENTRY
1	1	1	1	1000	10

Changes in the new world "Facts": Changes in fact table

DAY	CUSTOMER	PRODUCT	REVENUE	ORDER ENTRY
20.10.2002	4711	4422	1000	10

Slow changes: Changes in attributes of Business Subjects

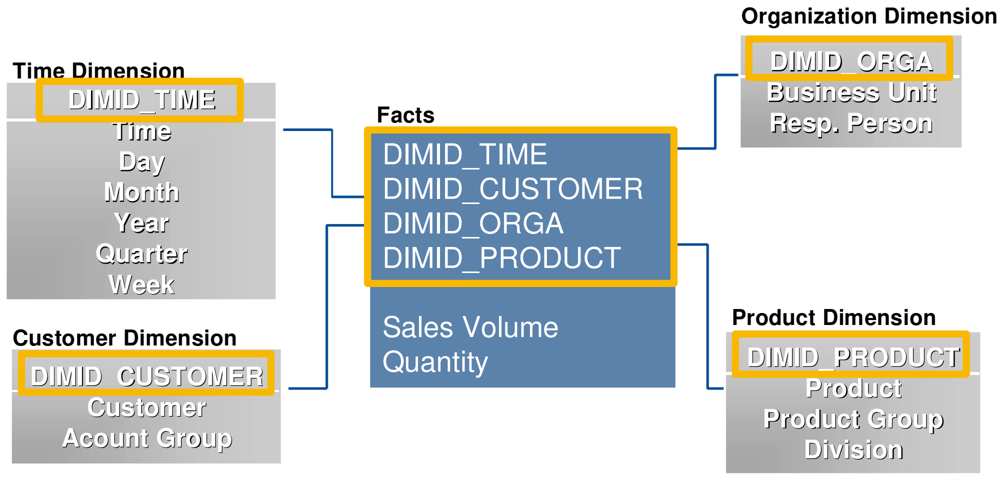
CUSTOMER ID	CUSTOMER	ACCOUNT GROUP
1	Smith	New customer

PRODUCT ID	PRODUCT	PRODUCT GROUP	DIVISION
1	Telephones xy	Communications	Direct

- Two types of changes happen in an InfoCube:
  - Regularly, real facts, e.g. a customer buys a product, are added to the InfoCube.
  - Changes in the attributes, which typically happens slowly over time.

Star Schema

Technical assignment of dimensions to facts



- In order to identify which facts belongs to which dimension values, the BW uses an artificial key, the DIMIDs.

Dimensions Values

Customer name and numbers are unfit for storage

- consistency → several cubes
- quick reading access

Introduction of SID

- mapping table SID → key
- mapping table key → texts

CUSTOMER
Smith

better ↓

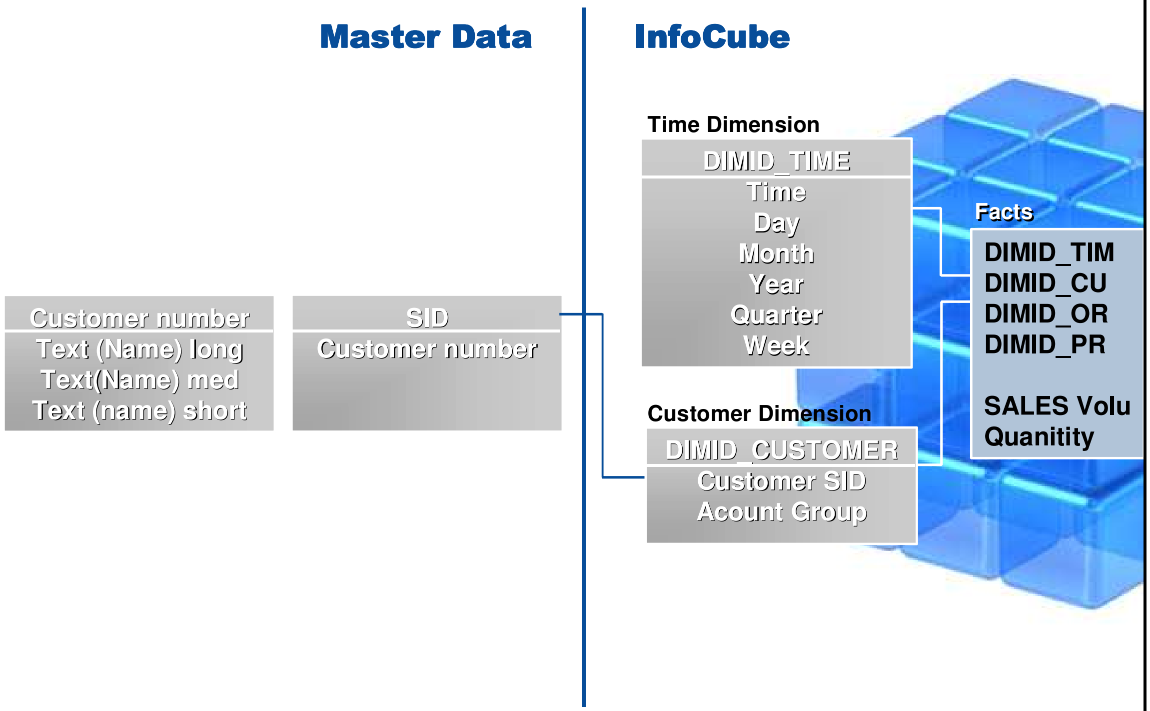
Customer Number
4711

better ↓

SID Customer
12

- To get better performance and to achieve consistency, BW does not use names or real keys in the InfoCubes, but instead uses artificial keys, called SID IDs (Surrogate ID), instead of real values in the dimensions.
- In order get the real value of the field, BW defines tables which are independent from the InfoCube. These are the so-called master data tables.
- The connection between the InfoCube / artificial key and the real value of a field is the SID table. There you can find which artificial key is used. For example, for customer Smith, the same SID is used for customer 4711 in every InfoCube. You can find the name of customer in the text table.

Master Data Tables



Business Content

Information gathering ✓

- Get the information needed ✓
- Get the processes ✓

Structure the information need ✓

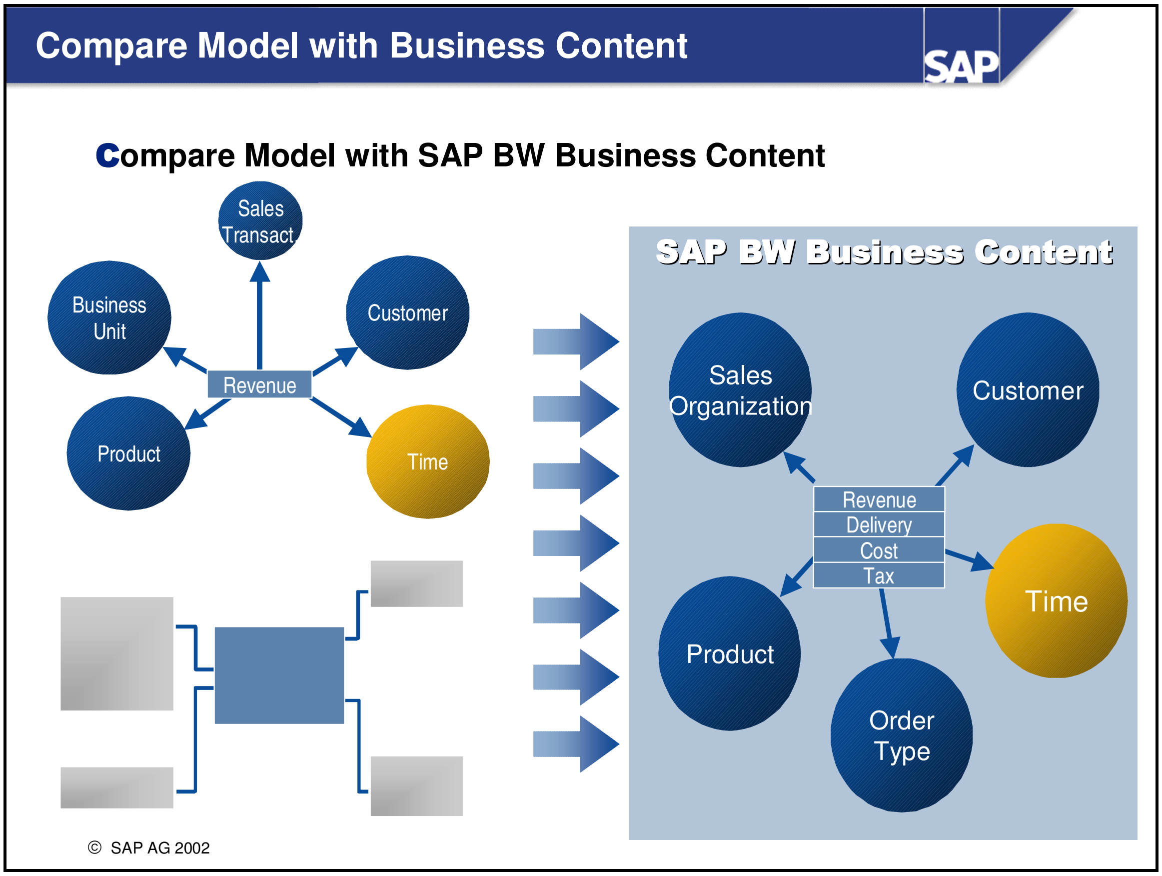
- Multidimensional structure ✓
- Logical model ✓

Transfer into physical model ✓

- BW data model ✓

Business Content

- Use of existing models



- Checking the Business Content is an ongoing process during the process of building of a dimensional model.
- This means that the Business Content can used during Information Gathering, during building the logical model (e.g. in order to decide about business subjects and attributes), and should be used when building a physical model.

Business Content Check

How Can I Check the Business Content?

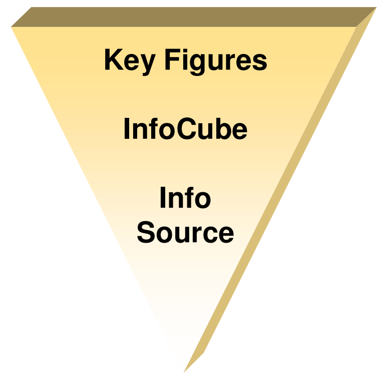
- Business Content Documentation
- Check with Prototype / IDES System

Identify Gaps

- Enhanced or new InfoProvider
- Standard, enhanced, new data sources

Key Figure Based Approach (Top Down)

1. **Get a clear understanding of your logical data model.**
2. **Break down the granularity of your performance indicators to basic key figures.**
3. **Find and compare your base key figures with the Business Content Repository.**
4. **Compare the scenarios of your logical data model with the Business Content InfoCubes, queries, and workbooks.**
5. **Check for performance indicators in Business Content Queries.**
6. **Investigate the data flow for identified key figures.**



- The main approach during the Business Content check should be a top down approach. Focus on key figures, find corresponding objects in BW and compare the dimension model. If the search for corresponding key figures is not successful, a bottom up approach in this special case could be a valid solution.
- It is very important to understand the business behind this model. Searching only for technical descriptions will never lead to a 100% result.
- Performance indicators are also present in Business Content. In most cases, they are modeled as calculated key figures within queries. An unsuccessful search for a particular performance indicator will possibly lead to the wrong conclusion – this performance indicator is not available in Business Content. Maybe all the key figures that are required to build this indicator are available. The fact that key figures are possibly also distributed to more than one InfoCube (MultiCubes) also needs to be taken into account.
- Use the repository browser for Business Content on- or offline. The offline tool is more flexible.
  If the key figure is part of Business Content, proceed with the next step (4).
  If it is not part of Business Content, jump to DataSource Approach and return.
- Focus on the business context to compare the scenarios. Check compounding, dimensions and the availability of key figures to calculate performance indicators (are there key figures you need for calculation in one InfoCube, – if not think about MultiCube scenarios). Check out the dimensions within the InfoCube and the master data model (e.g. there are display attributes in Business Content which could be redefined to navigation attributes).
- Are the performance indicators in the Business Content Queries calculated comparable to your requirement analysis?
- Investigate the data flow for identified key figures.

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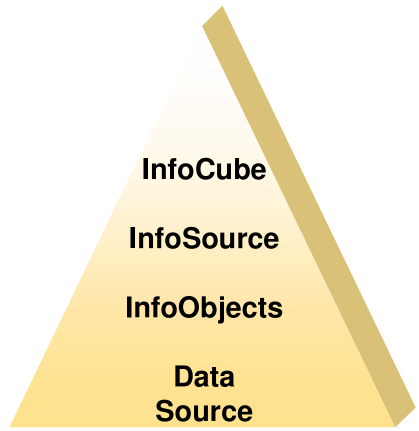
DataSource Approach (Bottom Up)

1. **Focus on the Business Process of your source system.**
2. **Check your DataSources for particular measures.**
3. **Look up DataSource for characteristics defined in dimensions in your logical data model.**
4. **Understand how Business Content maps the fields you found to InfoObjects.**



- The approach to check relevant business content for your project mainly depends on what type of project you are running. If it is R/3 driven or R/3 is at least part of the sourced systems, then the bottom-up approach is recommended. The approach to check relevant business content for your project mainly depends on what type of project you are running. If it is R/3 driven or R/3 is at least part of the sourced systems, then the bottom-up approach is recommended.
- Find DataSources, InfoObjects.
  Since the customer already knows quite a lot about the R/3 System, he is usually very keen on getting the right data into BW. Therefore, it is much easier for a BW-Consultant to talk in terms related to the SAP System, since these are familiar to the customer. This is usually the level of the DataSource.
- Find InfoSources, InfoCubes, and Queries. Once you have analyzed the details of the DataSource and you found out that all relevant fields exist, you can go ahead searching for the respective InfoSources and InfoCubes assigned to them. If fields are missing, you have to check whether they can be added, that is, if they are available in the system. From here, you find the queries in order to check what kind of Business Content may have already been represented in existing performance indicators.

Determine DataFlow

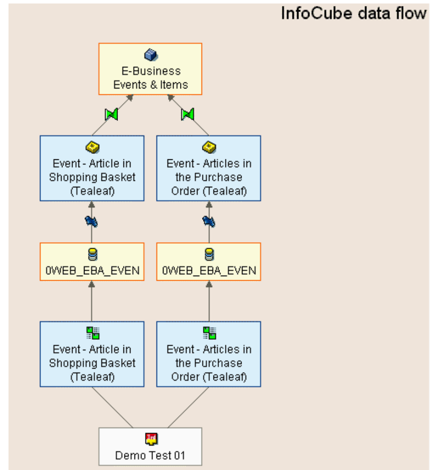
Data Model should determine Data Flow

Business Content Check

- Transaction data
- Master data

Enhancements

- On Business Content objects
  - Source system (data source)
  - Transfer Rules
  - Update Rules
  - Generic DataSource
- Generic DataSources
- Additional InfoProvider for data consolidation



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Logical Model: Unit Summary

Now you will be able to:

- Identify the steps of the requirements analysis
- Setup a logical model based on the requirements analysis
- Analyze the Business Content
- Identify gaps between your requirements and delivered objects

SAP BW Architecture

Contents

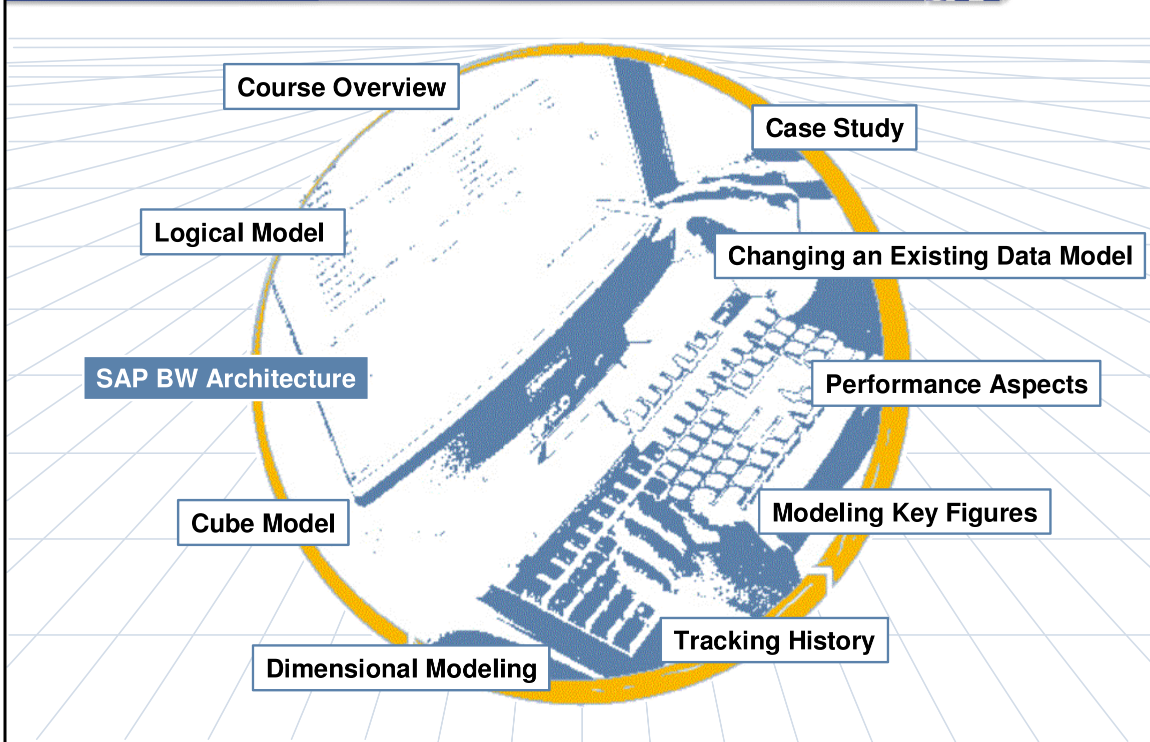
- SAP BW InfoProvider
- SAP BW InfoSets

SAP BW Architecture: Unit Objectives

At the conclusion of this unit, you will be able to:

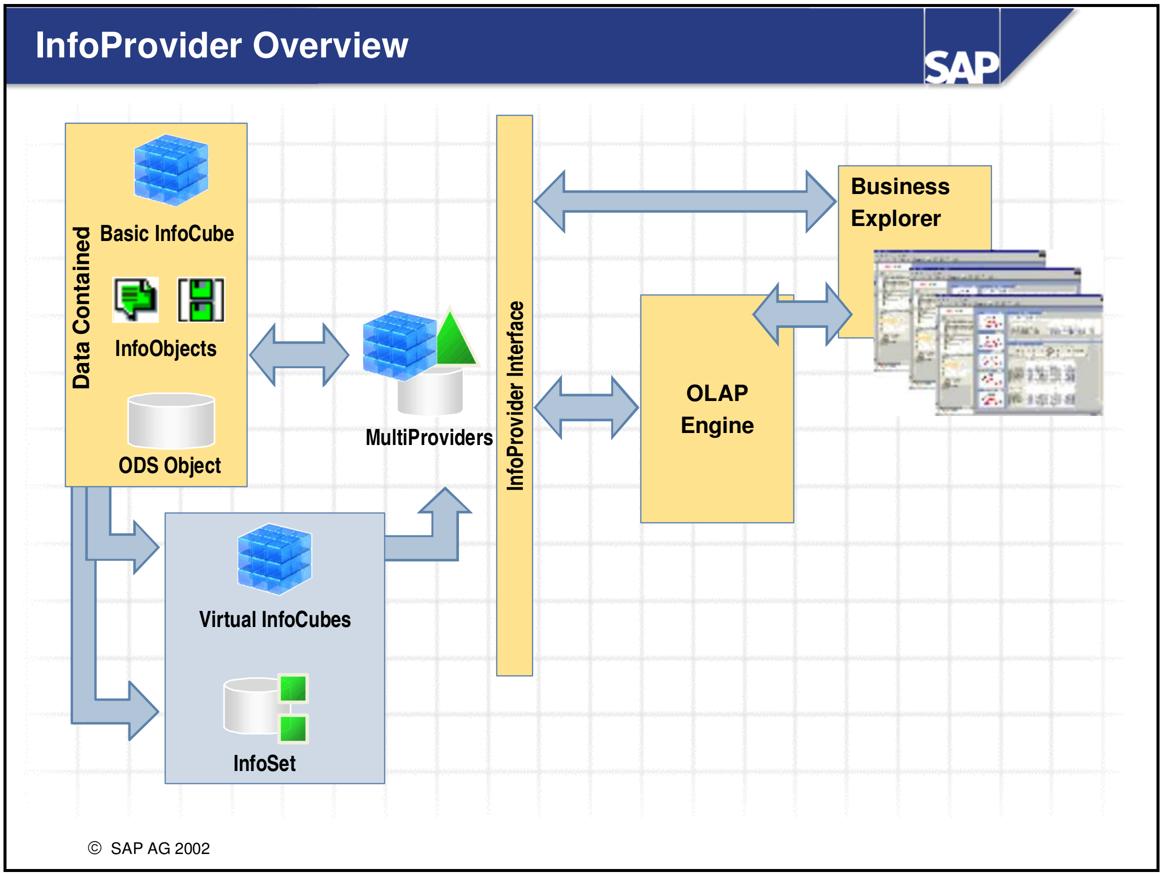
- Explain the different types of InfoProviders
- Create InfoSets
- Use Temporal Joins with InfoSets

SAP BW Architecture: Overview Diagram



SAP BW Architecture: Business Scenario

You are asked to identify which type of SAP BW InfoProvider matches best the reporting needs of your logical model.



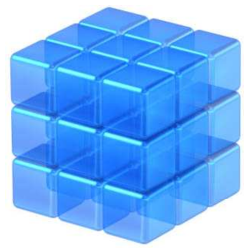
- InfoProviders are objects for which you can create and execute queries in SAP BW. These include objects that physically store data – the data targets, such as InfoCubes, operational data store objects (ODS objects), and InfoObjects (characteristics with attributes or texts). They also include objects that do not contain any actual data, such as, InfoSets, RemoteCubes and MultiProviders. InfoProviders are the objects or views relevant to reporting.
- Data targets are SAP BW objects that have their own data store (which physically contains data). These objects include InfoCubes, ODS objects and InfoObjects (characteristics with attributes or texts). The system supplies data targets with data from the source systems using a load process (or by writing directly into the tables for transactional object types).

InfoCubes

There are different types of InfoCube:

Physical data stores

- BasicCubes
  - Standard type
  - Transactional type



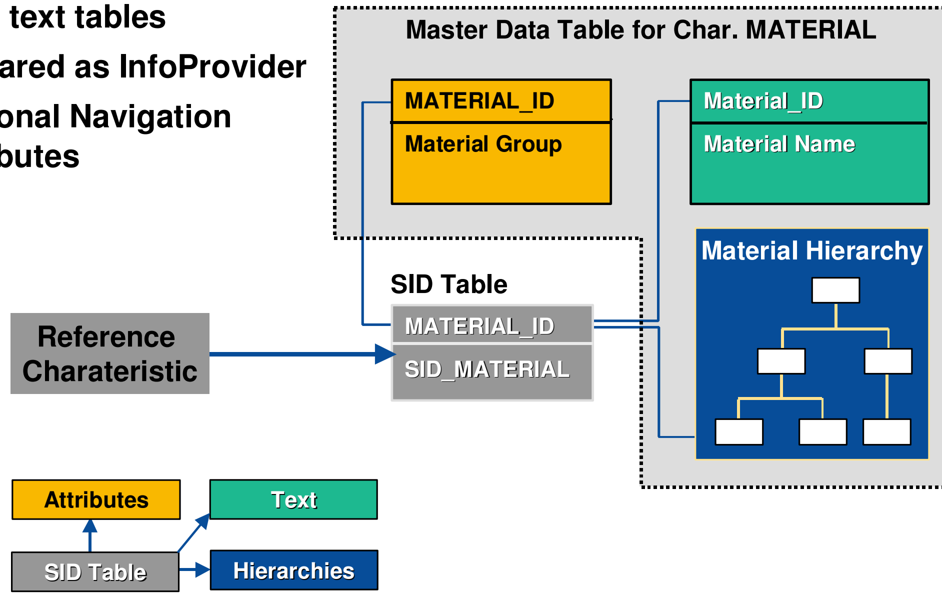
Virtual data stores

- RemoteCubes
- SAP RemoteCubes
- Virtual InfoCubes with Services

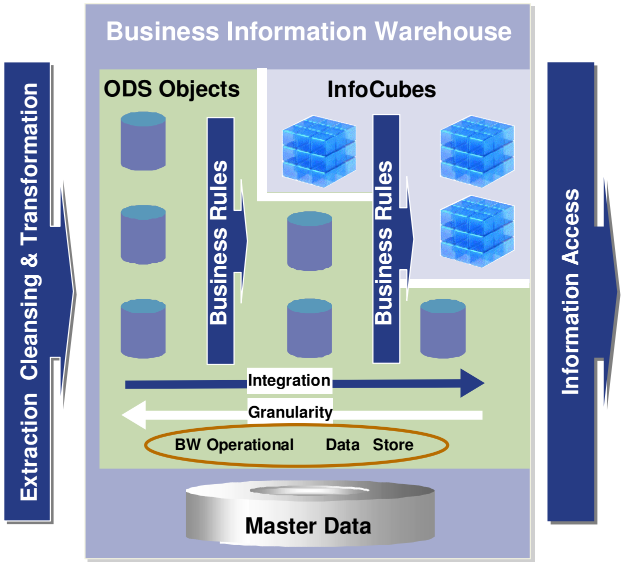
- InfoCubes are data targets. They describe (from a reporting point of view) a self-contained dataset of a business-orientated area. They can also be seen as InfoProviders if reports and analyses in BW are executed using them.
- Only BasicCubes physically contain data on the database. Virtual InfoCubes simply display logical views of a dataset. The type of InfoCube is not important as far as reporting is concerned.
- Transactional InfoCubes are used only in conjunction with SEM. The data from this kind of InfoCube is accessed transactionally, meaning data is written to the InfoCube (possibly by several users at the same time) and reread as soon as possible. Standard BasicCubes are not suitable for this. You should use standard BasicCubes for read-only access (for example, reading reference data).
- A RemoteCube is an InfoCube whose transaction data is not managed in the Business Information Warehouse but externally. Only the structure of the RemoteCube is defined in BW. The data is read for reporting using a BAPI from another system.
- An SAP RemoteCube is a RemoteCube that allows the definition of queries with direct access to transaction data in other SAP systems. Master data and hierarchies are not read directly in the source system. They are already replicated in BW when you execute a query.
- A virtual InfoCube with services is an InfoCube that does not have its own physical data storage in BW. A **user-defined** function module is used as a DataSource. This function is used primarily in the SAP Strategic Enterprise Management (SEM) application.

InfoProvider for Attributes and Texts

- **W**ith attribute tables
- **W**ith text tables
- **D**eclared as InfoProvider
- **O**ptional Navigation Attributes



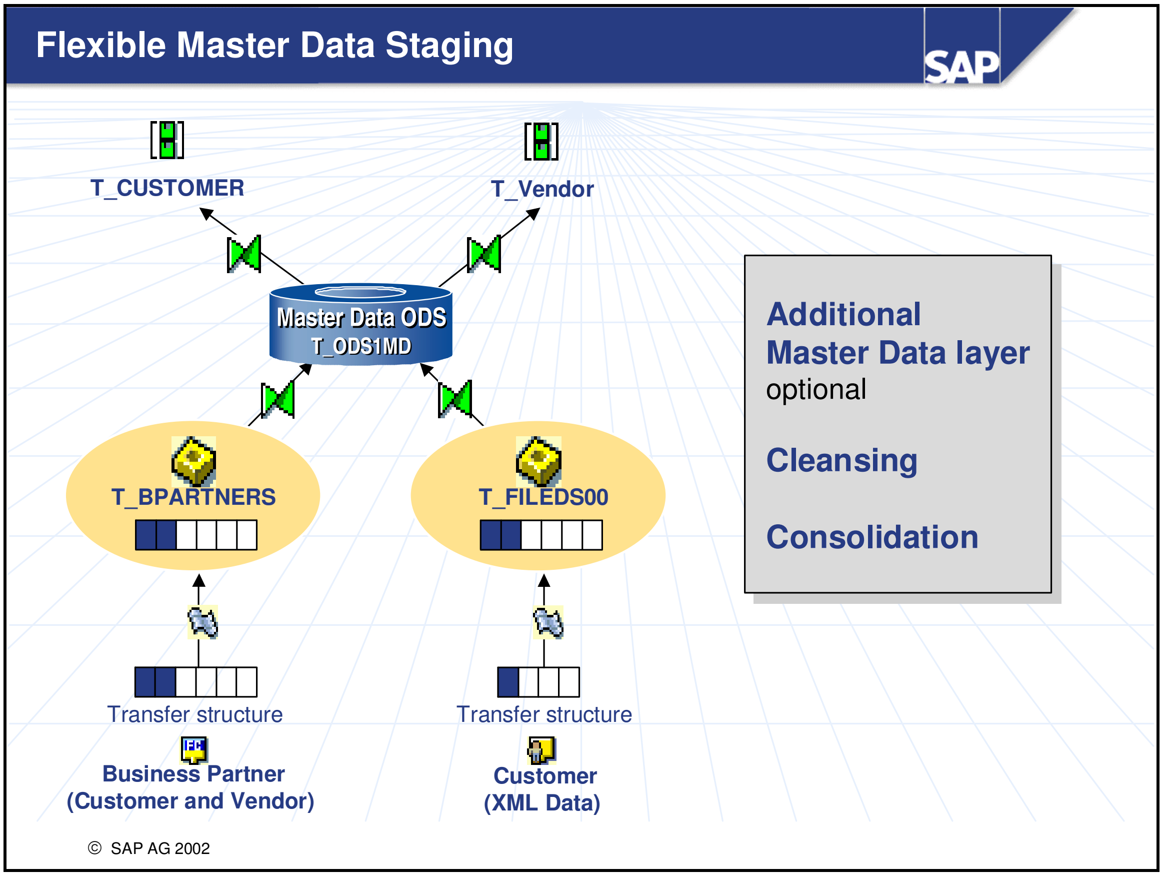
ODS-Objects



ODS (Operational Data Store)

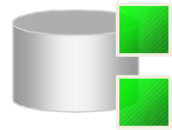
- ODS objects serve to store **consolidated and cleansed** data on a **document level** from one or more InfoSources.
- The ODS objects are **integrated in the BW Data Warehouse architecture** and may consist of multiple levels.
- Data in an ODS object can be analyzed by Business Explorer mainly to support **operational reporting**.

- An ODS object acts as a storage location for consolidated and cleansed transaction data on a document (atomic) level.
- It describes a consolidated dataset from one or more InfoSources. You can analyze this dataset in a BEx query or an InfoSet query.
- An ODS object contains key fields (for example, document number/item) and data fields that can also contain character fields (for example, order status, customer) as key figures. The data from an ODS object can be updated via a delta update into InfoCubes and/or other ODS objects in the same system or across different systems.
- Unlike multi-dimensional data storage using InfoCubes, the data in ODS objects is stored in transparent, flat database tables. Fact tables or dimension tables are not created.
- The cumulative update of key figures is supported for ODS objects, just as it is with InfoCubes, but with ODS objects it is also possible to overwrite data fields. This is particularly important with document-related structures, since changes made to documents in the source system do not apply solely to numeric fields such as order quantity, but also to non-numeric fields such as goods receiver, status, and delivery date. To map these changes in the BW ODS objects, the relevant fields in the ODS objects must also be overwritten and set to the current value.



- The new master data layer enables you to bring master data from different sources together in one consolidated object before storing it in separate master data tables.
- For example, you are dealing with two kinds of Business Partners: Customer and Vendors coming from an ERP system. In addition you load customer data via XML data coming from an online store.
- Master data may also be added to InfoCubes.

SAP BW InfoSets



Semantic view of data sources, no physical data target.

InfoSets can be used to join tabular data (join ODS objects, master data or master data and ODS objects).

InfoSets as InfoProviders:

- Provide data for queries, but only reference to other InfoProviders like ODS objects or master data tables.
- Are integrated into the Administrator Workbench.
- Can be part of a MultiProvider.
- Are accessed via OLAP engine - the full range of BW OLAP features are utilized (Authorizations, Texts, Variables, Hierarchies, CFK, etc.).
- Have Business Explorer as reporting front-end (all reporting and Web reporting features available).

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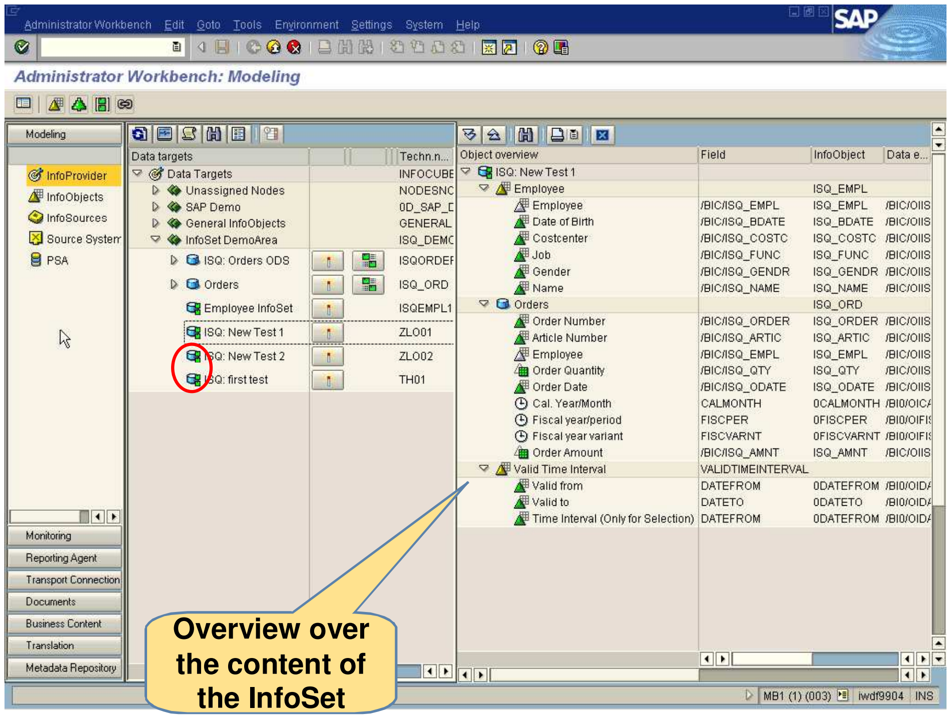
Integration into Administrator Workbench



- The InfoSet is now a new type of repository object and is available under the InfoProvider tab. InfoSet may be accessed as follows:
  - *Administrators Workbench (TCode RSA1); Modeling → InfoProvider Tree → Right Mouse on InfoArea → Create InfoSet…,*
  - SAP Menu → Modeling → Object Maintenance → InfoSets
  - Alternatively: TCode RSISET
- Most of the functions are available on a context menu on the InfoSet.

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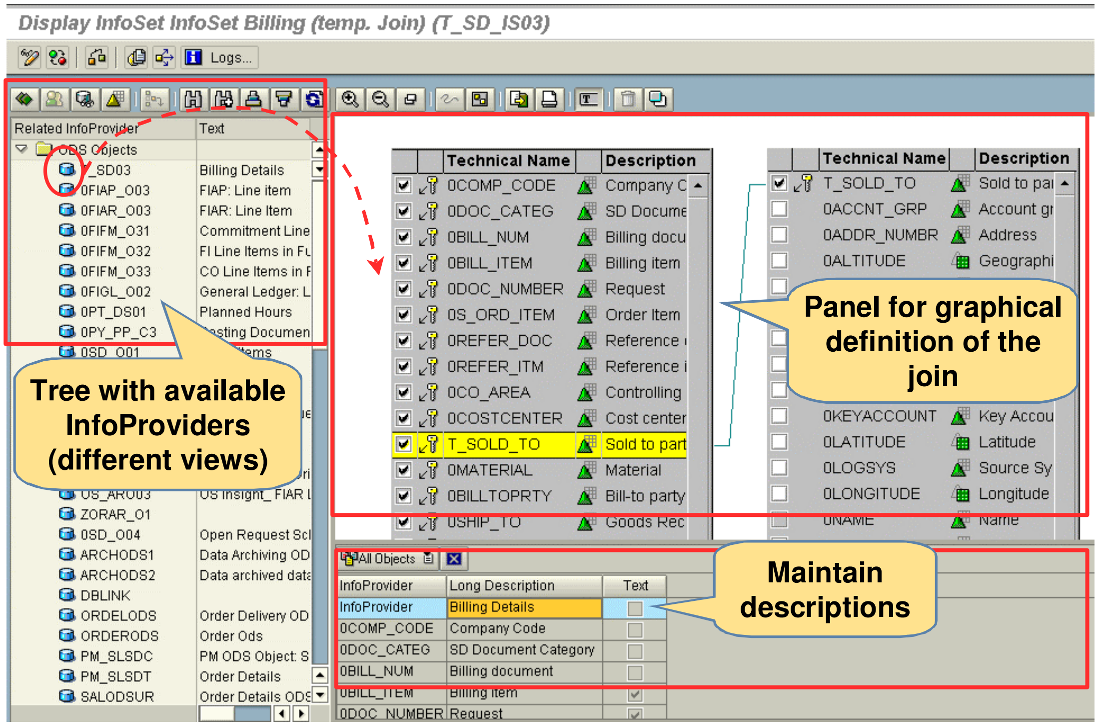
InfoSet Builder: Overview



- InfoSets are a semantic layer. No data is stored at the InfoSet level.
- InfoSets are not just available to LISTVIEW, but also through the BEx Analyzer.

Trees to Select Relevant InfoProviders

Different trees

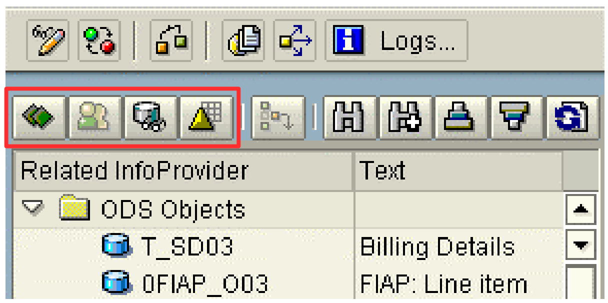
Lists InfoObjects/ODS Objects by InfoArea

Related InfoProviders:

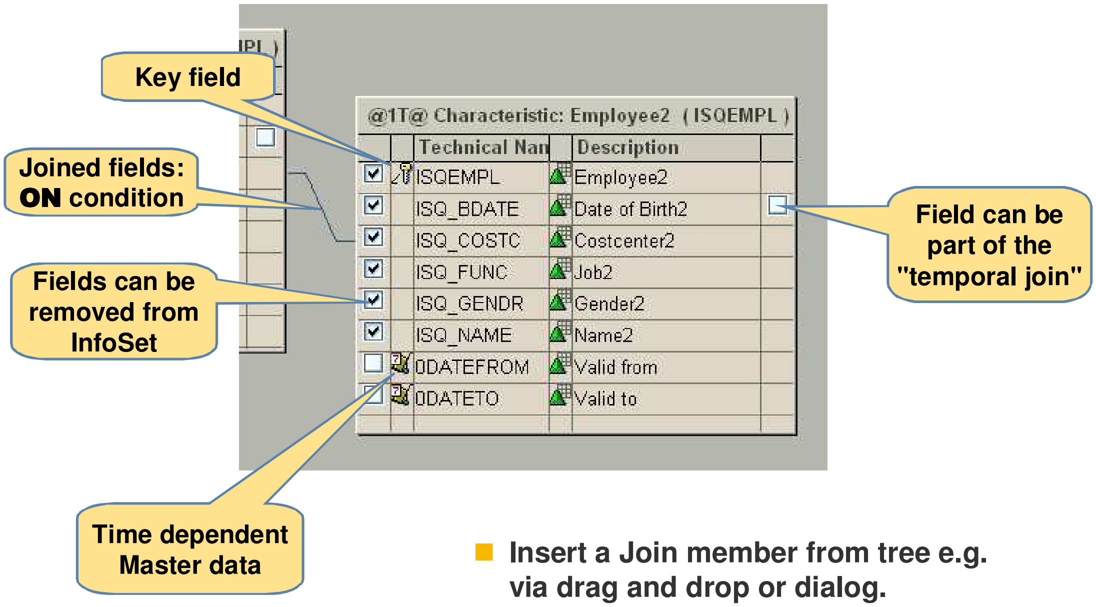
- All characteristics which can be reasonably joined (and have master data)
- All ODS Objects having one of the already used attributes in their key

List ODS Objects

List InfoObjects



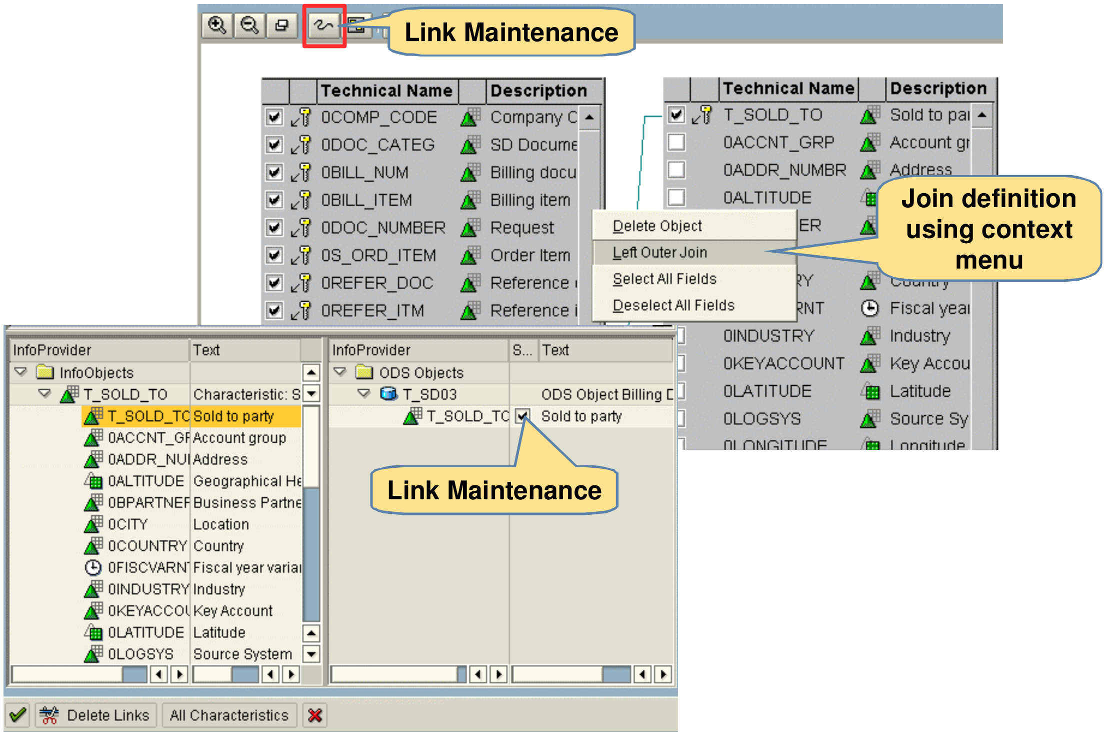
Join Definition I



- Insert a Join member from tree e.g. via drag and drop or dialog.
- Navigation window as a helper.

- In a Join definition, it is possible to take a subset of objects, and not necessary to highlight all fields.
- A join condition is displayed as a line connecting exactly one InfoObject from a row in one object with exactly one InfoObject from a row in another object.

Link Maintenance



- In a tree structure on the left-hand side of the screen, all of the InfoProviders that are already included in the join are displayed along with their fields or attributes. If you double-click on one of these fields or attributes, the system displays on the right-hand side of the screen all of the fields or attributes with which you are able to create a join condition.
- In the Selection column, set one or more of the indicators for the fields or attributes for which you want to create a join condition. The system generates valid join conditions between the fields or attributes that you specify.
- You use the *Delete Links* pushbutton to undo all of the join conditions.
- You use the *All Characteristics* or the *Basic Characteristics Only* pushbutton to choose between the corresponding display variants.

Left Outer Join

Table 1

Key	Attr.
1000	A
1003	B

Equal Join

Table 2

Key
1000
1001
1002
1003

→

1000	A
1003	B

Table 1

Key	Attr.
1000	A
1003	B

Left outer

Table 2

Key
1000
1001
1002
1003

→

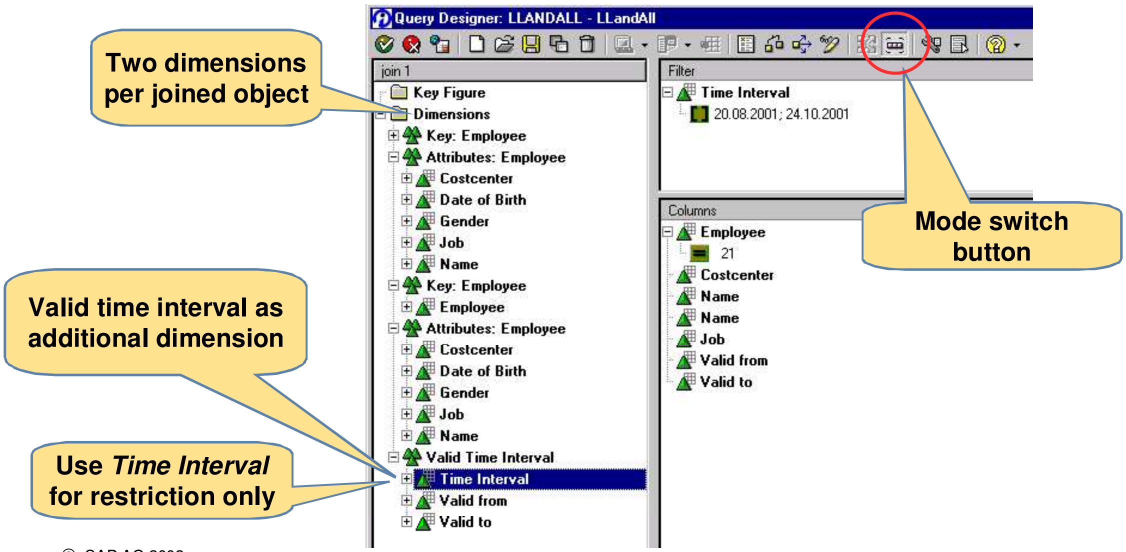
1000	A
1001	#
1002	#
1003	B

- An equal join condition is true if the value of the connected fields is equal.
- InfoObjects can be used for a join, if they use the same data type and length.
- Left outer join:
  All of the records in the first table are included in the result set.
  If, in the second table, there is no record corresponding to a record in the first table, a record containing fields with initial values (blank fields) is used in the second table.

Queries on InfoSets

Tabular definition mode in BEx Analyzer

- Recommended when reporting on tabular InfoProviders
- Mixing of key figures and characteristics possible



- Switching between multidimensional and tabular mode is always possible.
- InfoSets appear with two dimensions per joined object (key and attributes).
- Temporal Joins: Valid time interval as additional dimension
- Use Time Interval for restriction only and Valid from / valid to for output only

Temporal Join: A Simple Example

Cost center & profit center are both time-dependent (Joined via PROFITC)

PROFITC	RESP	DATEFROM	DATETO
BW	Miller	1.1.2000	30.6.2001
BW	Martin	1.7.2001	31.12.9999

Join

CSTCNTR	PROFITC	RESP	DATEFROM	DATETO
4711	BW	Smith	1.1.2001	31.5.2001
4711	BW	Clark	1.6.2001	31.12.2001
4711	BW	Brooklyn	1.1.2002	31.12.9999
0815	WCM	James	1.1.2001	31.1.2001
0815	WCM	Johnson	1.2.2001	31.12.9999

- The example shows two time dependent attribute tables for characteristic profit center (PROFITC) and cost center (CSTCNTR).
- Characteristic cost center has PROFITC as an attribute. This attribute is used to join both tables in the InfoSet.
- When joining two time dependent characteristics, the temporal join is used to determine the result.

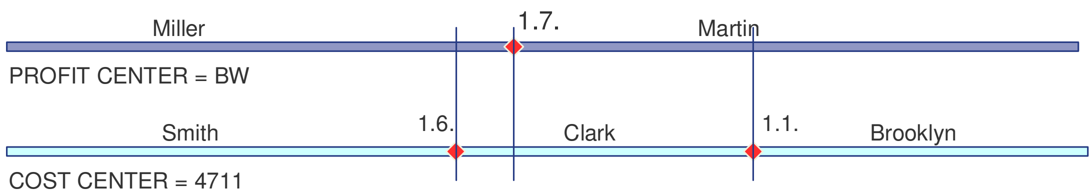
Temporal Join with Time Dependent Master Data

COST CENTER = 4711 and PROFIT CENTER = BW

RESP	FROM	TO	RESP	FROM	TO
Smith	***1.1.2001***	***31.5.2001***	Miller	1.1.2000	30.6.2001
Clark	***1.6.2001***	**31.12.2001**	Miller	1.1.2000	***30.6.2001***
Brooklyn	1.1.2002	31.12.9999	Miller	1.1.2000	30.6.2001
Smith	1.1.2001	31.5.2001	Martin	1.7.2001	31.12.9999
Clark	**1.6.2001**	***31.12.2001***	Martin	***1.7.2001***	31.12.9999
Brooklyn	***1.1.2002***	***31.12.9999***	Martin	1.7.2001	31.12.9999

Valid time interval

No overlapping time intervals, not in the result set



- Records with no overlapping time interval are not in the result set.
- Valid time interval is the maximum of the DATEFROMs and the minimum of the DATETOs.
- If max (DATEFROMs) > min (DATETOs), the record is not in the result set.

Temporal Join

Time dependent master data

Customer	Revenue class	DATEFROM	DATETO
1000	0	01.01.1000	31.12.1996
1000	5	01.01.1997	31.03.1997
1000	4	01.04.1997	30.06.1997
1000	0	01.07.1997	30.09.1998
1000	4	01.10.1998	31.12.1998
1000	5	01.01.1999	31.03.1999
...	...	...	...

Join

Temporal Operand

ODS

Customer	Billing Doc.	Date	Billing Quantity
1000	90005255	28.02.1997	520 ST
1000	90005328	31.05.1997	85 ST
1000	90009099	31.12.1998	291 ST
1000	90009342	31.12.1998	45 ST
1000	90010837	31.03.1999	198 ST
...	...	...	...

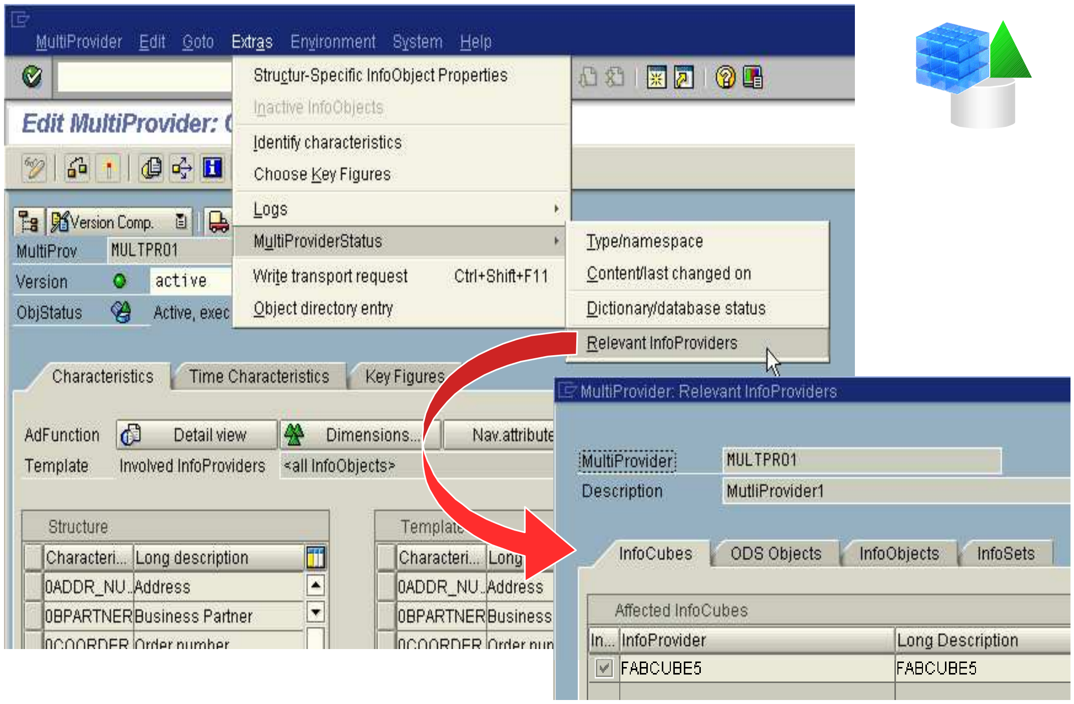
- An InfoSet joining ODS Objects and time dependent master data can use the temporal join, if a field with datatype DATE is marked as an temporal operand, which is used to select on DATEFROM and DATETO in the Q-table of the characteristic.

Result using Temporal Join

Customer	Billing Doc.	Date	Revenue Class	Billing Quantity
1000	90005255	28.02.1997	5	520 ST
1000	90005328	31.05.1997	4	85 ST
1000	90009099	31.12.1998	4	291 ST
1000	90009342	31.12.1998	4	45 ST
1000	90010837	31.03.1999	5	198 ST
1000	90010838	31.03.1999	5	265 ST
1000	90011676	30.04.1999	2	264 ST
1000	90023097	30.11.2000	5	174 ST
1000	90031402	07.01.2002	2	3 ST
1000	90031576	14.01.2002	2	1 ST

- In the query on the InfoSet with temporal join between ODS object and master data for every record of the ODS Object the temporal operand is used to select the time dependent master data.

Relevant InfoProviders for a MultiProvider



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- A MultiProvider combines data from several InfoProviders and makes it available for use in reporting. The MultiProvider does not contain any data itself. Its data comes exclusively from the InfoProviders on which it is based. You can create a MultiProvider from any combination of InfoProviders.
- The following objects can be combined to form a MultiProvider:
  - InfoCubes
  - ODS Objects
  - InfoObjects
  - InfoSets
- MultiProviders are based on a UNION connection (union), unlike joins in BW InfoSets (intersection).

SAP BW Architecture: Unit Summary

Now you will be able to:

- Explain the different types of InfoProvider
- Create InfoSets
- Use Temporal Joins with InfoSets

Unit: **SAP BW Architecture**

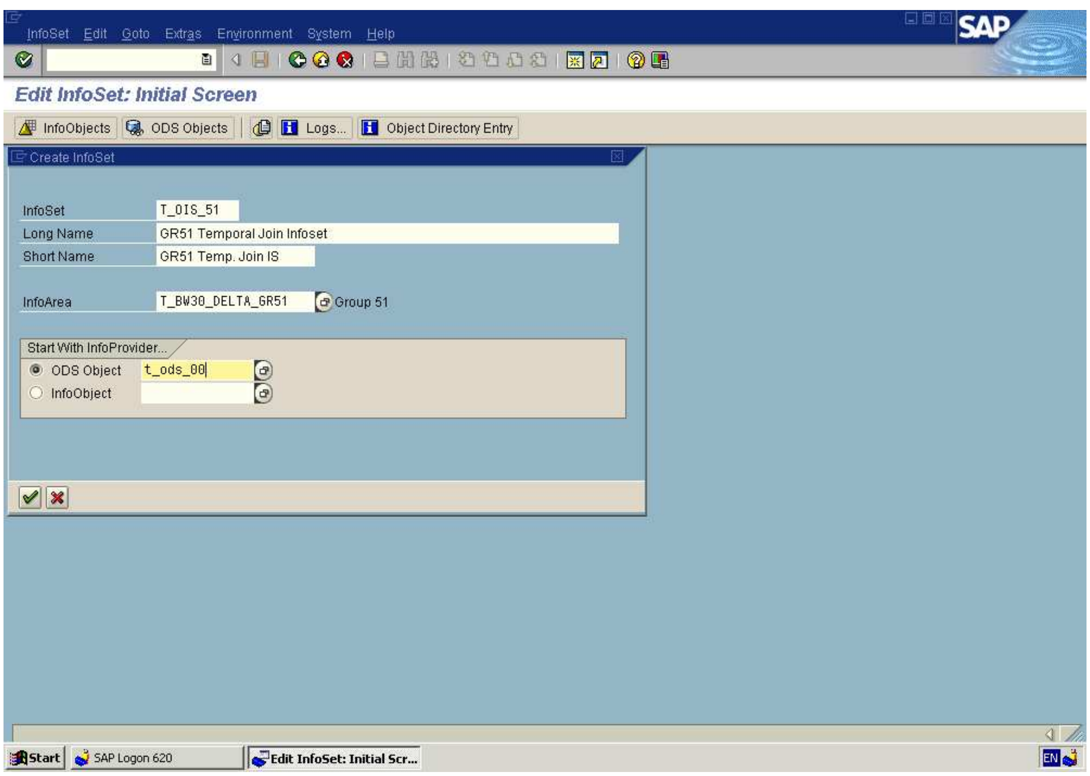
Topic: **InfoSets**

At the conclusion of this exercise, you will be able to:

- Create an InfoSet with a temporal join using an ODS Object and an InfoObject as InfoProviders

When joining an ODS Object (containing transaction data per posting date as the detail level) and a master data table containing time dependent attributes in an InfoSet, a temporal join can be used to enable the posting date dynamically determine the correct time dependent attributes in a query on the InfoSet's data.

1-1 Create an InfoSet **T_OIS_##** with a description of **GR## Temporal Join InfoSet** in your InfoArea. Start with the predefined InfoProvider ODS Object **T_ODS_00**.



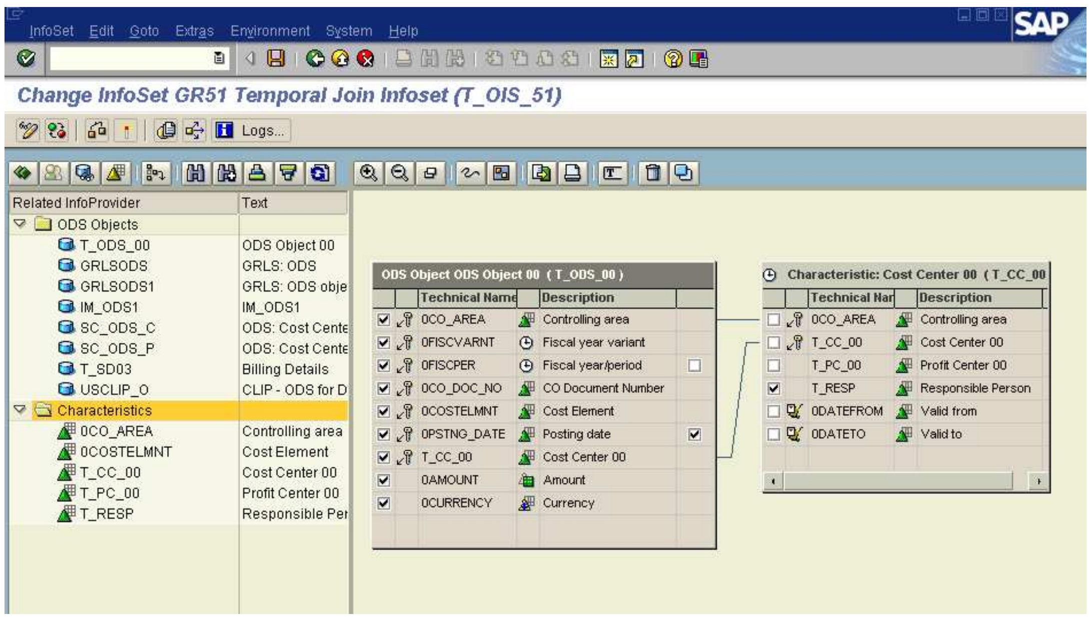
1-2 On the InfoSet definition screen, drag the characteristic **T_CC_00** as a second InfoProvider and drop it into the right hand side screen.

Define a join between the InfoObjects **0CO_AREA** and **T_CC_00** in the ODS Object and in the characteristic InfoProvider.

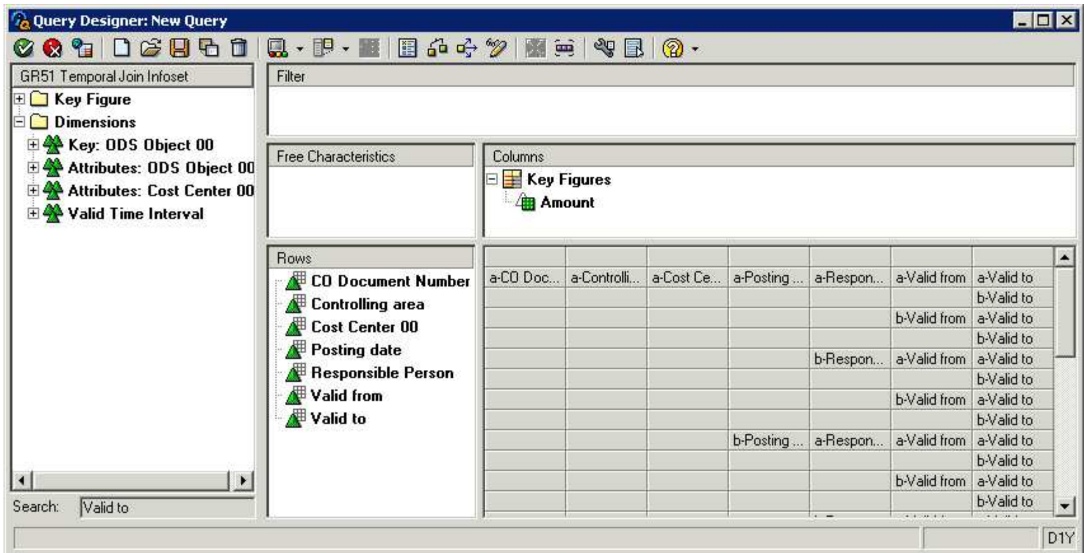
Check the checkbox for temporal join in the ODS Object's field **0PSTING_DATE**.

Choose only **T_RESP** to be used in the InfoSet from the characteristic InfoProvider.
(Deselect the flags for all other fields.)

Activate the InfoSet.



1-3 Create a query reporting time dependent data from your InfoSet **T_OIS_##**. The "Posting date" is used to dynamically determine the time dependent attribute "Responsible Person" for a cost center. Select and arrange the characteristics and key figures of the query as shown below:



1-4 Save and execute your query.

Cube Model

Contents

- Characteristic Master Data Settings
- SAP BW Star Schema
- Dimension Tables

- The SAP BW Data Model is designed to meet reporting requirements of a summarized nature.
- In order to maximize performance and meet the complex reporting needs of your business, you need to evaluate all InfoCube modeling options.

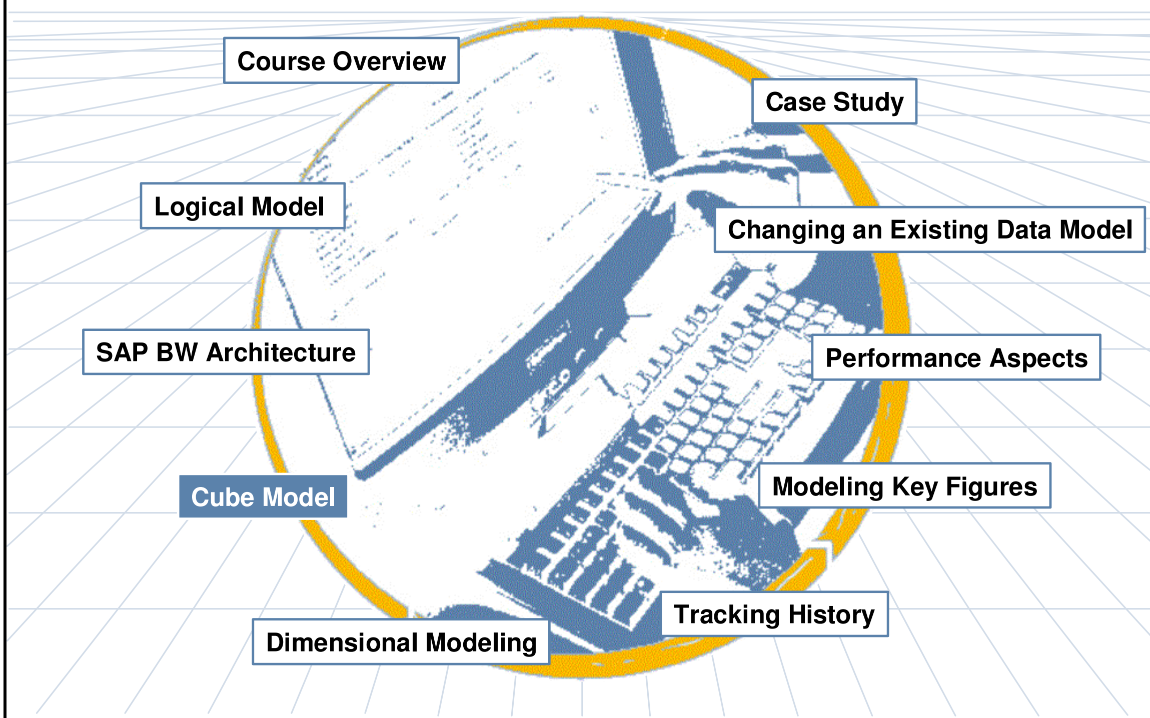
Cube Model: Unit Objectives

SAP

At the conclusion of this unit, you will be able to:

- Review the purpose of the SAP BW Star Schema
- Integrate Navigational Attributes into the Model
- Discuss key characteristics settings
- Consider Transitive Attributes
- Identify the key advantages of the SAP BW Star Schema
- Discuss criteria for placing InfoObjects inside or outside dimension tables

Cube Model: Overview Diagram



Business Scenario

Before you start to implement the logical model, you want to review the technical aspects of the Extended Star Schema used in SAP BW.

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Problems with the Basic Star Schema

Multilingual descriptions for attributes in the dimension tables are not supported.

Secondary indexes for the data are stored as alphanumeric fields in comprehensive tables. This makes it more difficult to access the data.

If attributes of the dimensions change over time, there is no way of maintaining the old and new values for the attribute.

Even if the majority of a company's master data is used across the different business processes, each star schema must duplicate all of the data that is required for all of the possible user-reports that might be generated.

All hierarchy relationships for the data must be modeled as attributes (characteristics) of a dimension table. It is not possible to generate user-defined hierarchy types.

- Although many data warehouse solutions are based on designs similar to the standard star schema, there are many restrictions and problems associated with this basic design. This is why the SAP BW has an extended star schema.

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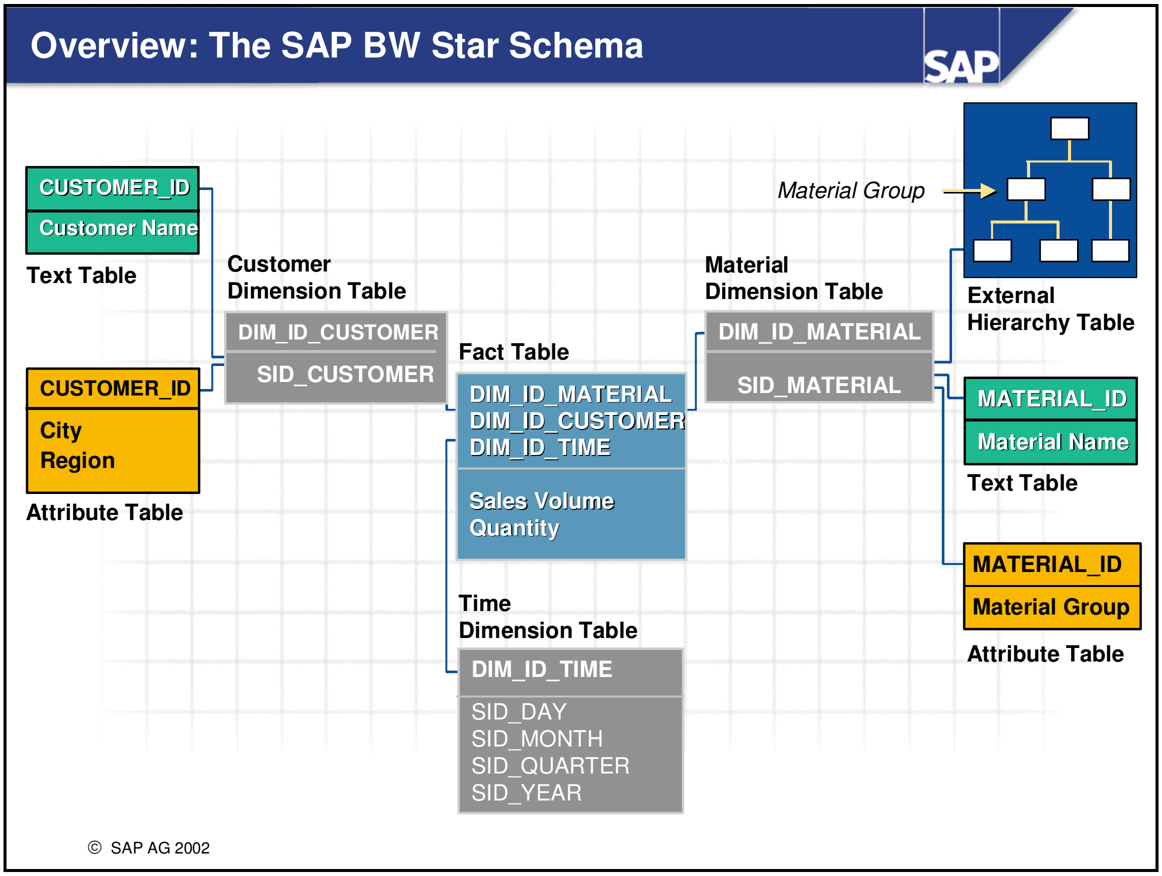
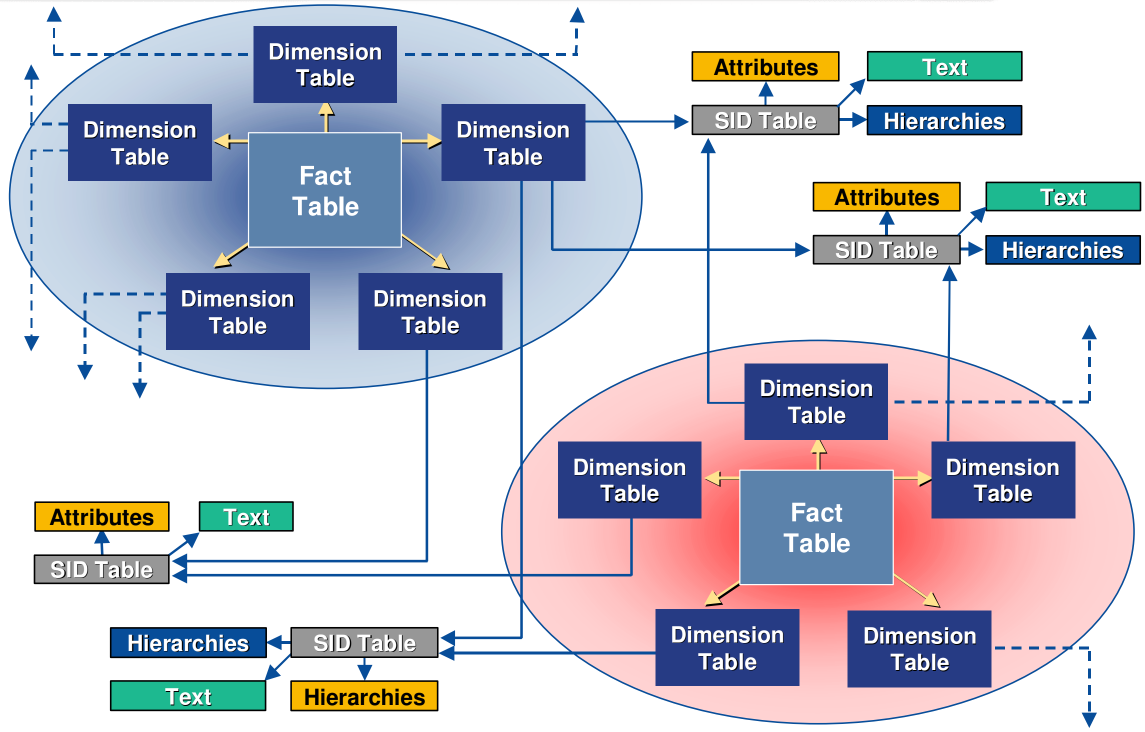


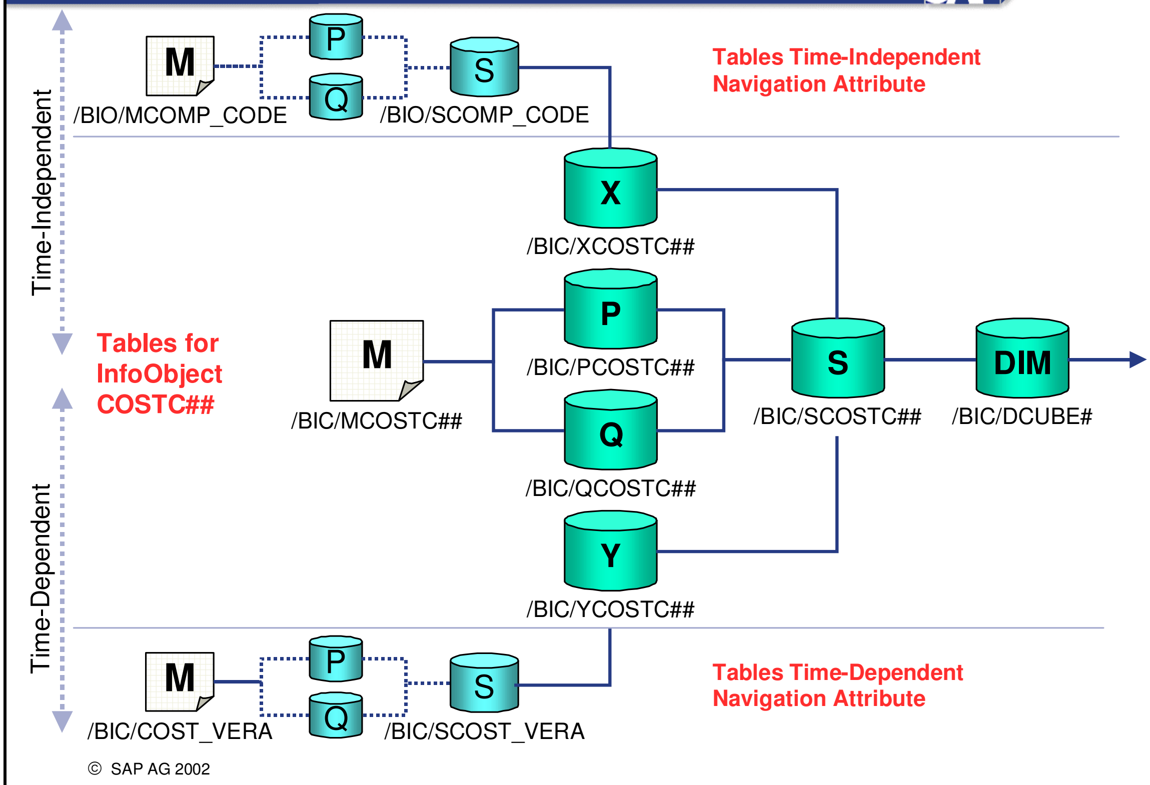
- The BW extended star schema differs from the basic star schema.
- Attributes located in the dimensions are called Characteristics.
- Attributes located in a master data table of a Characteristic are called attributes of the Characteristic.
- SID tables (pointer tables) provide the technical link to the Master Data (attribute, text and hierarchy) tables that are outside the dimension of a star schema.
- Dimension tables are built using the combination of numeric SID values of each Characteristic in the Dimension. Secondary indices on each Dimension improve performance.
- External information (attributes of the Characteristics, text descriptions and external hierarchies) is stored separately (shared) and linked to the InfoCubes.
- Historical relationships as well as the current state of the data can be maintained and reported on with only a small performance penalty.
- Multiple languages are supported for text with no decrease in performance.

InfoCube-Independent Use of Master Data



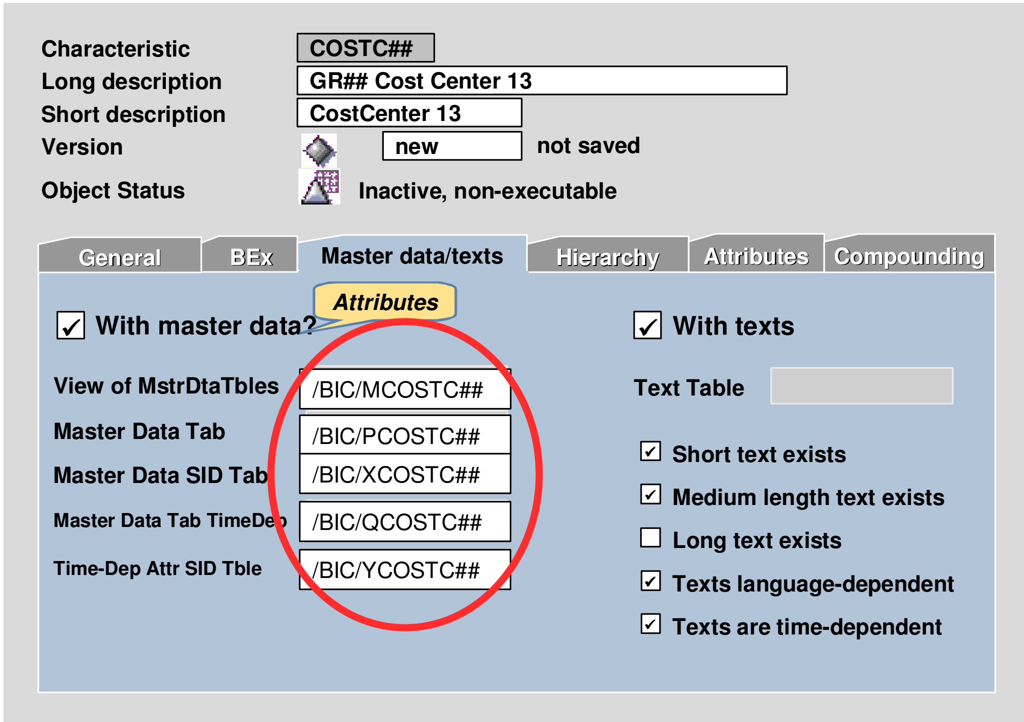
- The Extended Star Schema is divided by a solution-dependent part (InfoCube) and a solution-independent part (attribute, text and hierarchy tables) which is shared among other InfoCubes.

Extended Star Schema: Master Data Tables



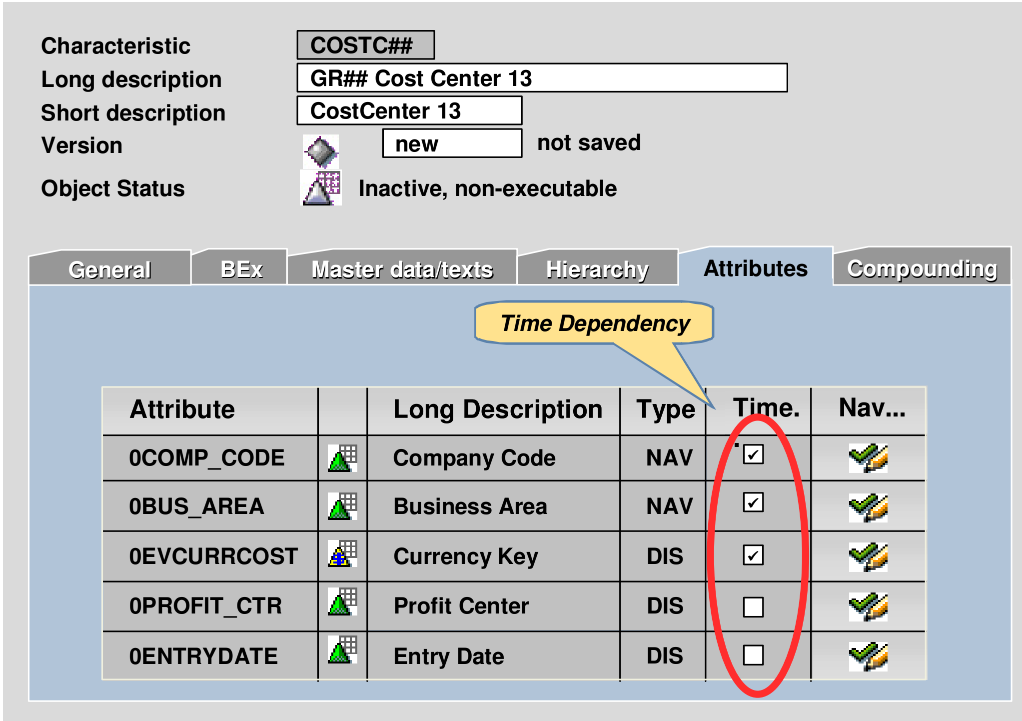
- The number of tables that are generated depends on the definition in the InfoObject maintenance.
- The S-table links time-independent and time-dependent attributes to the dimension tables of an InfoCube. The P-table and the Q-table are displayed in a view (M-table).
- Navigation attributes are read using the view (M) and the master data tables (P and Q) of the associated InfoObject, before they are linked using the X-table or the Y-table of the higher-level InfoObject to its corresponding S-table and then to the dimension tables of the InfoCube.

Master Data Tables



- Master Data tables are named based on their time dependency. For example, for InfoObject 0MATERIAL, the tables would be named as follows:
  - ‘P’ table = ‘PMATERIAL’ – time independent master data
  - ‘Q’ table = ‘QMATERIAL’ – time dependent master data
  - ‘M’ view = ‘MMATERIAL’ – combination of ‘P’ and ‘Q’ above
- As SID tables are created automatically, they too are created on the basis of the time dependency of the characteristic:
  - SID tables of InfoObjects:
    - ‘S’ table = ‘SMATERIAL’ – table to link material SIDs with material numbers
    - ‘X’ table = ‘XMATERIAL’ – table to link material SIDs with SIDs for time independent navigational attributes.
    - ‘Y’ table = ‘YMATERIAL’ – table to link material SIDs with SIDs for time dependent navigational attributes.
  - There are some relationships. For example, the ‘P’ table is linked to the ‘X’ table and the ‘Q” table is linked to the ‘Y’ table.
- In the above example, 0MATERIAL, being a time dependent navigational attribute, has a ‘Q’ and a ‘Y’ table. 0CUSTOMER has a ‘P’ table and a ‘X’ table.

Time Dependency



- Attributes can be either time dependent or time independent. Time dependent attributes have values that are valid for a specific range of dates, while time independent attributes do not have a validity period.
- The flags for time dependency determine the assignment of the attribute fields to the speciffic attribute table.

Master Data Tables

Structure: /BIC/S<...>

<...>	/BIC/<...>	SID	CHCKFL	DATAFL	INCFL
		0	X	X	X

$\underbrace{\text{<...> \quad /BIC/<...>}}_{\text{Key}}$

/BIC/PCOSTC

/BIC/COSTC	PROFIT_CTR
K100	P100
K200	P200
K300	P100
K400	P100

/BIC/QCOSTC

/BIC/COSTC	DATETO	DATEFROM	RESP_PERS
	99991231	10000101	
K100	99991231	10000101	H. Müller
K200	19980930	10000101	H. Müller
K200	99991231	19981001	H. Meier
K300	99991231	10000101	H. Meier
K400	99991231	10000101	H. Meier

/BIC/SCOSTC

/BIC/COSTC	SID
	0
K100	1
K200	2
K300	3
K400	4

- The P- and Q-tables are linked to the S-table using the original key from the source system.
- The SID is used to link to the dimension tables.

P-Table / Q-Table

☑ With master data?

View of MasterDtaTbles	/BIC/MCOSTC##
Master Data Table	/BIC/PCOSTC##
Master. Table. Time.dep.	/BIC/QCOSTC##
Time-dep. Attr. SID Table	/ BIC/YCOSTC##

Attribute		Type	time..
0COMP_CODE		NAV	☑
0BUS_AREA		NAV	☑
0EVCURRCOST		DIS	☑
0PROFIT_CTR		DIS	☐
0ENTRYDATE		DIS	☐

Structure: /BIC/P<...>

/BIC/<...>	OBJVERS	CHANGED	<Attribute>[1]	<Attribute>[2]	<Attribute>[3]	...
	A					

Key

Structure: /BIC/Q<...>

{...}	/BIC/<...>	OBJVERS	DATETO	DATEFROM	CHANGED	<Attribute>[1]	...
		A	99991231	10000101			

Key

- Time independent **display** attributes are generated in the P-table.
- Time dependent **display** attributes are generated in the Q-table

Navigation and Display Attributes

- Characteristic: COSTC##
- Long description: GR## Cost Center 13
- Short description: CostCenter 13
- Version: new not saved
- Object Status: Inactive, non-executable

General | BEx | Master data/texts | Hierarchy | Attributes | Compounding

Display/Navigation Attributes

Navigation Attributes On/Off

Attribute		Long Description	Type	Time.	Nav...
0COMP_CODE		Company Code	NAV	☑	
0BUS_AREA		Business Area	NAV	☑	
0EVCURRCOST		Currency Key	DIS	☑	
0PROFIT_CTR		Profit Center	DIS	☐	
0ENTRYDATE		Entry Date	DIS	☐	

- Attributes of a Characteristic InfoObject are delineated on the Attributes tab page, along with superior InfoObjects specified in the Compounding tab page.
- All of the InfoObjects specified then become Attributes of the Characteristic.
- All specific Attributes default to "display" attributes. They can only be shown as additional information in combination with its Characteristic. You cannot navigate through a query with a display attribute.
- You can change "display" attributes to "navigational" attributes which means with respect to navigation, they behave like Characteristics, even though they are not included in the Dimension table.
  - Defining a display attributed as navigational also opens two additional fields which allow for alternate descriptions for the navigational attribute, so as to distinguish them from display attributes when both are used in the same query.
- Using navigational attributes, changes in the data do not require realignment of the fact table. An attribute can be marked as being *display* or *navigational* in the Attributes tab of the InfoObject.
- Creating an InfoObject with navigation attributes automatically creates SID tables for navigation attributes too. Through this concept the reading process of the OLAP processor during a query execution is reduced to the consideration of the SID tables. No master data tables need to be read for the navigation attribute, which improves performance.

X-Table for Navigation Attributes

Structure: /BIC/X<...>

SID	OBJVERS	/BIC/<...>	CHANGED	S__NAV
0	A			0

$\underbrace{\text{SID}\quad\text{OBJVERS}}_{\text{Key}}$

/BIC/XCOSTC

SID	/BIC/COSTC	S__PROFIT_CTR
0		0
1	K100	11111
2	K200	22222
3	K300	11111
4	K400	11111

/BI0/SPROFIT_CTR

PROFIT_CTR	SID
	0
P100	11111
P200	22222
P100	11111
P100	11111

Read Step, S- to X-Table

Y-Table for Navigation Attributes

Structure: /BIC/Y<...>

SID	OBJVERS	DATETO	DATEFROM	/BIC/<...>	CHANGED	S__NAV
0	A	99991231	10000101			0

$\underbrace{\text{SID OBJVERS DATETO}}_{\text{Key}}$

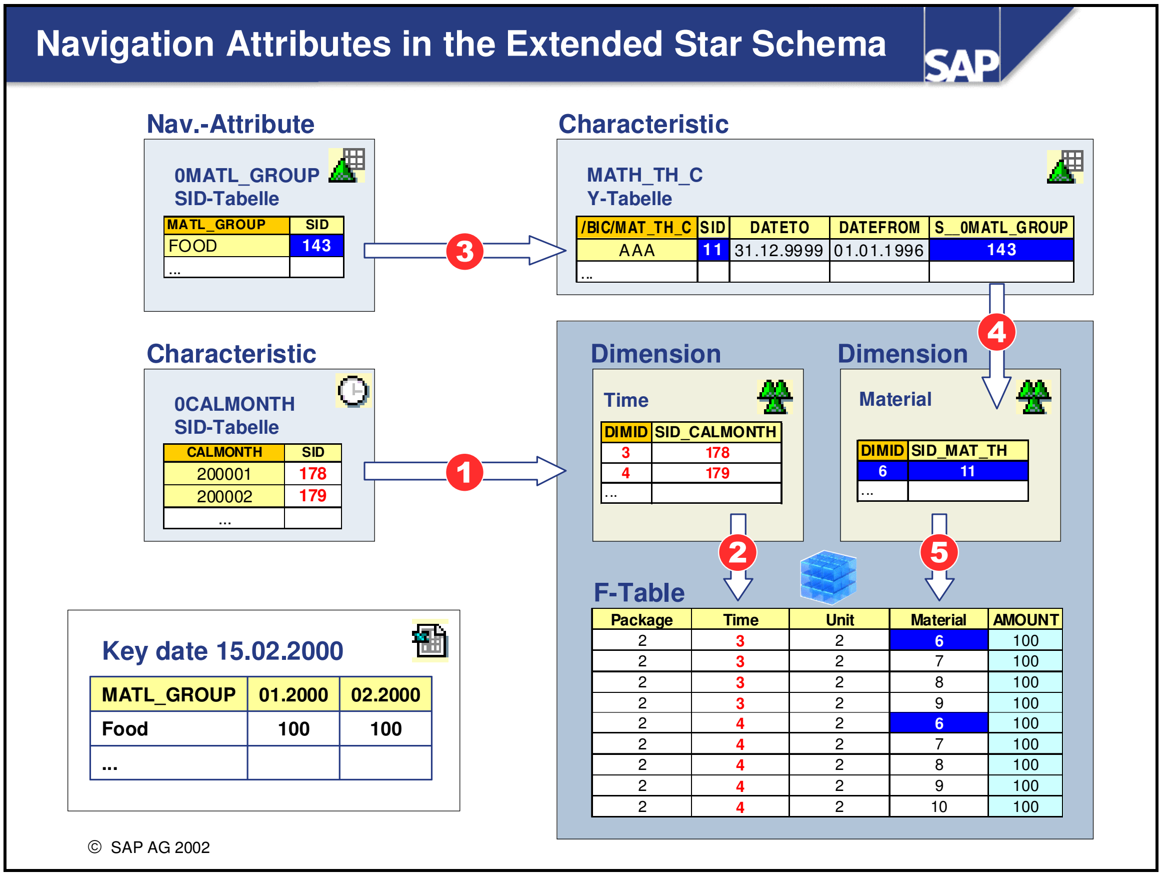
/BIC/YCOSTC

SID	DATETO	DATEFORM	/BIC/COSTC	S__PROFIT_PERS
0	99991231	10000101		0
1	99991231	10000101	K100	1010
2	19980930	10000101	K200	1010
2	99991231	19981001	K200	2020
3	99991231	10000101	K300	2020
4	99991231	10000101	K400	2020

/BI0/SRESP_PERS

RESP_PERS	SID
	0
H. Müller	1010
H. Müller	1010
H. Meier	2020
H. Meier	2020
H. Meier	2020

Read Step, S- to Y- Table



- The first step in reading data using the *material group* (0MATL_GROUP) navigation attribute, is to read the data using the **SID table of the navigation attribute**.
  When data is read using the 0CALMONTH characteristic, there is a direct link between the SID table of the InfoObject and the dimension table.
- The **SID of the navigation attribute 0MATL_GROUP** links to the Y-table of the characteristic (in this case, MATH_TH_C) - this applies to time-dependent navigation attributes. The X-table is used for navigation attributes that are non time-dependent.
- In the Y-table, the key date of the query determines the data record that is valid for this particular time period.
  In the dimension table, the **SID of the** ***material*** **characteristic** determines the DIM ID.
- The DIM ID links the dimension table to the fact table.
- Again, it is the DIM ID that accesses the fact table.

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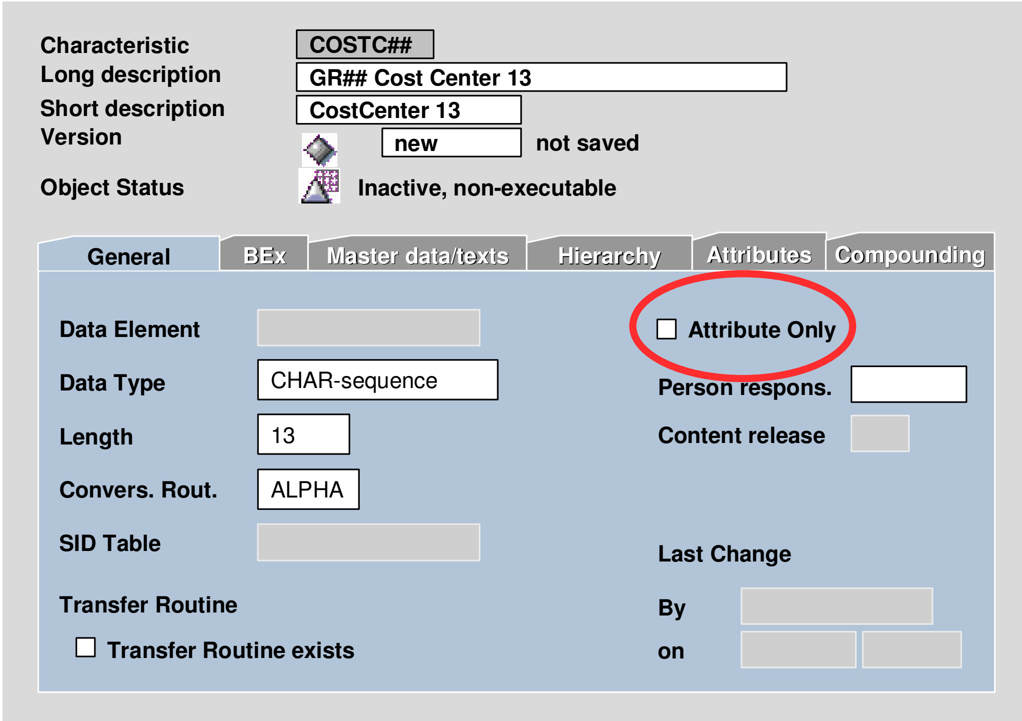
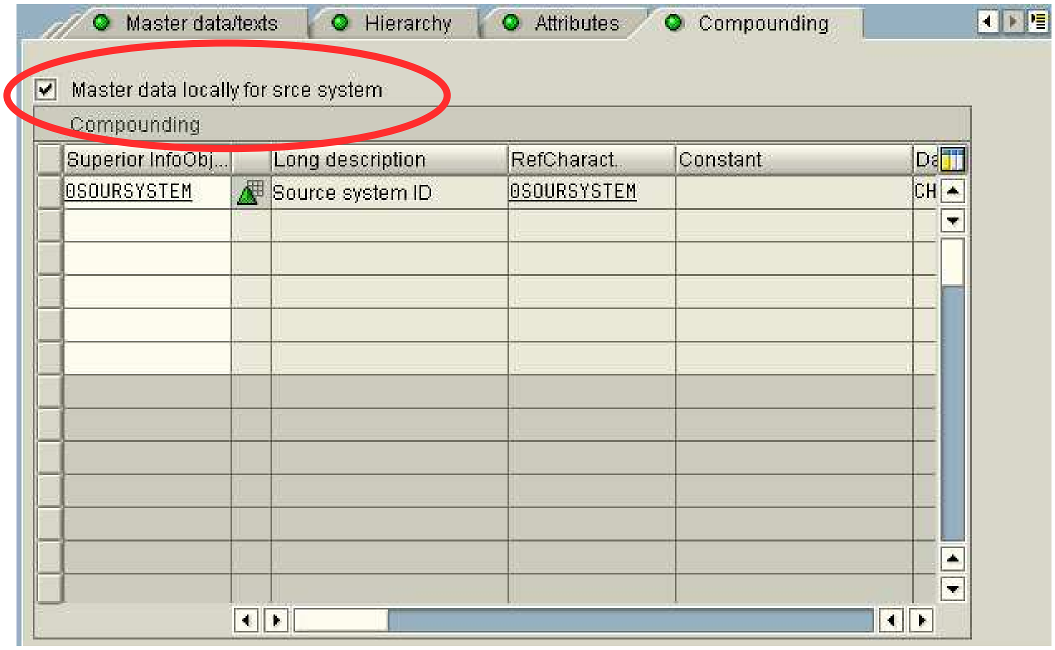
Attribute Only



- If you select *Attribute only*, the created characteristic can be used only as a display attribute for another Characteristic, and not as an independent Characteristic or navigation attribute in the InfoCube/ODS object.

Compounding



- In this tabstrip, you determine whether you want to compound the Characteristic to other InfoObjects.
- You sometimes need to compound InfoObjects in order to map the data model. Some InfoObjects cannot be defined uniquely without compounding
  - For example, you can only evaluate the characteristic ‘storage location’ in connection with ‘plant’, if storage location A for plant B is not the same as storage location A for plant C. In this case, define a compounding characteristic ‘storage location’ to ‘plant’, so it is clear what the characteristic is.
- One exception in compounding, is the option of compounding Characteristics to the source system ID [Extern]. You can do this by setting the *Master data is valid locally for the source system* indicator. You may need to do this if there are identical characteristic values for the same Characteristic in different source systems, but these values indicate different objects.

Text Tables

☑ With texts

Text Table: /BIC/T<...>

- ☑ Short text exists
- ☑ Medium-length text exists
- ☐ Long text exists
- ☑ Texts language-dependent
- ☑ Texts are time-dependent

Structure: /BIC/T?...?

{...}	/BIC/?...?	LANGU	DATETO	DATEFROM	TXTSH	TXTMD

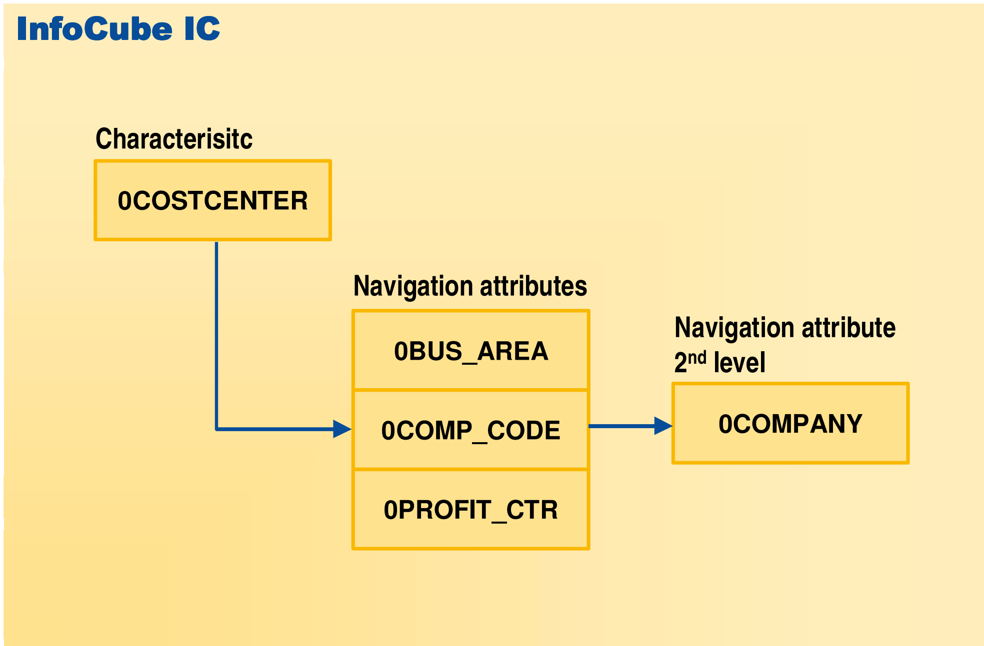
$\underbrace{\{...\}\ \ /BIC/?...?\ \ LANGU\ \ DATETO}_{\text{Key}}$

Example

CO_AREA	/BIC/TCOSTC##	LANGU	DATETO	DATEFROM	TXTSH	TXTMD
1000	T900000001110	D	31.12.9999	01.01.1994	Board	Board

$\underbrace{CO\_AREA\ \ /BIC/TCOSTC\#\#\ \ LANGU\ \ DATETO}_{\text{Key}}$

Transitive Attributes



- If a characteristic was included in an InfoCube as a navigational attribute, it can be used for navigation in queries. This characteristic can itself have further navigational attributes, called transitive attributes.
- These attributes are not automatically available for navigation in the query. As described in this procedure, they must be switched on.
- In the above example, a user requested a way to query on cost centers by COMPANY.

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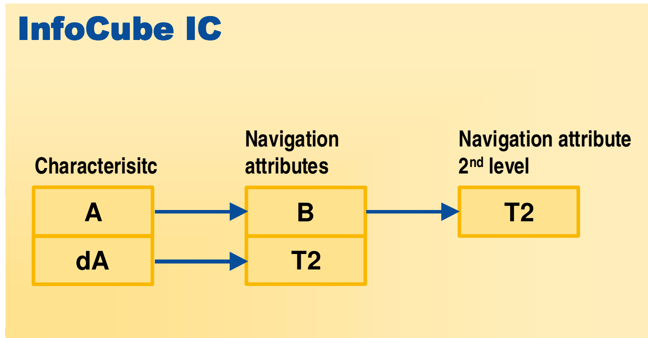
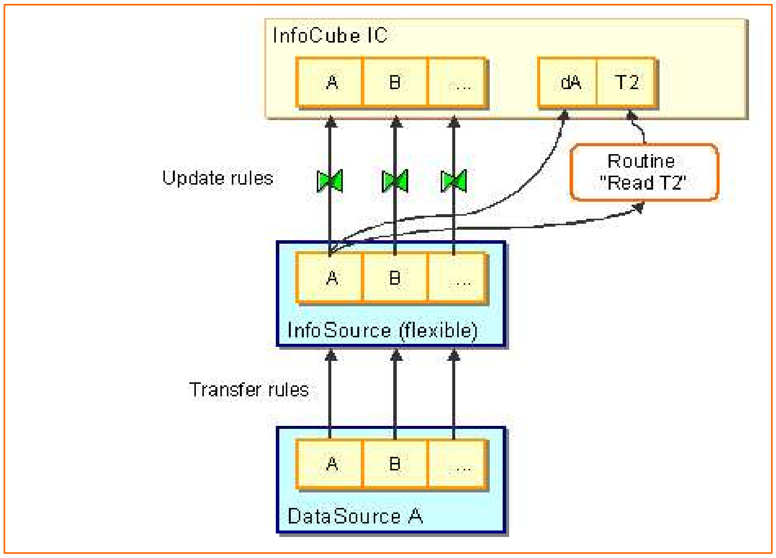
Set-Up for Transitive Attributes



- **Create a new characteristic dA which has the transitive attributes requested in the query as navigation attributes (for example T2).**
- **dA has the same technical settings for the key field as characteristic A.**
- **Make dA non-navigational in the RSDCHA table.**
- **Add dA to the InfoCube > make T2 navigational.**
- **Create a query using T2.**

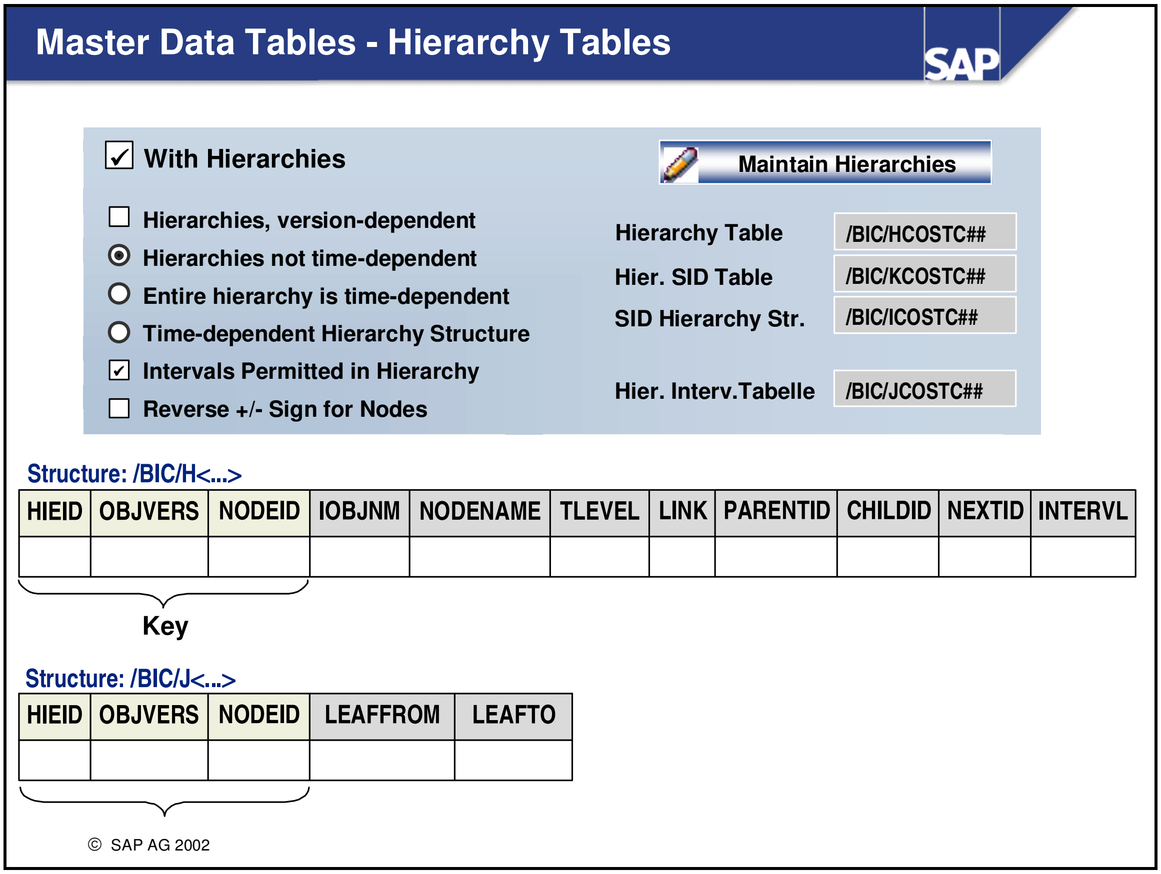
- After creating and saving characteristic dA, go to Transaction SE16, select the entry for this characteristic from table RSDCHA (CHANM = <characteristicname> and OBJVERS = 'M') and set field CHANAV to 2.
- This makes characteristic dA unusable in queries. This is not necessary technically, but improves the readability in the query definition.
- Start Transaction RSD1 (InfoObject maintenance) again and activate the characteristic.
- Including Characteristics in the InfoCube (Include characteristic dA in InfoCube IC). Switch on its navigational attribute T2. The transitive navigational attribute T2 are now available in the query.
- Now adjust the update rules to the InfoSources for InfoCube IC so that the newly included characteristic dA is computed in exactly the same way as the existing characteristic A. The values of A and dA in the InfoCube must be identical.

Data Loads for Transitive Attributes



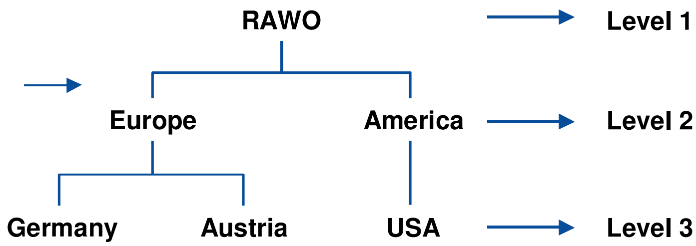
If the extractor for DataSource A is not delta-enabled, the data is updated in the two different data targets (master data table of characteristics A and dA) using a flexible InfoSource and two different update rules.

- The update rules in the data target master data table of characteristic dA must cause attribute T2 to be read. Since this can be very complicated, function modules will be provided in the future that offer you this service.
- It is better for the coding for reading the transitive attributes (in the update rules) if you include the attributes to be read in the InfoSource right from the beginning. This means that you only have update rules that perform a one-to-one mapping. The additional attributes that are included in the InfoSource are not filled in the transfer rules. They are only computed in the update rules in a start routine that must be created. The advantage is that the coding for reading the attributes (which can be quite complex) is stored in one place in the update rules.
- In both cases the order at load time must be adhered to and must be implemented either organizationally (load times in the scheduler) or by process chain. It is essential that the master data to be read (in our case the master data of characteristic B) already exist in the master data tables in the system when the data providing the DataSource of characteristic A is loaded.
- If it is a delta-enabled extractor, an ODS object from which you can always execute a full update in the master data table of characteristic dA is used. Update rules from the ODS are also used to write the master data table of the characteristic dA with a full update.



- A hierarchy is a method of displaying a Characteristic structured and grouped according to individual evaluation criteria.
- A BW hierarchy has the following properties:
  - Hierarchies are created for basic Characteristics (Characteristics that do not reference other Characteristics). An example of a basic Characteristic is 0MATERIAL.
  - Hierarchies are stored in special Master Data tables. They behave in a similar way to master data, and can therefore be used and modified in all InfoCubes.
  - You can define several hierarchies for a single Characteristic.
  - A hierarchy can have a maximum of 98 levels.
- If you want to create a hierarchy, or upload an existing hierarchy from a source system, you have to set the *with hierarchy* indicator. The system generates a hierarchy table with hierarchical relationships for the Characteristic.
- When activated, the BW system will create several tables to house the hierarchies which can be loaded or created for the Characteristic. The tables include a SID table and once which houses the structure of the hierarchy.
  - A table housing interval data is created only if the checkbox *Intervals permitted in hierarchy* is checked.

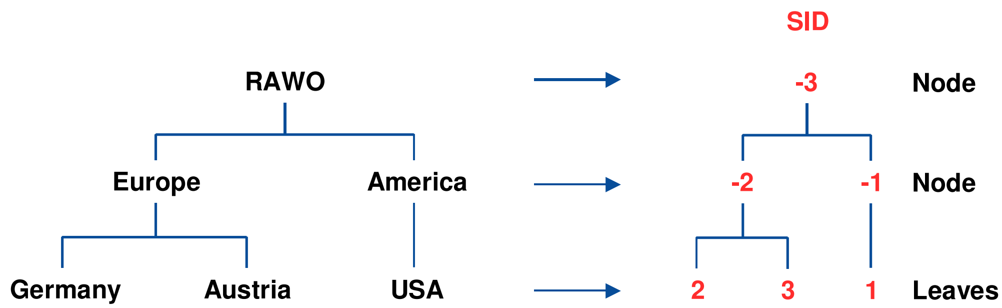
H-Table for Hierarchies



/BIC/HCOUNTRY

HIEID	OBJ VERS	NODEID	IOBJNM	NODENAME	TLEVEL	LINK	PARENT ID	CHILD ID	NEXTID	INTERVL
<ID>	A	1	0HIER_NODE	ROOT	1		0	2	0	
<ID>	A	2	0HIER_NODE	EUROPE	2		1	3	4	
<ID>	A	3	0COUNTRY	AUSTRIA	3		2	0	6	
<ID>	A	4	0HIER_NODE	AMERICA	2		1	5	0	
<ID>	A	5	0COUNTRY	USA	3		4	0	0	
<ID>	A	6	0COUNTRY	GERMANY	3		2	0	0	

SID-Tables for Hierarchies



/BIC/SCOUNTRY

COUNTRY	SID
USA	1
GERMANY	2
AUSTRIA	3

/BIC/ICOUNTRY

SUCC	PRED
-2	-3
2	-2
3	-2
-1	-3
1	-1

/BIC/KCOUNTRY

CODENAME	SID
AMERICA	-1
EUROPE	-2
ROOT	-3

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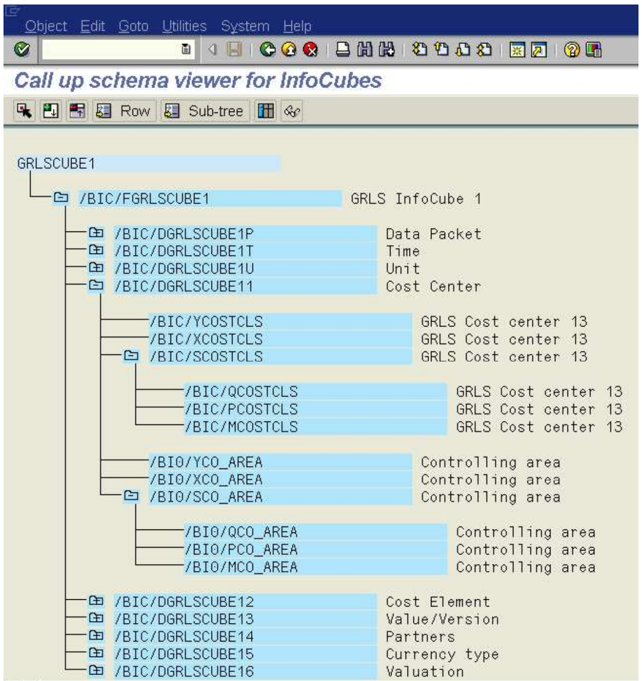
Listschema Transaction



F Fact Table
D Data Packet Dimension Table (SAP Defined)
D Time Dimension Table (SAP defined)
D Unit Dimension Table (SAP defined)
D Cost Center Dimension Table (User defined)
Y Time dependent navigational attribute SID table
X Time independent navigational attribute SID table
S InfoObject SID table
Q Time dependent master data (attributes) table
P Time independent master data (attributes) table
M InfoObject master data table (combination of P and Q)
Y Time dependent navigational attribute SID table
X Time independent navigational attribute SID table
S InfoObject SID table
Q Time dependent master data (attributes) table
P Time independent master data (attributes) table
M InfoObject master data table (combination of P and Q)
D Cost Element Dimension Table (User defined)
D Value/Version Dimension Table (User defined)
D Partners Dimension Table (User defined)
D Currency Type Dimension Table (User defined)
D Valuation Dimension Table (User defined)

- Go to the LISTSCHEMA transaction in BW > enter 'B' for Basic Cube > Enter the name of the InfoCube > Execute.
- While in the transaction, you can view the contents of tables by highlighting a row then calling up the SE16 Browser by pressing the icon left of the eyeglasses.

Table Partitioning

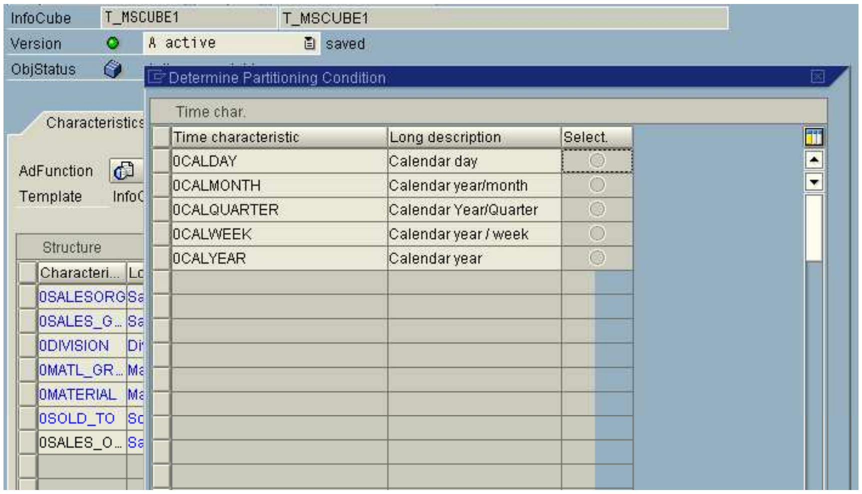
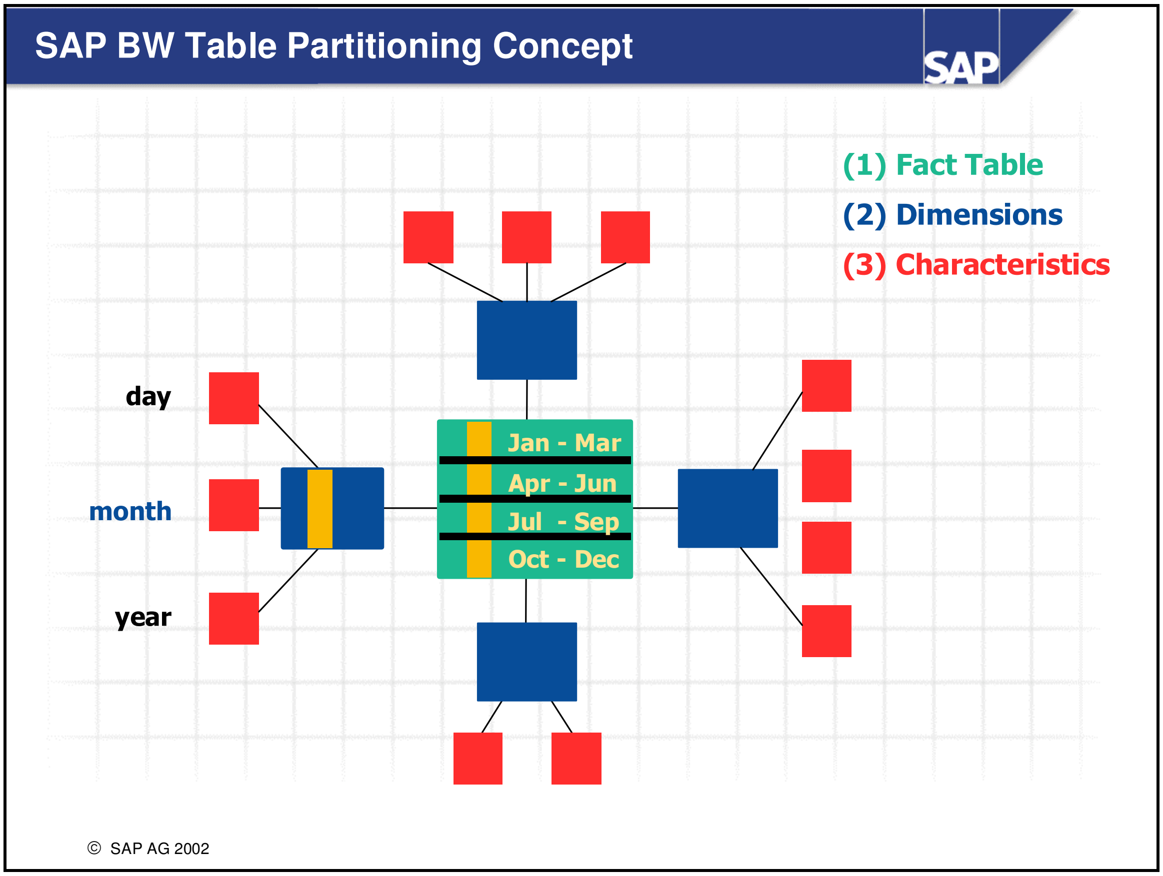


Table Partitioning

- database level
- "low-level partitioning"
- e.g. fact table range partitioned by month

- Table partitioning needs to be set up after the InfoCube has been created and before data has been loaded into the InfoCube.
- This type of partitioning is called “range partitioning” and can only be set up based on a time InfoObject.
- Once the time Characteristic has been selected then the date range needs to be selected and the number of partitions entered.
- Table Partitioning which is a feature provided by the underlying DB platform; BW takes advantage of that feature.
  - Platforms with table partioning:
    - IBM DB2/UDB; IBM DB2/390; Informix; Oracle
  - Platforms without table partioning:
    - IBM DB2/400; Microsoft SQL Server; SAP DB



- This is a simple example of how a reporting scenario can be partitioned using the table partitioning concept:
- Table Partitioning
  - The basic InfoCube in itself can be partitioned on the database level. That means that the fact table inside the respective star schema (which physically represents an InfoCube) are partitioned. This is indicated by those horizontal lines splitting the fact table into various partitions/fragments.
- Fact tables can be partitioned over a time characteristic, either 0CALMONTH (as in the example here) or 0FISCPER. The reasons for this approach are the following:
- The DBMS require that ranges are defined when the Fact table is created, i.e. one needs to know the future values of the partition column in advance. This is fairly straightforward for 0CALMONTH or the 0FISCPER as users normally have a clear idea what the time frame of their data is. In other words: when you specify an InfoCube to be partitioned then you only have to know the time interval for which data will be loaded into the cube.
- Partitioning over time usually leads to well balanced partitions/fragments as the same amount of data is loaded into the cube at regular points in time. Archiving usually works over time: data before a certain date is archived rather than data for a certain sales region.

Cube Model: Unit Summary

Now you will be able to:

- Review the purpose of the SAP BW Star Schema
- Integrate Navigational Attributes into the Model
- Discuss key characteristics settings
- Identify the key advantages of the SAP BW Star Schema
- Discuss criteria for placing InfoObjects inside or outside dimension tables

Exercises 1

Unit: Cube Model

Topic: BW Star Schema

At the conclusion of this exercise, you will be able to:

- Create a basic InfoCube
- Investigate Partitioning
- Set Line Item Dimensions and High Cardinality (discussed in detail in the Modeling Dimensions Unit)

Your company has decided to use an InfoCube to meet reporting requirements of a summarized nature. First of all, you need to consider some of the master data settings for a characteristic to see how they will affect data modeling

1 Create a basic InfoCube in an InfoArea with a line item dimension with high cardinality.

1-1 In your InfoArea *BW330 Group ## (T_BW330_GR##)* create a basic InfoCube by copying the existing InfoCube *T_GR00SOR*.
Use the technical name **T_GR##SOR** and description **GR## Sales Order Cube.**

1-2 Now determine the dimension to which the characteristic 0DOC_NUMBER is assigned. Mark this dimension to be a line item dimension and with high cardinality.

1-3 Check and activate your InfoCube.

1-4 Using the transaction LISTSCHEMA, what consequences does this line item dimension have on the data model of your InfoCube?

2 Partition a basic InfoCube in your InfoArea by calendar year and month.

2-1 Change your InfoCube T_GR##SOR. Enter a partition condition within the InfoCube maintenance for the time characteristic 0CALMONTH with a value range from 01.1999 to 12.2000.

2-2 What is the maximum number of partitions to be entered in order to get the data of 2 calendar months in one partition?

____

2-3 Save and activate the changes to InfoCube T_GR##SOR.

2-4 Using the transaction LISTSCHEMA look at the structure of the fact table. What new field has been added after the DIM keys?

____

Solutions 1

Unit: **Cube Model**

Topic: **BW Star Schema**

1 Create a basic InfoCube in an InfoArea with a line item dimension with high cardinality.

1-1 In your InfoArea *BW330 Group ## (T_BW330_GR##)* create a basic InfoCube by copying the existing InfoCube *T_GR00SOR*.
Use the technical name **T_GR##SOR** and description **GR## Sales Order Cube.**

Administrator Workbench → Modeling →InfoObjects → BW Training 3.0 → BW Customer Training → BW330 Modeling → BW330 Group ## (T_BW330_GR##)

Select your InfoArea **BW330 Group ## (T_BW330_GR##)** and right click.

From the context menu, select **Create InfoCube**.

Enter the name **T_GR##SOR** and description **GR## Sales Order Cube**.

From the drop down list find and select InfoCube **T_GR00SOR** or enter the InfoCube name in the field *Copy From*.

Select radio button for **Basic Cube** in *InfoCube Type*.

Click the **Create** button.

1-2 Now determine the dimension to which the characteristic 0DOC_NUMBER is assigned. Mark this dimension to be a line item dimension and with high cardinality.

On the *Characteristics* tab, click the **Dimensions** button.

Switch to the *Assign* tab.

Determine which dimension contains the InfoObject **0DOC_NUMBER**.

Return to the *Define* tab.

Mark the dimension determined above as both *Line item* and *High Cardinality.*

Select the **Continue** button.

1-3 Check and activate your InfoCube.

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1-4 Using the transaction LISTSCHEMA, what consequences does this line item dimension have on the data model of your InfoCube?

In the command field, enter **/nlistschema**.

For *InfoCube type*, enter **B**.

In the *InfoCube* field, enter the name of your InfoCube **T_GR##SOR**.

Execute.

Expand the fact table.

Find the dimension determined above and expand it.

Find the SID table (**/BI0/SDOC_NUMBER**) for the dimension table determined above.

Click the button **Call up transaction SE16** icon to see the structure of the table.

You will see that the SID table has already been populated.

Return to the Administrator Workbench.

2 Partition a basic InfoCube in your InfoArea by calendar year and month.

2-1 Change your InfoCube T_GR##SOR. Enter a partition condition within the InfoCube maintenance for the time characteristic 0CALMONTH with a value range from 01.1999 to 12.2000.

Find your InfoCube **T_GR##SOR** and right click on it to open the context menu.

From the context menu, select **Change**.

Use the menu path:

Extras → Partitioning

In the *Determine Partitioning Condition* dialog box, you will see the time characteristic InfoObjects that are part of the InfoCube definition. One will be grayed out. Select the radio button **Select** for the InfoObject **0CALMONTH**.

In the *Value Range (Partitioning Condition)* dialog box, enter the values **01.1999** and **12.2000** in the *From* and *To* fields.

Select **Continue**.

2-2 What is the maximum number of partitions to be entered in order to get the data of 2 calendar months in one partition?
(**24 periods / 2) + 2 = 14 partitions**

2-3 Save and activate the changes to InfoCube T_GR##SOR.

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2-4 Using the transaction LISTSCHEMA look at the structure of the fact table. What new field has been added after the DIM keys?

In the command field, enter **/nLISTSCHEMA**

For *InfoCube type*, enter **B**.

In the *InfoCube* field, enter the name of your InfoCube **T_GR##SOR**.

Execute.

Select the fact table.

Click the button **Call up transaction SE16**.

What new field has been added after the DIM keys?

***The field SID_0CALMONTH* has been added as a result of the partitioning condition.**

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Exercises 2

Unit: Cube Model

Topic: Characteristics

At the conclusion of this exercise, you will be able to:

- Create a characteristic InfoObject
- Investigate master data settings that affect modeling
- Set up a transitive attribute

Your company has decided to use an InfoCube to meet reporting requirements of a summarized nature. First of all, you need to consider some of the master data settings for a characteristic to see how they will affect data modeling.

1 You will create a new InfoObject **T_CSTC##** (## is your group number). Your group number should be a part of your long description (**GR## Cost center**).

1-1 Create a new characteristic InfoObject named **T_CSTC##** in your InfoObject Catalog **Group## Characteristics** (**T_BW330_GR##_CHAR)** in your InfoArea ***Administrator Workbench → Modeling → InfoObjects → BW Training → BW Customer Training → BW330 Modeling → Group ##***

1-1-1 Select your InfoObject catalog and from the context menu select **Create InfoObject**

On the **General** tab, choose *data type* **CHAR,** *length* **13** and *conversion routine* **ALPHA.**

On the **Master data/texts** tab, ensure that the **With master data** and **With texts** check boxes are both selected and that **texts are language-dependent and time-dependent. Select both short and medium length texts.**

On the Hierarchy tab, **enable hierarchies** and specify **that intervals be permitted.** Hierarchies should **not be time dependent.**

On the **Compounding** tab specify the superior InfoObject **0CO_AREA**.

On the **Attributes** tab enter the following InfoObjects as attributes:
0COMP_CODE
0BUS_AREA
0RESP_PERS
0EVCURRCOST
0PROFIT_CTR
0ENTRYDATE

Mark all attributes as time dependent.

Activate 0COMP_CODE and 0BUS_AREA as Navigation Attributes using the standard text.

Save and activate your new InfoObject.

1-2 **Optional** – Look at the underlying tables created when you saved and activated your InfoObject **T_CSTC##.**

1-2-1 Go to the tab Master data/texts and double-click on the table titled **/BIC/MT_CSTC##** in the field View of MstrDtaTbls and view the structure of the table. What two fields do you see which relate to time?

____

Compare the structure of this table with the order of attributes you entered on the **Attributes** tab. Are there are similarities?

____

On the tab **Master data/texts** and double-click on the table titled **/BIC/QT_CSTC##** in the field **Master data tab time dep** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why or why not?

____

On the tab **Master data/texts** and double-click on the table titled **/BIC/YT_CSTC##** in the field **SID Tab time dep attr.** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why?

____

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On the tab **Master data/texts** and double-click on the table titled **/BIC/TT_CSTC##** in the field **Text Table** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why or why not?

____

Go to the tab **Hierarchy** and double-click on the table titled **/BIC/HT_CSTC##** in the field **Hierarchy table** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why or why not?

____

Return to the InfoObjects directory.

End Optional Exercise

1-3 You need 0COMPANY as a navigational attribute but it isn't in the data model. You must now set it up as a transitive attribute.

1-3-1 Create a new characteristic InfoObject named **COST_T##** with description '**Transitive Cost Center ##**' in your InfoObject Catalog **Group## Characteristics** (**T_BW330_GR##_CHAR)** in your InfoArea ***Administrator Workbench →Modeling →InfoObjects →BW Training 3.0 →BW Customer Training →BW330 Modeling →Group ##***

Copy from T_CSTC##.

Delete all copied attributes and add 0COMPANY.

Mark 0COMPANY as Navigation Attribute using standard description.

Leave all other settings the same.

Save **but don't activate**!

1-3-2 Goto SE16 for table RSDCHA and bring up the 'M' version of COST_T##. Change the field CHANAV to 2. This prevents COST_T## from being used in the query. This is not a required step. Save the change.

1-3-3 Go back to COST_T## and activate it in your other session.

1-3-4 Add COST_T## to InfoCube T_330GR## and assign it to dimension Cost Center. Make 0COMPANY navigational.

1-3-5 Create a query off InfoCube T_330GR## with 0QUANTITY in the columns and COMPANY in the rows.
Save query with a description 'Transitive Query ##' and technical name Transitive_Q## in your Favorites folder.

Note: Since master data has not been loaded for the new/changed tables, your query results will not represent a range of Company values.

Field Name or Data Type	**Values**
Description	Transitive Query ##
Technical Name	Transitive_Q##

Unit: **Cube Model**

Topic: **Characteristics**

At the conclusion of this exercise, you will be able to:

- Create a characteristic InfoObject
- Investigate master data settings that affect modeling
- Set up a transitive attribute

1 You will create a new InfoObject **T_CSTC##** (## is your group number). Your group number should be a part of your long description (**GR## Cost center 13**).

1-1 Create a new characteristic InfoObject named **T_CSTC##** in your InfoObject Catalog **Group## Characteristics** (**T_BW330_GR##_CHAR)** in your InfoArea ***Administrator Workbench →Modeling →InfoObjects →BW Training →BW Customer Training →BW330 Modeling →Group ##***

1-1-1 Select your InfoObject catalog and from the context menu select **Create InfoObject**

On the **General** tab, choose *data type* **CHAR,** *length* **13** and *conversion routine* **ALPHA.**

On the **Master data/texts** tab, ensure that the **With master data** and **With texts** check boxes are both selected and that **texts are language-dependent and time-dependent. Select both short and medium length texts.**

On the Hierarchy tab, **enable hierarchies** and specify **that intervals be permitted.** Hierarchies should **not be time dependent.**

On the **Compounding** tab specify the superior InfoObject **0CO_AREA**.

On the **Attributes** tab enter the following InfoObjects as attributes:
0COMP_CODE
0BUS_AREA
0RESP_PERS
0EVCURRCOST
0PROFIT_CTR
0ENTRYDATE

Mark all attributes as time dependent.

Activate 0COMP_CODE and 0BUS_AREA as Navigation Attributes using the standard text.

Save and activate your new InfoObject.

1-2 **Optional** – Look at the underlying tables created when you saved and activated your InfoObject **T_CSTC##.**

1-2-1 Go to the tab Master data/texts and double-click on the table titled **/BIC/MT_CSTC##** in the field View of MstrDtaTbls and view the structure of the table. What two fields do you see which relate to time?

Because you marked the attributes as time dependent, the field's 0DATEFROM and 0DATET0 were added to the master data table view.

Compare the structure of this table with the order of attributes you entered on the **Attributes** tab. Are there are similarities?

The order of the InfoObjects you entered as attributes is found here in the master data table view.

On the tab **Master data/texts** and double-click on the table titled **/BIC/QT_CSTC##** in the field **Master data tab time dep.** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why or why not?

This table does not differ from the master data table view. Since the attributes are all time dependent, the BW system creates the Q table which together with the P table (for time independent attributes) forms the M master data table view.

On the tab **Master data/texts** and double-click on the table titled **/BIC/YT_CSTC##** in the field **SID Tab time dep attr.** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why?

This table does differ from the master data table view since this table contains the necessary SIDs for the master data.

On the tab **Master data/texts** and double-click on the table titled **/BIC/TT_CSTC##** in the field **Text Table** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why or why not?

The text table does not contain any of the attributes, but does reflect the settings made in the master data/texts tab of the InfoObject.

Go to the tab **Hierarchy** and double-click on the table titled **/BIC/HT_CSTC##** in the field **Hierarchy table** and view the structure of the table. Does this table differ from **/BIC/MT_CSTC##** and why or why not?

This table does differ from the master data table view since this table reflects the settings made in the hierarchy tab of the InfoObject.

Return to the InfoObjects directory.

End Optional Exercise.

1-3 You need 0COMPANY as a navigational attribute but it isn't in the data model. You must now set it up as a transitive attribute.

1-3-1 Create a new characteristic InfoObject named **COST_T##** with description '**Transitive Cost Center ##**' in your InfoObject Catalog **Group## Characteristics** (**T_BW330_GR##_CHAR)** in your InfoArea ***Administrator Workbench → Modeling → InfoObjects → BW Training 3.0 → BW Customer Training → BW330 Modeling → Group ##***

Copy from T_CSTC##.

Delete all copied attributes and add 0COMPANY.

Mark 0COMPANY as Navigation Attribute using standard description.

Leave all other settings the same.

Save **but don't activate**!

Administrator Workbench → Modeling → InfoObjects → BW Training 3.0 → BW Customer Training → BW330 Modeling → GR##: InfoArea → Right Mouse Click(RMC) → Create InfoObject.

Use T_CSTC## as a template.

On the attribute tab delete all copied attributes.

Add 0COMPANY as an attribute.

Mark 0COMPANY as Navigation Attribute. Check the box to use the text from the standard InfoObject description.

Save but don't activate.

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1-3-2 Goto SE16 for table RSDCHA and bring up the ‘M’ version of COST_T##. Change the field CHANAV to 2. This prevents COST_T## from being used in the query. This is not a required step. Save the change.

Enter /OSE16 in the command field →Enter table RSDCHA.

Select CHANM = COST_T## and OBJVERS = M and execute (F8).

Flag the selected record and choose Change (F6).

Change the field CHANAV to 2 →Save.

1-3-3 Go back to COST_T## and activate it in your other session.

1-3-4 Add COST_T## to InfoCube T_330GR## and assign it to dimension Cost Center. Make 0COMPANY navigational.

Administrator Workbench →Modeling →InfoProviders →Search for T_330GR## →RMC →Change

Add COST_T## as a Characteristic →Press the Dimensions Button → Goto the Assign Tab →Scroll down →Check COST_T## →Double click on the ‘Cost Center’ Dimension

Choose Button Navigation Attributes and flag 0COMPANY as used in this InfoCube.

Continue →Activate.

1-3-5 Create a query off InfoCube T_330GR## with 0QUANTITY in the columns and COMPANY in the rows.
Save query with a description ‘Transitive Query ##’ and technical name Transitive_Q## in your Favorites folder.

Note: Since master data has not been loaded for the new/changed tables, your query results will not represent a range of Company values.

From the SAP Easy Access Screen →Business Explorer →Analyzer Choose Open →Queries →New →InfoAreas →Search for InfoCube ‘T_330GR##’.

Drag 0QUANTITY from the Key Figures folder to the columns.

Drag COMPANY from the Cost Center folder to the rows.

Save.

Field Name or Data Type	**Values**
Description	Transitive Query ##
Technical Name	Transitive_Q##

Dimensional Modeling

Contents

- Broad Dimensions
- Mixed Dimensions
- Categorical Dimensions
- M:N Entities
- Status Tracking
- Partitioning Dimensions
- Line Item Dimensions
- Modeling Data Mining

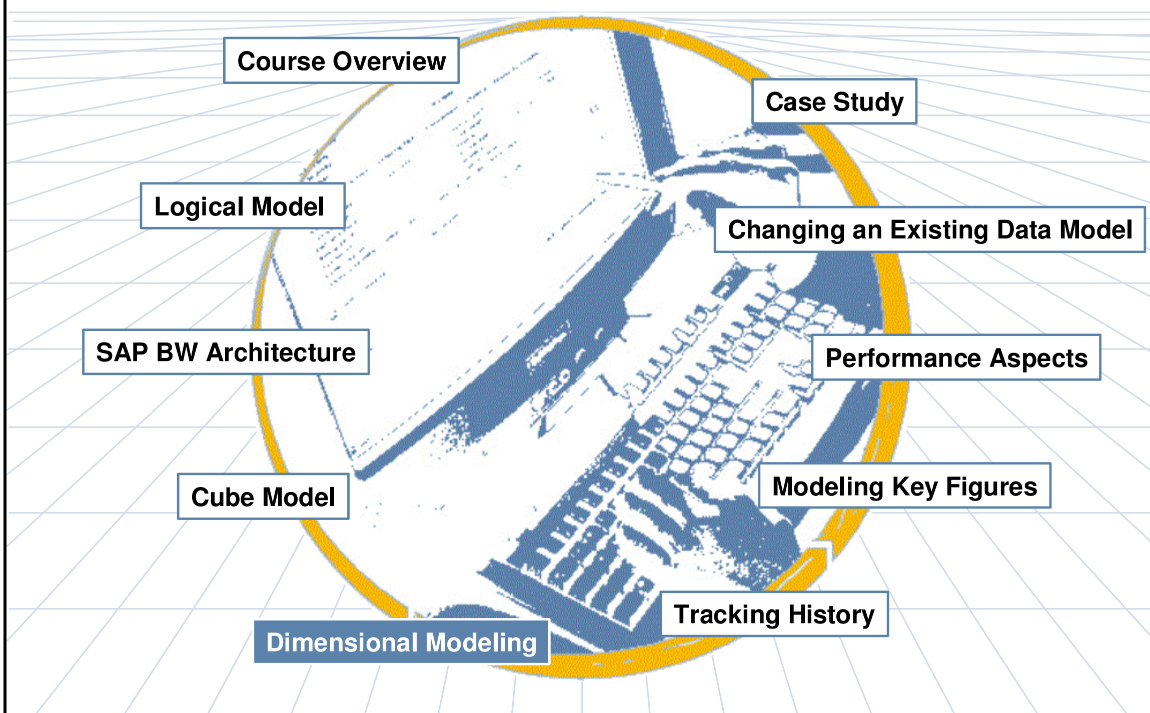
Dimensional Modeling: Unit Objectives

At the conclusion of this unit, you will be able to:

- Recognize typical modeling issues and suggest the appropriate solution
- Discuss the concepts and the recommended modeling solution along with loading implications

- The BW360 class covers performance aspects in much more detail.

Dimensional Modeling: Overview Diagram



Dimensional Modeling: Business Scenario

- You want to implement your logical data model. You have to decide how to design the dimensions of the SAP BW InfoCube.

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Technical Structure

Structure: /BIC/D[...]#

DIMID	SID_<...>[1]	SID_<...>[2]	SID_<...>[3]	...

Key

/BI0/SCO_AREA

CO_AREA	SID
	0
1000	111

/BIC/DCUBE1

DIMID	SID_0CO_AREA	SID_COSTC
0	0	0
10	111	1
20	111	2

/BIC/SCOSTC

COSTC	SID
	0
K100	1
K200	2

- In addition to the DIM ID as the key of the dimension table, there is one column for every characteristic in the dimension table.
- These columns contain the SID (surrogate ID) value for each characteristic.
- The SID is the value field of the SID table. The actual master data value is the key to the SID table.

Relationship of Characteristics in Dimension Tables

1:N

/BI0/SMATERIAL	
MATERIAL	SID
	0
M-01	1
M-02	2
M-03	3
HD-10GB	4
HD-20GB	5

/BI0/SMATL_GROUP	
MATL_GROUP	SID
	0
Monitor	1
Harddisk	2

/BIC/DCUBE01		
DIMID	SID_MATERIAL	SID_MATL_GROUP
0	0	0
1	1	1
2	2	1
3	3	1
4	4	2
3	4	2

N:M

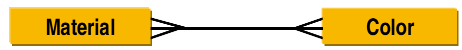
/BI0/SMATERIAL	
MATERIAL	SID
	0
M-01	1
M-02	2
M-03	3
HD-10GB	4
HD-20GB	5

/BI0/SCUSTOMER	
CUSTOMER	SID
	0
1000	1
1001	2
1002	3
1003	4
1004	5
1005	6
1006	7
1007	8
1008	9
1009	10
1010	11

/BIC/DCUBE01		
DIMID	SID_MATERIAL	SID_CUSTOMER
0	0	0
1	1	1
2	1	2
3	1	3
4	1	4
5	1	5
6	1	6
7	1	7
8	1	8
9	1	9
10	1	10
11	1	11
12	2	1
53	5	9
54	5	10
55	5	11

- The ideal relation between characteristics in the same dimension table is the 1:N relationship.
- For every possible combination there is only a single DIMID at a certain point of time.
- If the combination changes a new entry with a new DIMID is generated.
- The N:M relationship will normally cause very big dimension tables.
- The maximum number of entries in the dimension table is the Cartesian product of all SIDs (Assumption: transactional data are loaded for every possible combination of characteristics (e.g., customer and material.)

M:N Relationships of Master Data



Example: Material and Color

- If *COLOR* is an attribute of the characteristic *MATERIAL* then *COLOR* should be in the master data table for *MATERIAL*, just like *MATERIAL TYPE*.
- However, this is not possible since *MATERIAL* is the unique key of the master data table. The master data table can therefore contain one material with several colors only if it is time dependent. This is a typical problem of star schemas.

Variants in the source system (Compounded keys)

Material	Colour
A	RED
A	GREEN
C	RED
D	BLUE
D	YELLOW
E	RED

/BI0/QMATERIAL					
MATERIAL	OBJVERS	DATETO	DATEFROM	CHANGED	COLOUR
A	A	20020412	20020401		RED
A	A	99991231	20020413		GREEN

M:N Relationships: Two Dimensions

M:N relationships modeled in two dimension tables

/BI0/SMATERIAL

MATERIAL	SID
	0
A	1
B	2
C	3
D	4
E	5

/BIC/COLOUR

COLOUR	SID
	0
RED	1
GREEN	2
BLUE	3
YELLOW	4

/BIC/DCUBE01

DIMID	SID_MATERIAL
0	0
1	1
2	1
3	3
4	4
5	4
6	5

/BIC/DCUBE02

DIMID	SID_COLOUR
0	0
1	1
2	2
3	3
4	4

Fact table

DIMID01	DIMID02	AMOUNT
1	1	1200
1	2	5645
3	1	598
4	2	5597
4	1	356
5	1	2697

- Usually, M:N relationships mean that the two characteristics are stored in different dimensions, for example CUSTOMER and MATERIAL. This kind of relationship is described by facts or key figures, for example sales orders.
- In companies that use the R/3 Sales Order variant configurator, several colors are often used per product.
- This provides information which reflects characteristic relationships that exist at the time of the transaction. For example, this solution captures whatever color is selected for the product on the sales order.

M:N Relationships: One Dimension

M:N relationships modeled in one dimension table

/BI0/SMATERIAL	
MATERIAL	SID
	0
A	1
B	2
C	3
D	4
E	5

/BIC/COLOUR	
COLOUR	SID
	0
RED	1
GREEN	2
BLUE	3
YELLOW	4

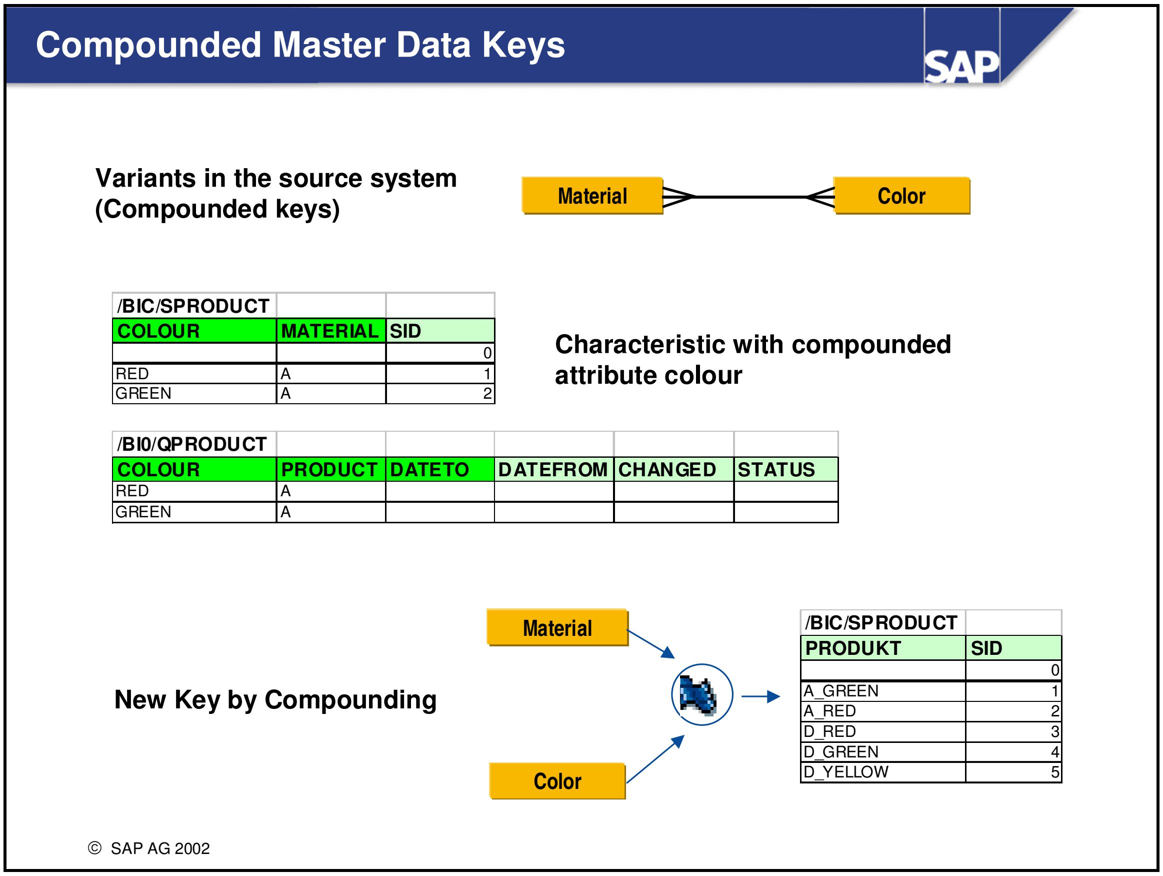
/BIC/DCUBE01		
DIMID	SID_MATERIAL	SID_COLOUR
0	0	0
1	1	1
2	1	2
3	3	1
4	4	2
5	4	1
6	5	1

Number of records in the dimension?

Ratio of records in the dimension table to fact table?

Fact table	
DIMID	AMOUNT
1	1200
2	5645
3	598
4	5597
5	356
6	2697

- In most cases the alternative to model the N:M relationship in one dimension will not be the best way.
- You should check the actual number of records in the dimension table and its ratio to the number of records in the fact table.
- As a rule of thumb there should be a ration of 1:10 – 1:20. That means small dimension tables and bigger fact tables.



/BIC/SPRODUCT		
COLOUR	MATERIAL	SID
		0
RED	A	1
GREEN	A	2

/BI0/QPRODUCT					
COLOUR	PRODUCT	DATETO	DATEFROM	CHANGED	STATUS
RED	A				
GREEN	A				

/BIC/SPRODUCT	
PRODUKT	SID
	0
A_GREEN	1
A_RED	2
D_RED	3
D_GREEN	4
D_YELLOW	5

- Compounded keys from the source can be modeled by compounded attributes in a single characteristic. Especially if there is a demand for time dependent reporting of further attributes of this variant.
- Compounded keys can be merged into a single key of a characteristic during the staging process. This must be done twice, for both master data and transactional data.

Unrelated Characteristics in the Same Dimension

Why combine unrelated characteristics?

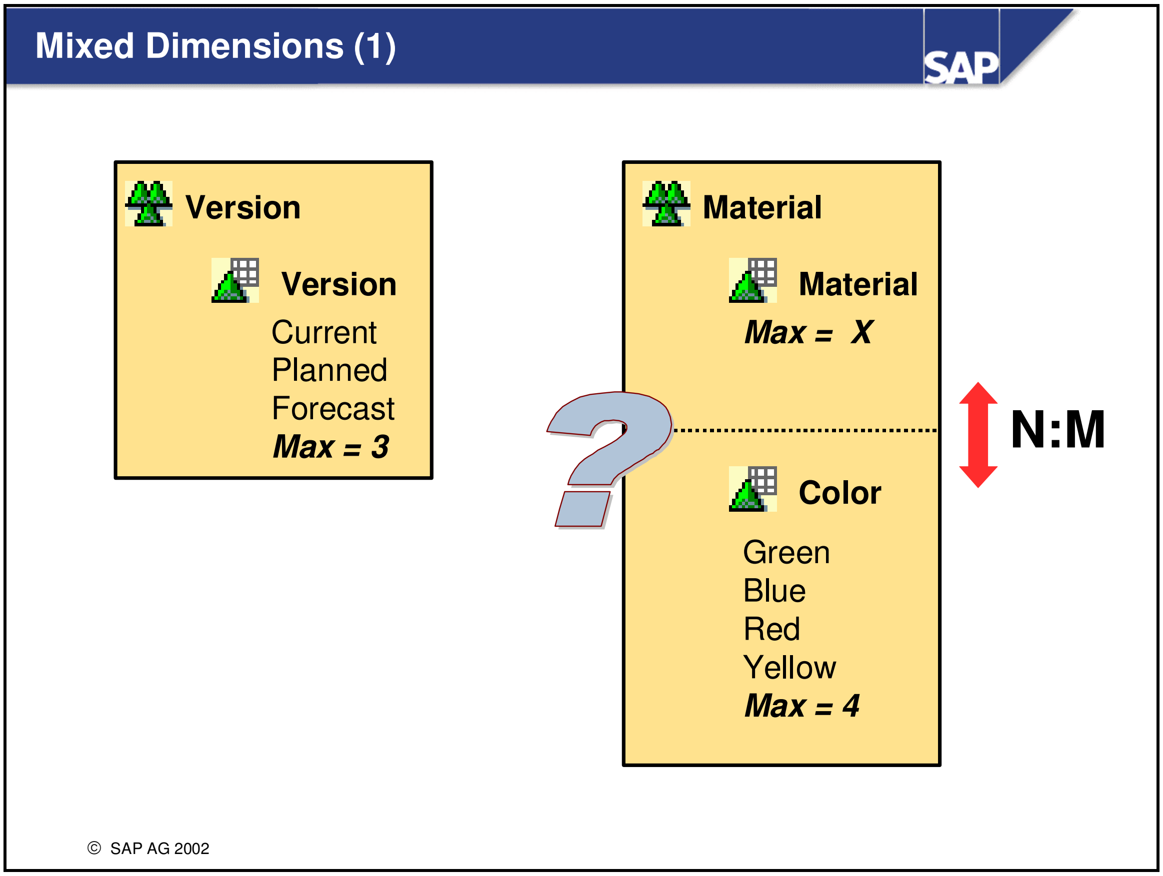
Technical restrictions

- 13 free dimensions in BW

Performance and storage

- Combine smaller dimensions – reduce table joins

- If you merge two small DIM tables you get a slightly larger table, but it means that only one table has to be accessed when data is loaded or a query is executed. Of course, you would not want to place two strong entities (such as MATERIAL and CUSTOMER) in the same dimension table.
- In the majority of cases 13 dimension tables are more than adequate.
- The rule of thumb is to group characteristics with a parent:child relationship in the same dimension.



- Characteristics with an N:M relationship can be combined in the same dimension, if the maximal number of records is clearly definded and the Cartesian product of the characteristic results only in a small dimension table.

Mixed Dimensions (2)

Version/ Color

Version

Current
Planned
Forecast
Max = 3

Color

Green
Blue
Red
Yellow
Max = 4

Material

Material

DIM	Version	Color
1	Current	Green
2	Current	Blue
3	Current	Red
4	Current	Yellow
5	Planned	Green
6	Planned	Blue
7	Planned	Red
8	Planned	Yellow
9	Forecast	Green
10	Forecast	Blue
11	Forecast	Red
12	Forecast	Yellow

- Characteristics VERSION and COLOR have an N:M relationship.
- Nevertheless they can be used in the same dimension, because the maximum number of records is 3 X 4 = 12.

Broad Dimensions

How do we handle dimensions and master data tables containing millions of records?

Broad Customer Dimensions

- Use the demographic attributes of the customer to create a smaller demographic dimension.
  - ☺ Improves query performance significantly
  - ☺ Available immediately after transaction data is loaded
  - ☹ High demands made on the system during loading
- Use aggregates for demographic characteristics in the customer dimension
  - ☺ Improves query performance significantly
  - ☹ Requires a large amount of memory space
  - ☹ Maintenance required by the aggregates following a data transfer

A combination of both methods is the most successful.

- Experts talk of a 10-20 to one relationship between the size of the fact table and the size of the dimension tables. Although the optimal relationship is difficult to determine, a large fact table and smaller dimension tables provide the best system performance.
- Note: In some cases, you may want to consider line-item dimensions. For example, retail companies could put the CUSTOMER characteristic in a separate dimension and make it a 'Line Item Dimension'.

Categorization

When?

- Staging Process
  - Master Data
  - Transactional Data
- Query runtime

Where?

- Characteristic in a Categorical Dimension
- Master Data Attribute
- Time dependency

Categorical Dimensions

Support reports by generating artificial attributes that classify a characteristic.

- *CUSTOMER* is classified by income group, size, and so on.

Categorical dimensions are usually related to attributes rather than to characteristics:

- Income bracket - CUSTOMER income
- Size of customer - annual sales, potential sales, A/R balance, etc.

Whether you create categorical dimensions or hand over the categorization process to a query depends on:

- how complex the categorization process is
- how frequently categorization is used in queries

The decision to create a category dimension comes from the MDM.

- If you want to use a query for categorization purposes, you need, for example, to include all the customers whose income is greater than X but less than Y.
- Category dimensions allow you to use the *Income* characteristic with the values A < 1000, 1001 < B < 5000, and 5001 < C < 6000 during the data transfer. The user then simply filters out all the “B” customers.

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Categorical Dimensions in SAP BW

- If the categorization changes, you need to ask the same questions as discussed in the section on 'slowly changing' dimensions.
- From an analytical point of view, the attributes in the category dimension have to be stored in the master table of the categorized characteristic.
- In SAP BW, categorical dimensions are usually part of the dimension of the categorized characteristic.
- Use aggregates with category attributes.

- If a customer moves from one category to another, how do you model this change in the history?
- An example of the second bullet point: income would be an attribute of 0SOLD_TO.
- An example of the third bullet point: income would be in the same dimension as 0SOLD_TO.

Modeling Data Mining

Data mining can be used to automatically determine significant patterns and hidden associations from large amounts of data.

Clustering Models

Association Analysis Models

Classification

- Decision Tree Models (future data)
- Scoring Models
- ABC Classification Models (only historical)

- Clustering is used to split data into homogeneous groups. The model looks for a global structure for the data with the aim of partitioning the data into clusters.
- Association analysis can be used to establish composite effects and thereby identify cross-selling opportunities, for example. The search for associations considers objects with information content that is remotely comparable. Statements are formulated about partial structures in the data and take the form of rules.
- Decision trees display data using (non-continuous) category quantities. The display rules are determined in training using those sections of historic data where the assignment to categories is already known.
- In Scoring, data is displayed using continuous quantities. If required, discretion can then be applied to split the data into classes. The scoring function can either be specified using weighted score tables or be determined by using historic data as linear or nonlinear regression of a target quantity.
- ABC Classification displays data grouped into classes of A, B, C and so on, using thresholds and classification rules. The classified results are then charted or listed.

Data Mining Examples & Key Steps

Practical examples:

- Determine potential customers in consumer products businesses
- Develop promotion strategies using customer buying patterns
- Analyze potential bad debt expense by studying customer payment history

Key Steps (using the wizard)

- Create Model
- Select InfoObjects from a Query
- Provide model parameters > activate
- Train model with history (from a query)
- Apply the model to new data (from a query)
- Analyze results

- The transaction code to access the data mining workbench is RSDMWB. The delivered role for CRM related data mining is SAP_BWC_CUSTOMER_BEHAVIOR.
- Queries need to be Released for OLE DB for OLAP.
- Currently, only CRM courses include data mining. See the description for the CR900 and TRCAM6 classes.

Status Attributes in BW

Attributes that tell you the status of a characteristic must be placed in a separate dimension if they change frequently. Otherwise, the dimension tables become too large.

- **Example: The promotion status of products can change frequently, or the promotion status may vary by outlet.**
- **Use a dimension for the promotion status. Reporting on the status therefore takes place in the fact table.**

- If you integrate the status into the same dimension with article and outlet, you generate a large number of records in this table. For example, think about a retailer with 5,000 outlets in a country with 50,000 products with up to 10 different promotions!
- This scenario calls for a separate dimension table with status as the characteristic. The result is a smaller, more efficient set of dimension tables.

Partitioning: Modeling Aspects

If several of the following entities appear during the modeling phase -

Current sales / planned sales / forecast sales /
Current units / planned units / forecast units

you need to answer the following questions:

- **Do you model these units as facts or as characteristics of a dimension?**
- **What modeling options are available if a user wants to introduce several sales forecast versions that change over time?**

You can design a *Version* characteristic and give it the values *Original, Current, 1st Qtr Forecast*, and *1st Half Forecast* as an example.

If you position this characteristic in its own dimension table, you effectively add a record identifier to the basic structure of the schema.

Actual data could also be stored in a separate InfoCube from planned data (by version) and could be combined via a MultiProvider.

This type of dimension is called a partitioning dimension.

**Frank Mc Guff*

- We have a *Version* characteristic with three values to model our example: *Actual, Plan,* and *Forecast* each in a separate dimension and the two basic facts *Sales* and U*nit.*
- It is very easy to add another scenario, for example, a quarterly forecast.
- This solution has the effect of using an additional key field to sort fact table records. 0VALTYPE is frequently used for this purpose as well.
- In business content FI/CO InfoCubes, actual data is typically stored separately from planned data.

Partitioning Example (1)

Dimension 1

Dimension 2

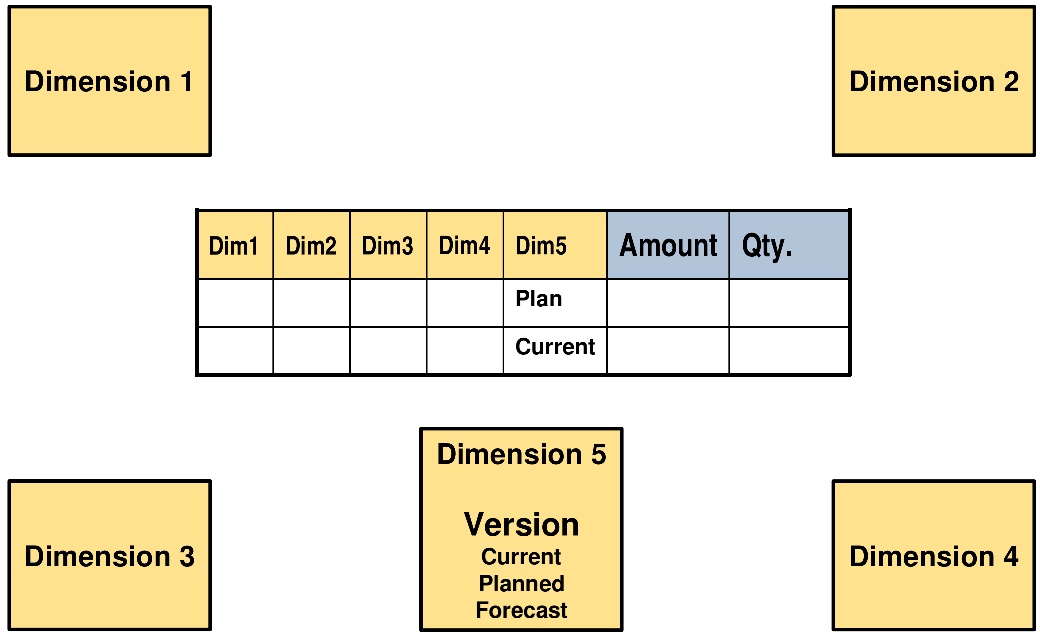
Dim1	Dim2	Dim3	Dim4	Current Amount	Planned Amount	Forec. Amount	Current Qty.	Planned Qty.	Forec. Qty.

Dimension 3

Dimension 4

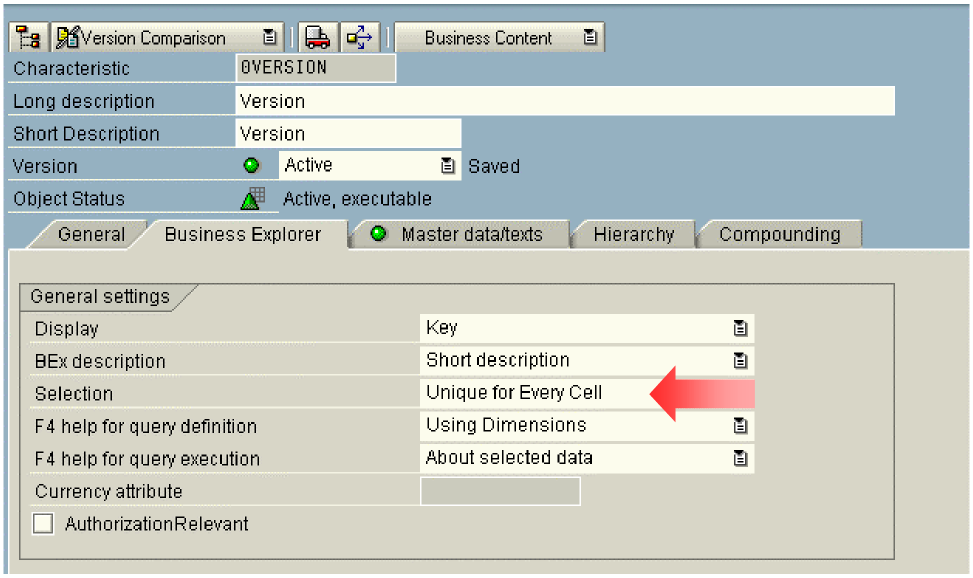
- Modeling with several key figures in the fact table.

Partitioning Example (2)



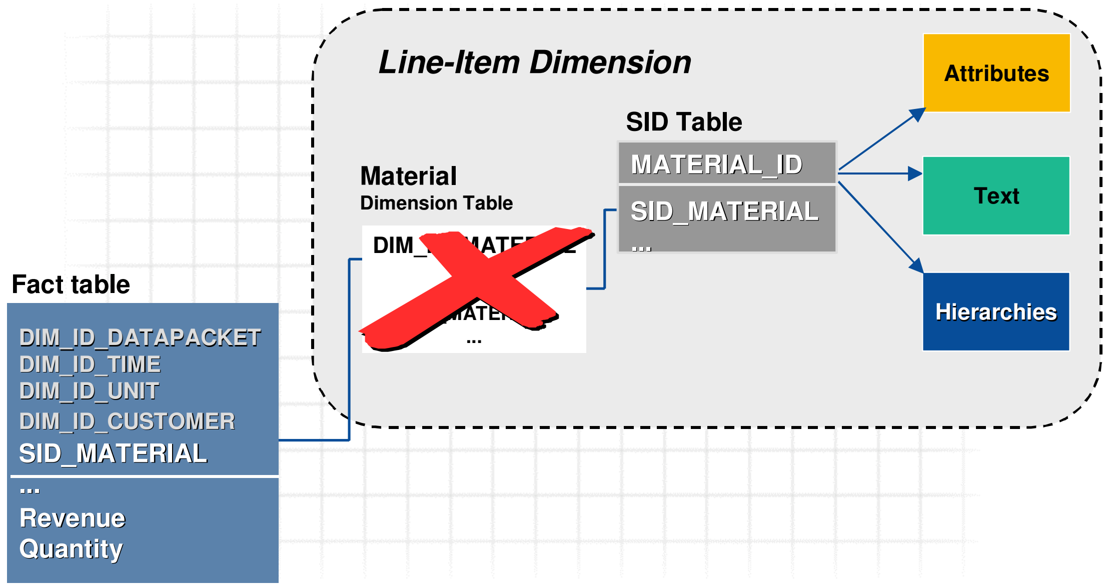
- In this example, only two key figures are used in the fact table.
- An new dimension with the partitioning characteristic VERSION is added.
- Any new value for the characteristic VERSION can be used to enhance the reporting without changing the data model.

Prevent Aggregation of Partitioning Characteristic



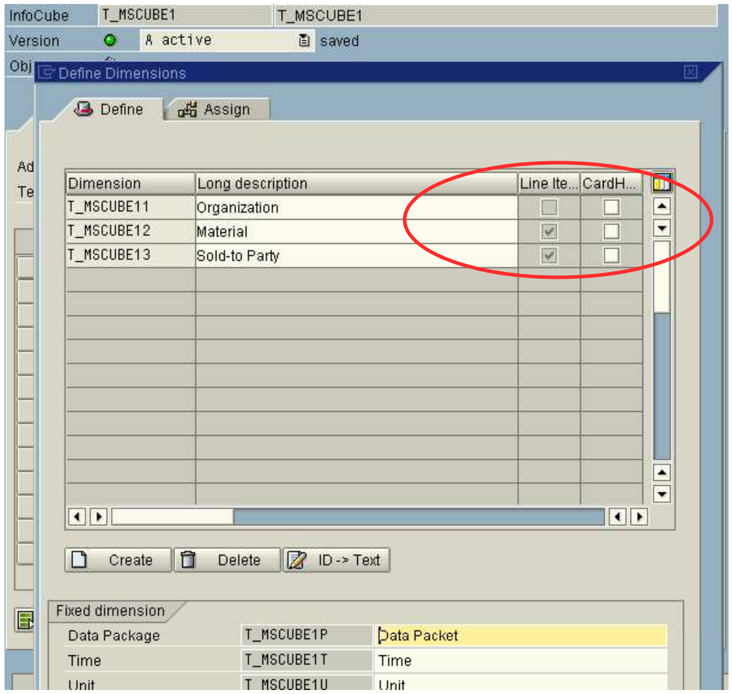
- The selection describes if and how the values of a characteristic in queries should be restricted
- If the value ‚Unique for Every Cell' has been selected, the characteristic must be restricted to one value in every column and in every structure for all the queries. The characteristic can not then be aggregated.
- Typical examples for such characteristics are 'Plan Actual Indicator' or 'Value Type'.

Degenerate or Line-Item Dimensions



- A degenerate dimension is a large dimension that is approaching the size of the fact table.
- In a degenerate dimension with order numbers, all the descriptive attributes are located in other dimensions.
- When activating the InfoCube, no dimension table is created.
- The line item dimension is set in the InfoCube in change mode in the dimension pop-up on the define tab. The SID of the 'degenerate' dimension is then placed into the fact table by the system with a field name of 'RSSID' which can be viewed via SE11 > /BIC/F<InfoCube name>.
- If only a limited history of line item detail is required, an ODS Object should be considered.

Where to Set Line Item in InfoCube



- The setting for Line Item Dimensions is set by clicking on the Dimensions icon in the Characteristics tab of InfoCube maintenance.
- When creating the dimensions in the InfoCube maintenance, flag the relevant dimension as a Line Item dimension.
- Dimensions set as Line Item Dimensions should contain only one characteristic.
- We do recommend that you use ODS objects, where possible, instead of InfoCubes for line items.
- "High Cardinality" is used to adjust indexing for a dimension for which the box is checked:
  - The flag defines which index type should be used:
    - Low cardinality (Bitmap where values are often repeated)
    - High cardinality (B-tree where the values are not often repeated) Only pertains to an Oracle DB
  - Switch on the flag if the dimension size is > 10% of the fact table.
  - Should be used in conjunction with Line Item Dimension.

Dimensional Modeling: Unit Summary

Now you will be able to:

- Recognize typical modeling issues and suggest the appropriate solution
- Discuss the concepts and the recommended modeling solution along with loading implications

Exercises

Unit: Dimensional Modeling

Topic: Dimension Tables

At the conclusion of this exercise, you will be able to:

- Discuss the placement of Characteristics within the various tables associated with an InfoCube.

Your company has decided to use an InfoCube to meet reporting requirements of a summarized nature. First of all, you need to consider some of the master data settings for a characteristic to see how they will affect data modeling

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1 Find InfoCube **0SD_C01** in Metadata Repository.

1-1 Go to the **Metadata Repository** in the Administrator Workbench.

1-1-1 Choose **InfoCube** in the list of activated objects.

1-1-2 Scroll in the list to InfoCube **Customer (0SD_C01)**.
Note: The InfoCubes are listed in alphabetic by name.

1-1-3 Click on the InfoCube **Customer 0SD_C01**.

1-1-4 Once the data has loaded, click on *InfoCube - schematic display as star schema* to view the InfoCube Star Schema Diagram.

1-2 Together with your partner or team answer the following questions:

1-2-1 Why are these characteristics in the InfoCube?

1-2-2 What determines which dimension table contain them?

1-2-3 Where else could some of these characteristics be located?

1-2-4 What affect would that have on the structure of the InfoCube and the data?

1-2-5 What affect would moving some of the attributes located in master data tables into dimensions have on the structure of the InfoCube and the data?

1-3 Discuss with your partner or team alternatives of the data model:

1-3-1 Use ***/oLISTSCHEMA*** to open the transaction in a new session and analyze the number of entries in the dimension tables of InfoCube **0SD_C01**.

1-3-2 Analyze the number of entries in the S-tables.

Solutions

Unit: Dimensional Modeling
Topic: Dimension Tables

1 Find InfoCube **0SD_C01** in the Metadata Repository.

1-1 Go to the **Metadata Repository** in the Administrator Workbench.
Administrator Workbench → Metadata Repository

1-1-1 Choose **InfoCube** in the list of activated objects.

1-1-2 Scroll in the list to InfoCube **Customer (0SD_C01)**.
Note: The InfoCubes are listed in alphabetic by name.

1-1-3 Click on the InfoCube **Customer 0SD_C01**.

1-1-4 Once the data has loaded, click on *InfoCube - schematic display as star schema* to view the InfoCube Star Schema Diagram.

1-2 Together with your partner or team answer the following questions:

1-2-1 Why are these characteristics in the InfoCube?

The data model determines the presence of these characteristics.

1-2-2 What determines which dimension table contain them?

Of the dimensions in the InfoCube, three are pre-determined by SAP (InfoPacket, Time and Unit). The InfoObjects in the Unit dimension are dictated by the choice of key figures.

The remaining dimensions and the InfoObjects contained in them are determined according to the reporting requirements. Reporting requirements also determine which time InfoObjects are selected for the Time dimension.

1-2-3 Where else could some of these characteristics be located?

Some of the characteristics in the user-defined dimensions could be located in master data tables as either display attributes or navigational attributes or both.

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1-2-4 What affect would that have on the structure of the InfoCube and the data?

Removing some of the characteristics in the user-defined dimensions would require offloading the data, modifying the InfoCube dimensions and reloading the historical data.

1-2-5 What affect would moving some of the attributes located in master data tables into dimensions have on the structure of the InfoCube and the data?

Adding some characteristic attributes into InfoCube dimension tables would require an offloading of data, modification of the InfoCube and a reload of historical data. In addition, objects in the InfoCube data flow would have to modified and re-activated to accommodate these new characteristics as keys to the facts.

1-3 Discuss with your partner or team alternatives of the data model:

1-3-1 Use ***/oLISTSCHEMA*** to open the transaction in a new session and analyze the number of entries in the dimension tables of InfoCube **0SD_C01**.

In transaction LISTSCHEMA choose InfoCube type 'B' and InfoCube '0SD_C01' and execute.
Expand the tree, highlight the specific dimension table and choose button 'Call up transaction SE16 (Shift + F4)'.
Choose 'Number of entries'.

It could be possible to use a mixed Dimension of Version (2 records) and Value Type (3 records).

1-3-2 Analyze the number of entries in the S-tables.

The maximum number of records in a mixed Dimension Version/Value Type could be higher than the number actually used in this InfoCube. It has to be clearly defined which combinations can occur to calculate the maximum number of records in the dimension table.

Tracking History & Hierarchies

Contents

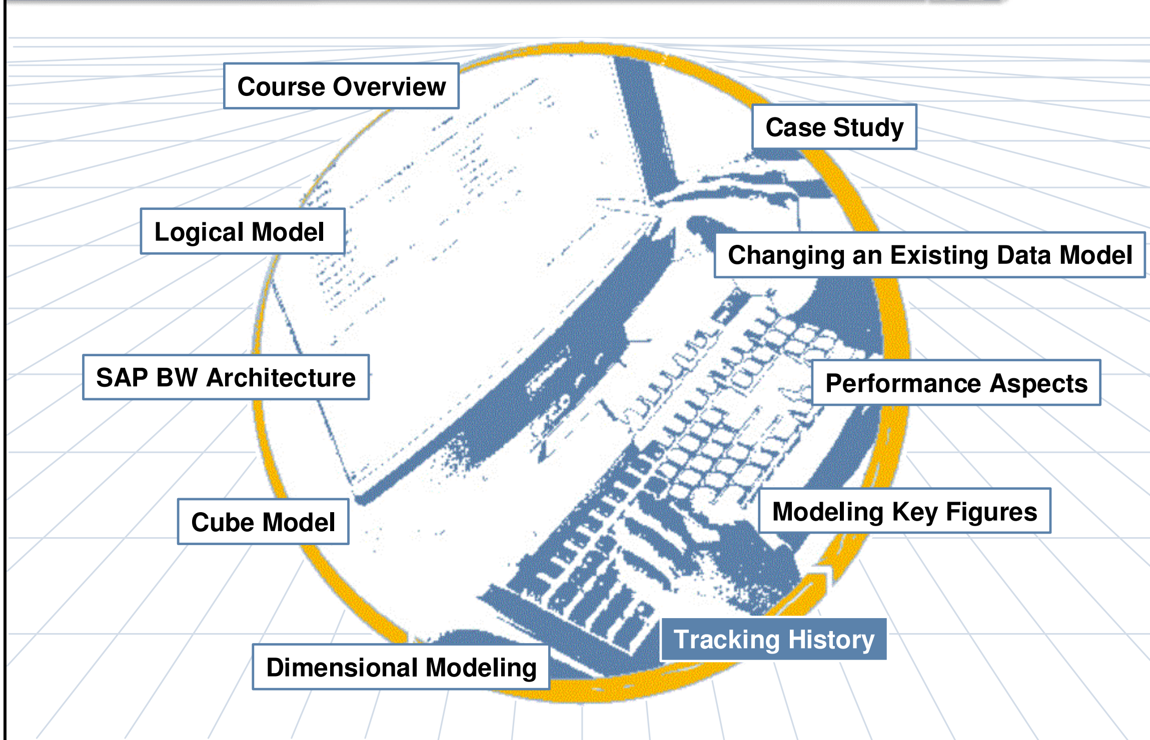
- Model various real world reporting requirements using four main options for tracking history including slowly changing dimensions
- Identify modeling impacts of hierarchies
- View the numerous display options of hierarchies in queries

Tracking History & Hierarchies: Unit Objectives

At the conclusion of this unit, you will be able to:

- Understand the different demands users have for reporting historical events
- How do we deal with changes between characteristics that reside in the same dimension
- Understand the difference between display and navigational attributes
- Consider navigational attributes as well as hierarchies
- Understand how hierarchies work in BW in the back-end and front-end

Tracking History & Hierarchies: Overview Diagram



Tracking History & Hierarchies: Topic Objectives

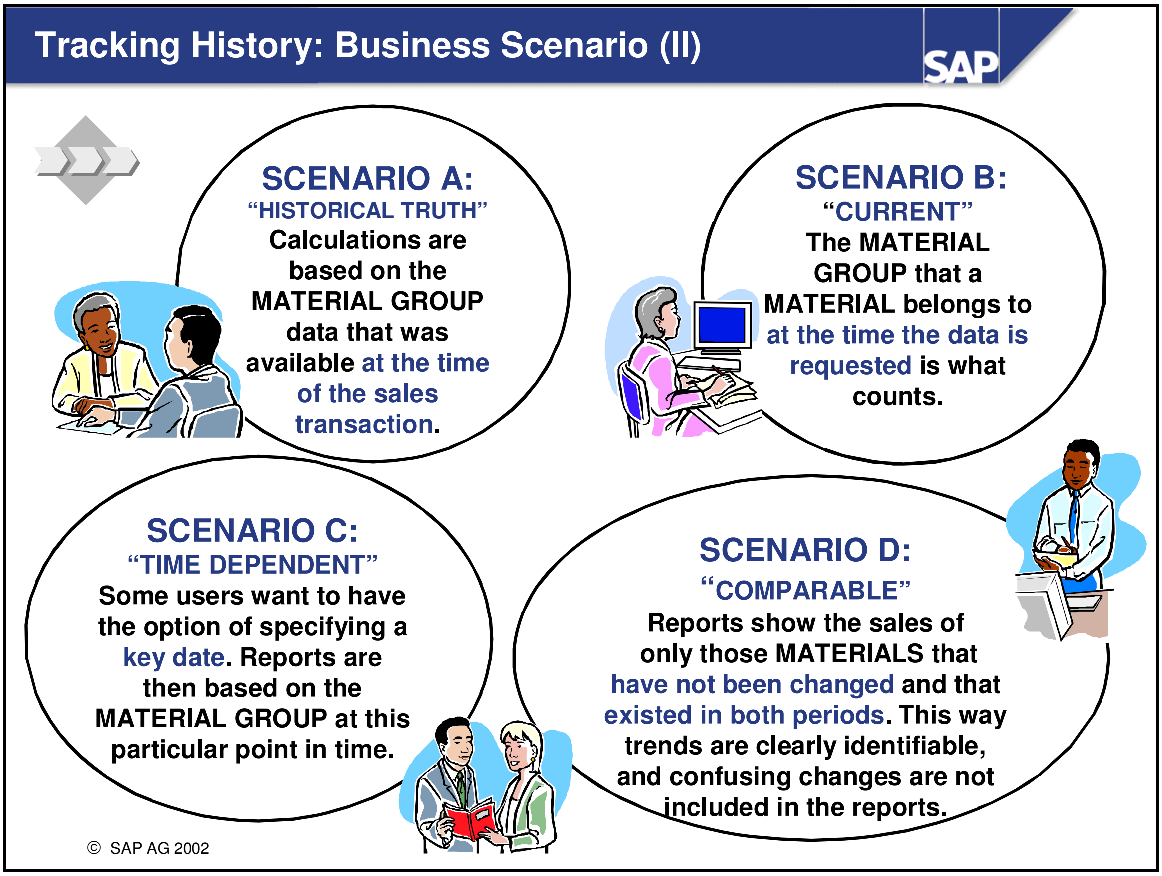
- List the different requirements that users have for reporting on historical events
- Model each of these requirements in BW

Tracking History: Business Scenario (I)

As a member of the BW project team you are interviewing users to find out what they require from sales reports according to MATERIAL GROUP.

One particular question is what happens to the reports if a MATERIAL changes MATERIAL GROUP, for example, from *Food* to *Chemical,* in the middle of a period?

The users have four basic opinions on this issue.



- Often different users have different ideas on how to track historical data. In this section, we are going to look more closely at the four scenarios shown above. These requirements can be met simultaneously from the same Star Schema.
- The key date mentioned in C is located in the query properties and is accessed from the Query Designer.

Historical Data: The Role of the Fact Table

Changes that occur over time are usually taken into account when transaction data is loaded into the fact table.

Each data record in the fact table is identified by a certain set of generic dimension keys representing a unique combination of characteristic values based on transaction data.

Example:

- **CUSTOMER 'X' purchases MATERIAL 'A' on day 'Y'. This new relationship between 'X', 'A', and 'Y' becomes a new record in the fact table.**

Note: The fact table usually only shows events that have actually taken place and not events that have not happened!

- If incoming data has a combination of characteristics which already exists in the fact table, the key figures for the incoming data are aggregated with the existing fact records. Only the Request ID is different, because it identifies different loads of data. Of course, compression will eliminate the request ID as a key field.
- In addition, the fact table is not able to record the situation: "We have NOT received a sales order for 100 cartons from company XYZ Inc.". An InfoSet query that joins the master data and an ODS Object should be considered in this case.

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Historical Data: Dimensions that Change Slowly*

Changes to attributes in different dimensions (a sales transaction, for example) as shown in the previous slide make up the day-to-day business of a data warehouse.

How do we deal with changes to attributes in the same dimension?

Example: Marital status

- **What products do married people buy?**
- **Which products did married people buy last year?**

During the design phase it is important that you are aware of possible changes to attributes in the same dimension and that you consider how you are going to deal with these changes.*

** introduced by Ralph Kimball*

- Our example focuses on changes that are made to the MATERIAL GROUP (food, chemicals, and so on) in the material master. As MATERIAL to MATERIAL GROUP assignments change through time in the OLTP system, you will need to decide how they are recorded in BW.
- For example, do the BW users only need the relationship captured in the sales order when it was created or would they like to do their analysis based on the latest assignment from the master data tables?

Tracking History: OLTP Supporting Data

SAP

Displaying data in the OLTP system:

OLTP Material Master Report 01/2000	
MATERIAL	MATERIAL GROUP
AAA	FOOD
BBB	FOOD
CCC	CHEMICALS
DDD	CHEMICALS

OLTP Material Master Report 02/2000	
MATERIAL	MATERIAL GROUP
AAA	FOOD
BBB	CHEMICALS
CCC	CHEMICALS
DDD	CHEMICALS
EEE	CHEMICALS

Changed on Feb 1st 2000

NEW MATERIAL

SALES TRANSACTION HISTORY

MATERIAL	Month/Year	Amount
AAA	01/2000	100
BBB	01/2000	100
CCC	01/2000	100
DDD	01/2000	100
AAA	02/2000	100
BBB	02/2000	100
CCC	02/2000	100
DDD	02/2000	100
EEE	02/2000	100

- This is the data that exists in the OLTP (On Line Transaction Processing System) or R/3 system. It represents sales orders and the material master table in R/3.
- Sales orders capture the MATERIAL to MATERIAL GROUP relationships that exist in master data tables at the time of order creation. As new assignments are made in R/3, new sales orders reflect the change however existing orders remain the same.

Scenario A: At the Time of the Sales Order

Modeling Method: Model the MATERIAL GROUP as a characteristic of the MATERIAL dimension.*

Dimension table: MATERIAL

Dim ID	MATERIAL	MATERIAL GROUP
1	AAA	FOOD
2	BBB	FOOD
3	CCC	CHEMICALS
4	DDD	CHEMICALS
5	BBB	CHEMICALS
6	EEE	CHEMICALS

New DIM ID

Fact Table

Dim Mat	Dim Time	Amt
1	01/2000	100
2	01/2000	100
3	01/2000	100
4	01/2000	100
1	02/2000	100
3	02/2000	100
4	02/2000	100
5	02/2000	100
6	02/2000	100

Master data tables are not required!

*SIDs and time dimension are not shown and characteristic values are shown in dim tables for Illustration purposes.

Report:

MATERIAL GROUP	01/2000	02/2000
Chemicals	*$ 200*	*$ 400*
Food	$ 200	$ 100

- The material group is stored in the dimension table of the MATERIAL characteristic (*InfoCube Maintenance* > *Characteristics*).
- If the MATERIAL GROUP is not provided when the transaction data is loaded, you have to create an update rule to determine the characteristic value.
- The most efficient and beneficial way of doing this is to store the MATERIAL GROUP characteristic in the master data table of the MATERIAL characteristic. By reading the master data attributes during the loading process, the special update rule allows you to add the characteristic to the dimension table. The user does not need to generate any coding.
- If a characteristic is included in both the dimension table and the master data table, the navigational attribute should have a different name (NAV_MAT_GRP, for example) to make the difference clear to the query builder (see scenario B).
- This data can easily be depicted using a hierarchy based on the characteristic relationships in the dimension table. (later in this unit)

Scenario B: At the Time of the Data Request (1)

Modeling Method: Model the material group as a time-*in*dependent navigational attribute of the material number.*

Dimension table MATERIAL	
Dim ID	**MATERIAL**
1	*AAA*
2	BBB
3	CCC
4	DDD
5	EEE

Master data table P MATERIAL	
MATERIAL	**MATERIAL GROUP**
AAA	*FOOD*
BBB	CHEMICALS
CCC	CHEMICALS
DDD	CHEMICALS
EEE	CHEMICALS

Fact Table		
Dim MAT	**Dim Time**	**Amount**
1	*01/2000*	*100*
2	01/2000	100
3	01/2000	100
4	01/2000	100
1	*02/2000*	*100*
2	02/2000	100
3	02/2000	100
4	02/2000	100
5	02/2000	100

Report: Run in February

MATERIAL GROUP	01/2000	02/2000
Chemicals	$ 300	$ 400
Food	*$ 100*	*$ 100*

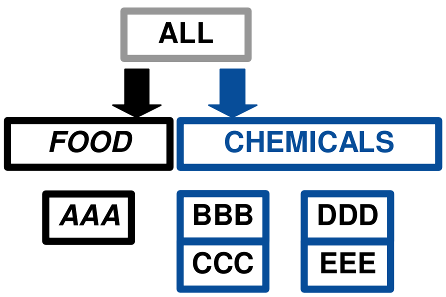
*SIDs and time dimension are not shown

- The MATERIAL GROUP characteristic is stored in the master data table of the MATERIAL characteristic (*InfoObject maintenance* > *Attributes*).
- The MATERIAL GROUP characteristic has to be designated as a navigational attribute in MATERIAL and the appropriate InfoCube to enable the drilldown and filter functions to work.
- (Time-dependency is not needed for the MATERIAL characteristic (*InfoObject maintenance* > *Master data*).
- Important: To avoid having to reconstruct the InfoCube, there must be a higher-level attribute in either the master data table or in an external hierarchy. This requirement is different than scenario A.

Scenario B: At the Time of the Data Request (2)

Modeling Method: Model the material group as a time-*independent* external hierarchy of MATERIAL.*

Dimension table: MATERIAL	
Dim ID	**MATERIAL**
1	*AAA*
2	BBB
3	CCC
4	DDD
5	EEE



Fact Table		
Dim MAT	**Dim Time**	**Amount**
1	*01/2000*	*100*
2	01/2000	100
3	01/2000	100
4	01/2000	100
1	*02/2000*	*100*
2	02/2000	100
3	02/2000	100
4	02/2000	100
5	02/2000	100

Report: Run in February

MATERIAL GROUP	01/2000	02/2000
Chemicals	$ 300	$ 400
Food	*$ 100*	*$ 100*

*SIDs and time dimension are not shown

- In this case, we use a time-independent external hierarchy. Hierarchies are normally extracted from R/3. Typical standard hierarchies include: Product, Customer, Vendor, Cost Center, and Profit Center.
- Ad Hoc Hierarchies can also be created in BW. This is appropriate when a unique, one time requirement arises that cannot be met via a standard hierarchy from R/3. The result is a flexible solution which is offset by the cost of maintaining the hierarchy.

Scenario C: At any Point in Time (1)

Modeling Method: Model the MATERIAL GROUP as a time-dependent navigational attribute of MATERIAL.*

Dimension table: MATERIAL	
Dim ID	MATERIAL
1	AAA
2	BBB
3	CCC
4	DDD
5	EEE

Fact Table		
Dim MAT	Dim Time	Amount
1	01/2000	100
2	01/2000	100
3	01/2000	100
4	01/2000	100
1	02/2000	100
2	02/2000	100
3	02/2000	100
4	02/2000	100
5	02/2000	100

Master data table QMATERIAL			
MATERIAL	MATERIAL GROUP	From	To
AAA	FOOD	1/1/1996	12/31/9999
BBB	FOOD	1/1/1996	1/31/2000
CCC	CHEMICALS	1/1/1996	12/31/9999
DDD	CHEMICALS	1/1/1996	12/31/9999
BBB	CHEMICALS	2/1/2000	12/31/9999
EEE	CHEMICALS	2/1/2000	12/31/9999

Report:
Key Date: 1/15/2000

MATERIAL GROUP	01/2000	02/2000
Chemicals	$ 200	$ 200
Food	*$ 200*	*$ 200*

*SIDs and time dimension are not shown

- The MATERIAL GROUP characteristic has to be designated as a time-dependent navigational attribute of MATERIAL to allow the drilldown and filter functions to work.
- Time dependent tables in BW have a time range of 1/1/1000 to 12/31/9999. As data is loaded, specific pieces of that time range are accounted for. When queries are built in the Query Designer, a key date is specified in the query properties which indicates to the system which data record to use.
- When EEE is loaded for example, the table entries will look as follows:

MATERIAL	FromDate	ToDate	MATERIAL GROUP
EEE	1/1/1000	1/31/2000	
EEE	2/1/2000	12/31/9999	Chemicals

Scenario C: At any Point in Time (2)

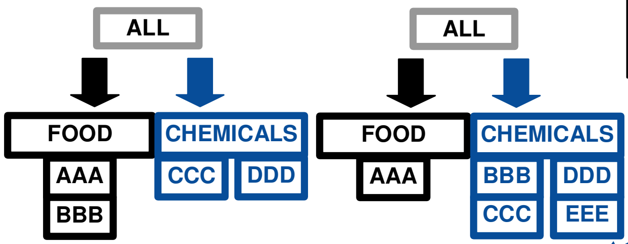
Modeling Method: Model the MATERIAL GROUP as a time-dependent external hierarchy of MATERIAL.

Dimension table MATERIAL

Dim ID	MATERIAL
1	AAA
2	*BBB*
3	*CCC*
4	*DDD*
5	*EEE*

Fact Table

Dim MAT	Dim Time	Amount
1	01/2000	100
2	01/2000	100
3	01/2000	100
4	01/2000	100
1	02/2000	100
2	02/2000	100
3	02/2000	100
4	02/2000	100
5	02/2000	100



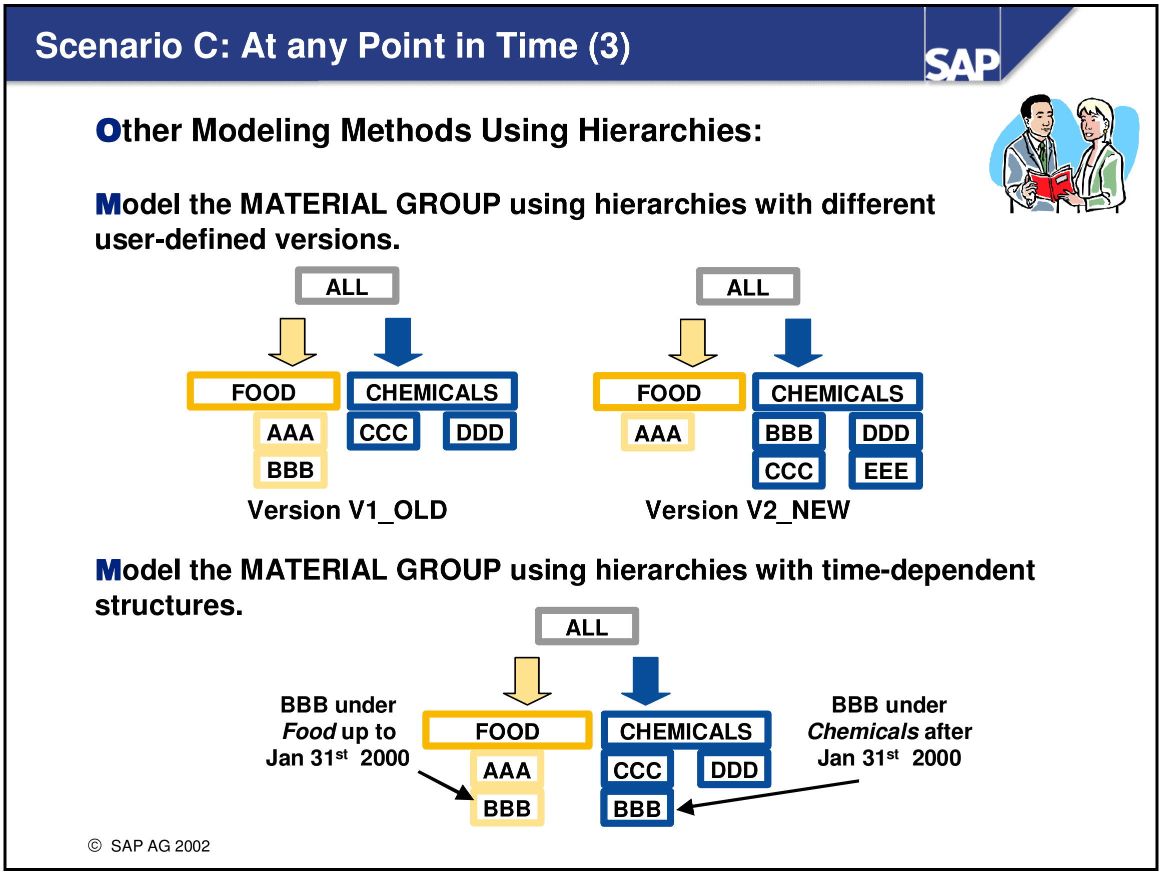
Valid up to Jan 31st 2000

Valid after Jan 31st 2000

Report:
Key Date: 02/15/2000

MATERIAL GROUP	01/2000	02/2000
Chemicals	$ 300	$ 400
Food	$ 100	$ 100

- The MATERIAL characteristic must allow time-dependent hierarchies, hierarchy structures, or user-defined versioning. This scenario permits reporting in BW which reflects master data relationships in R/3 at various points in time.



- These settings are made on the Hierarchy tab in change mode for the characteristic (MATERIAL in this example).
- For Example: within the framework of restructuring, you can assign an employee at different times to various cost centers.
- World
    Europe
        Germany
            O'Neill
    Americas
        USA
            Jones 01/01/99 to 5/31/99
            Dilbert
        Puerto Rico
            Jones 6/1/99 to 12/31/99
- Nodes, that hang in differing positions in the structure depending on time-dependency, can occur more than once.

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Scenario D: Comparing Existing and Unchanged Values

Modeling Method: Model MATERIAL GROUP as a time-dependent navigation attribute of MATERIAL with two <u>additional</u> attributes for defining time. (valid-From, valid-to)

Dimension table MATERIAL

Dim ID	MATERIAL
1	*AAA*
2	BBB
3	*CCC*
4	*DDD*
5	EEE

Master data table QMATERIAL

MATERIAL	MATGRP	Sys-From	Sys-To	Valid-From	Valid-To
AAA	FOOD	01/1996	12/9999	*01/1996*	*12/9999*
BBB	FOOD	01/1996	01/2000	01/1996	01/2000
CCC	CHEM	01/1996	12/9999	*01/1996*	*12/9999*
DDD	CHEM	01/1996	12/9999	*01/1996*	*12/9999*
BBB	CHEM	02/2000	12/9999	02/2000	12/9999
EEE	CHEM	02/2000	12/9999	02/2000	12/9999

Fact Table

Dim MAT	Dim TIME	Amount
1	*01/2000*	*100*
2	01/2000	100
3	*01/2000*	*100*
4	*01/2000*	*100*
1	*02/2000*	*100*
2	02/2000	100
3	*02/2000*	*100*
4	*02/2000*	*100*
5	02/2000	100

Report: Only existing and unchanged MATERIAL in the months 01/2000 and 02/2000

Key Date: 02/15/2000

Selected Filter Variables:

valid from: *<u>01/1996</u>* and valid to: *<u>12/9999</u>*

MATERIAL GROUP:	01/2000	02/2000
Chemicals	$ 200	$ 200
Food	$ 100	$ 100

- The MATERIAL GROUP characteristic and the two additional attributes (*valid-from* and *valid-to*) are stored as time-dependent navigation attributes in the master data table of the MATERIAL characteristic (*InfoObject maintenance* > *Attributes*).
- Note: The fields that the system defines for the start-date and the end-date in the table are not intended to be used for navigation purposes and do not appear directly in the query builder. The *Key Date* field in the query builder uses this date information and only one key date can be used, no ranges are allowed.
- The fields that determine key dates and validity intervals also provide additional reporting options. Using the key date in a query allows you to access different master data records for the same characteristic value.
- Hint: Defining a BW variable allows you to create flexible reports and analyses (BEx Query Designer) with different *valid-to* dates.
- Note: This data model can also be applied to scenarios B and C.

Concept of "Slowly Changing" Dimensions in BW

Which modeling method is the right one to use?

Requirements of the analysis

- Type of report and required performance

Changes expected in the data

- Structural changes
  - controlled, predictable changes
    for example, changes to the product hierarchy or a sales force reorganization
- Attribute changes
  - sporadic, unpredictable
    for example, marital status and address

- You must consider system performance and the option of creating aggregates for navigational attributes. You must also consider how and if to reconstruct the InfoCube in the event that the model with a characteristic as a dimension is chosen and the master data changes again.

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Modeling Methods: A Comparison

	MODELED WITH	FLEXIBILITY	PERFORMANCE	COMPLEXITY	Aggregates?
SCENARIO A HISTORICAL TRUTH	Dim	LOW	HIGH	LOW	YES
SCENARIO B CURRENT	NAV Hier	MED to HIGH	MED to HIGH	MED	YES
SCENARIO C TIME-DEPENDENT	T-NAV T-Hier	MED to HIGH	MED	MED to HIGH	YES(2)
SCENARIO D COMPARABLE	T-NAV(1)	HIGH	MED	HIGH	YES(2)

LEGEND: Dim = Dimension NAV = Navigational attribute
Hier = Hierarchy T = Time-dependent
(1) New user-attribute for specifying the date
(2) For a specific date

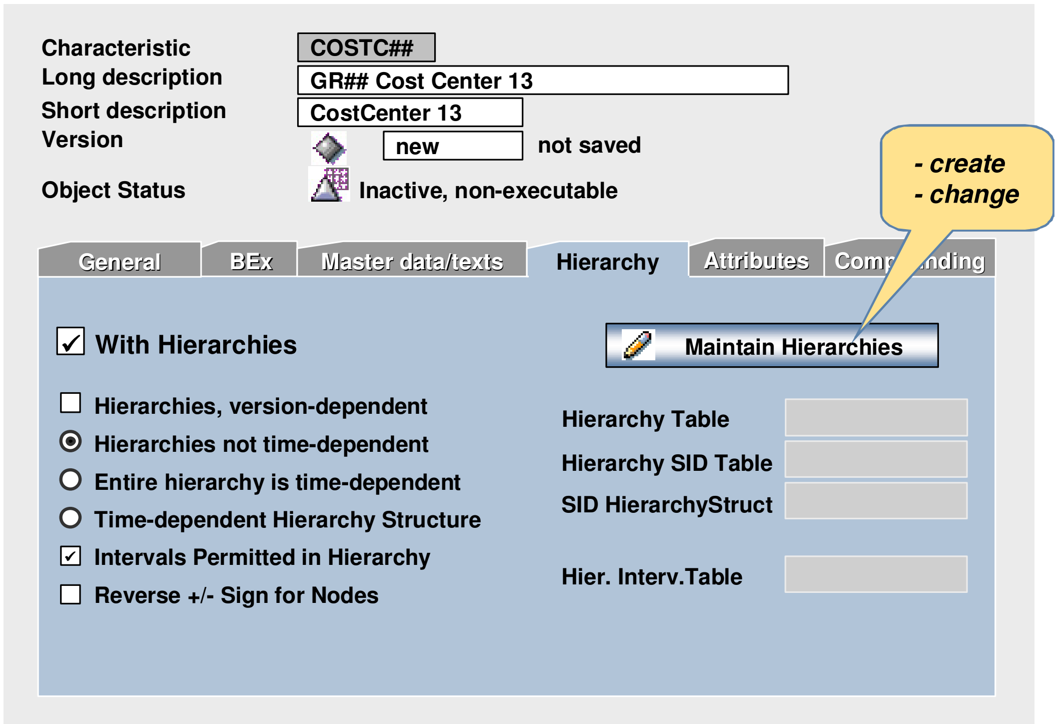
- Other considerations:
  - The value of historical data decreases over time.
  - It is possible to combine Scenario A with other scenarios. For example, MATERIAL GROUP could be in the MATERIAL dimension and also a time dependent navigational attribute of MATERIAL (Scenario C).

Hierarchies: Topic Objectives

- **R**eview the Query Designer's full range of hierarchy handling provided by the OLAP processor including dimensional hierarchies.
- **E**valuate the use of characteristic hierarchies
- **E**valuate the use of hierarchical data in dimensions
- **D**isplay both row and column hierarchies
- **U**se external characteristics in a hierarchy

- The next few slides cover settings on the back-end that affect how you can use hierarchies on the front-end.

Screenshot: Hierarchy Tab Page



- You set the parameters for a new InfoObject from a series of tab strips. The new object must be activated to be used. Changes can be be made later relatively easily.
- These settings have a big influence on the capabilities of the InfoObject and how it is used in BW.
- These settings also form the metadata for the InfoObjects which are stored in the metadata repository.

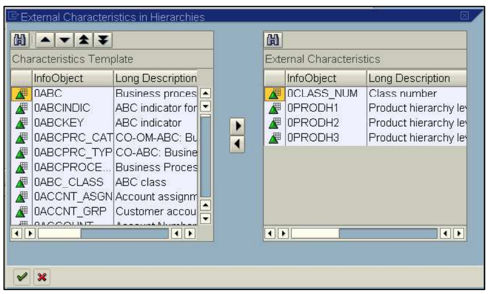
External Characteristics in Hierarchies

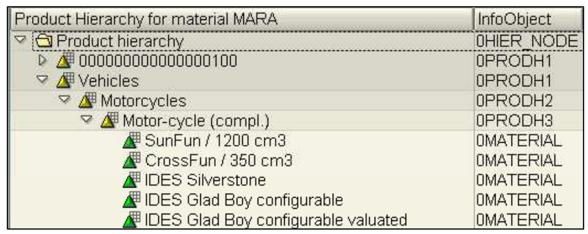
A hierarchy for an InfoObject (eg. 0MATERIAL) may have additional InfoObjects like 0PRODH1, 0PRODH2 , . . which can represent nodes in the material hierarchy.

New:

The additional InfoObjects are maintained in the external hierarchy folder of the InfoObject.

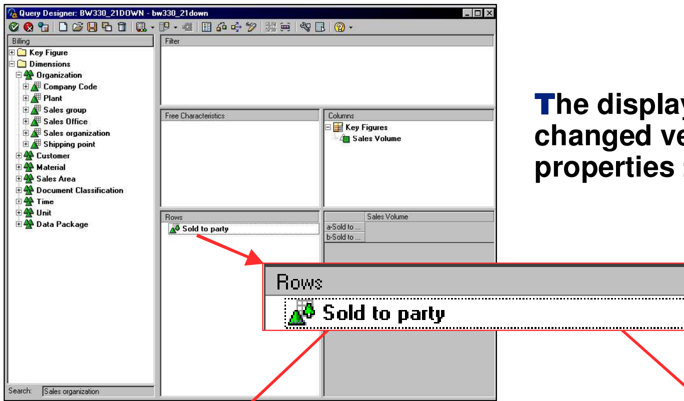
Only those InfoObjects which have been selected will be included in the communication structure





- This feature allows you to group characteristics by other characteristics. For example, create a hierarchy of cost centers organized by plant.
- In the slide above the InfoObjects 0PRODH1/2/3 are used to capture the three levels of the PRODUCT hierarchy coming up from R/3.
- External characteristics in Hierarchies are accessed from the Hierarchy tab in change mode.

Query Designer Display Options



The display of hierarchies can be changed very easily in the characteristic properties > hierarchy settings.

Node Position: Up

T_HIERKN3	T_HIERKN3	44.884.082,43 EUR
1360	Amadeus	6.946.850,41 EUR
1033	Karsson High Tech Markt	11.354.594,80 EUR
1032	Institut fuer Umweltforschung	7.446.449,91 EUR
1012	Autohaus Franzl GmbH	79.532,04 EUR
1002	Omega Soft-Hardware Markt	272.346,20 EUR
DE/09	Bavaria	26.099.773,36 EUR
1001	Lampen-Markt GmbH	19.311.785,15 EUR
DE/06	Hesse	19.311.785,15 EUR
T_HIERKN4	T_HIERKN4	45.411.558,51 EUR
T_HIERKN1	T_HIERKN1	136.822.065,88 EUR

Node Position: Down

Sold to party		Sales Volume
T_HIERKN1	T_HIERKN1	136.822.065,88 EUR
T_HIERKN2	T_HIERKN2	46.526.424,94 EUR
DE/07	Rhineland Palatinate	125.840,91 EUR
2006	Etelko Textilien	125.840,91 EUR
DE/05	Nrth Rhine Westfalia	46.400.584,03 EUR
7777	Flatter & Asche AG	99.645,00 EUR
4999	Hallmann Anlagenbau GmbH	16.654,52 EUR
2152	Bit Market	832,93 EUR
2141	Jaspers Computers	227.516,93 EUR
2130	COMPU Tech. AG	7.810.034,14 EUR

- In the Query Designer > characteristic properties > display hierarchy.
- The display options include:

Expand To Level:	1 through X
Position of Lower Level Nodes:	Up or Down
Diplay of Posted Nodes:	Display or Hide
Nodes With Only One Level:	Display or Hide

Universal Presentation Hierarchies (1)

Characteristic with Hierarchy: The first example contains the characteristic SOLD-TO PARTY hierarchy contained within the values for the characteristic REGION.

Rows
- Region
- Sold to party

Sold to party | Key Figures

Region		Sold to party		Sales Volume
DE/05	Nrth Rhine Westfalia	▽ T_HIERKN1	T_HIERKN1	46.400.584,03 EUR
		▽ T_HIERKN2	T_HIERKN2	46.400.584,03 EUR
		▷ DE/05	Nrth Rhine Westfalia	46.400.584,03 EUR
DE/06	Hesse	▽ T_HIERKN1	T_HIERKN1	19.311.785,15 EUR
		▽ T_HIERKN4	T_HIERKN4	19.311.785,15 EUR
		▷ DE/06	Hesse	19.311.785,15 EUR
DE/07	Rhineland Palatinate	▽ T_HIERKN1	T_HIERKN1	125.840,91 EUR
		▽ T_HIERKN2	T_HIERKN2	125.840,91 EUR
		▷ DE/07	Rhineland Palatinate	125.840,91 EUR

Hierarchy with Characteristic: This example contains the characteristic SOLD-TO PARTY shown as a hierarchy with the appropriate REGION values for each node.

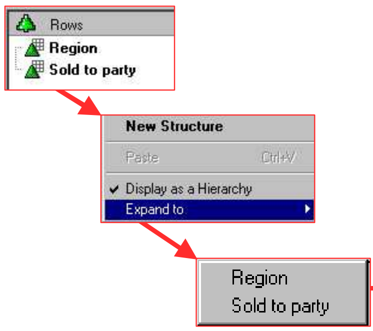
Rows
- Sold to party
- Region

Sold to party		Region		Sales Volume
▽ T_HIERKN1	T_HIERKN1	DE/05	Nth Rhine Westfalia	46.400.584,03 EUR
		DE/06	Hesse	19.311.785,15 EUR
		DE/07	Rhineland Palatinate	125.840,91 EUR
		DE/08	Baden-Wuerttemberg	44.884.082,43 EUR
		DE/09	Bavaria	26.099.773,36 EUR
		Result		**136.822.065,88 EUR**
▽ T_HIERKN2	T_HIERKN2	DE/05	Nth Rhine Westfalia	46.400.584,03 EUR
		DE/07	Rhineland Palatinate	125.840,91 EUR
		Result		**46.526.424,94 EUR**

- Combining characteristics with hierarchies is new in 3.0 and is available in both the rows and columns.

Universal Presentation Hierarchies (2)

- **In this case there are two non-hierarchical characteristics shown in one column in hierarchical form.**
- **This format is generated by setting the rows object to “Display as hierarchy” and expanding it to the characteristic “SOLD-TO PARTY”.**
- **Since this is dimension data, it yields ‘historical truth’.**



Region		Sales Volume
Overall Result		**273.353.639,97 EUR**
AE/#	AE/Not assigned	3.988.500,00 EUR
2402	Jashanmal International Trading Co	3.988.500,00 EUR
AR/#	AR/Not assigned	8,41 EUR
100066	Cliente 2	8,41 EUR
DE/#	DE/Not assigned	4.985.217,31 EUR
99	Einmalkunde	2.600,00 EUR
1508	Deutsche Computer AG	5.036,08 EUR
R110	SB Warenhaus R110	2.942.723,36 EUR
R111	SB Warenhaus R111	910.413,46 EUR
R112	SB Warenhaus R112	1.124.444,41 EUR

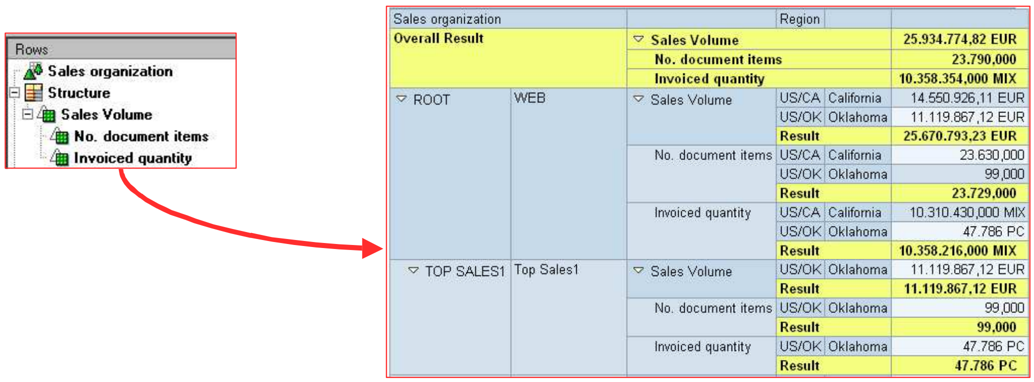
- Right mouse click on the rows column header to bring up the option to Display as a Hierarchy and Expand To.

Combining Hierarchies and Structures

In this example you have 3 columns

The first is the SALES ORGANIZATION hierarchy expanded to the default level

Then for each line, the structure is expanded by key figure level, and for each structure line you get the REGION.



- These key figure levels can be used to highlight the more important KPI‘s (key performance indicators).
- In the Query Designer, key figures can be indented for emphasis. If there are multiple key figures in a structure, right mouse click > level up/down for the appropriate indentation.

Tracking History & Hierarchies: Unit Summary

Now you will be able to:

- Model various real world reporting requirements using four main options for tracking history including slowly changing dimensions
- Identify modeling and display impacts of hierarchies

Exercises

Unit: Tracking History & Hierarchies

Topic: Hierarchies

At the conclusion of this exercise, you will be able to:

- Maintain hierarchy settings in the Administrator Workbench
- Display hierarchical data in Queries

Your company uses hierarchies to provide structured drilldowns in reports. You need to understand how to configure for hierarchies and how to display them in queries.

1-1 Review the hierarchy settings in the administrator workbench.

1-1-1 External Characteristics in Hierarchies for InfoObject T_SOLD_TO.

Note the settings for hierarchies including Time Dependency. Select the External Characteristics in Hierarchies button.

What InfoObject is selected to be used in the customer hierarchies?

____

Close the pop-up.

1-1-2 Maintain Hierarchies

Select the Maintain Hierarchies button and double click on the first active hierarchy. Open up the hierarchy and note 0REGION in the nodes and note also the from/to dates.

1-2 Build a query with the T_SOLD_TO hierarchy and display results in Web.

1-2-1 Build Query from Cube 'T_SDC03' with a hierarchy in the rows.

You can display the technical names of the InfoCubes by clicking on the wrench icon on top of the screen.

1-2-2 Choose Characteristics and Key Figures then display in Web.

Drag & Drop ‘SOLD TO PARTY’ from the Customer Dimension to the rows, add a hierarchy that expands to the 4th level.

Save the Query in your folder as:

Field Name or Data Type	**Values**
Description	*Hier in rows ##*
Technical Name	*Hier_in_rows##*

View the results on the Web, you’ll be asked for a user and password that you have been using to access the server.

Display the query on the Web

1-3 Build a query with a hierarchy based on dimension tables.

1-3-1 Build query from the ‘Billing Cube’ with INVOICED QUANTITY in the columns and REGION above SOLD TO in the rows. Move COUNTRY to ‘Free Characteristics’.

1-3-2 Restrict REGION to: Bremen, Hesse, and Hamburg.

1-3-3 Set the dimension hierarchy in the rows and expand to Sold To.

Save Query to your folder as:

Field Name or Data Type	**Values**
Description	*Dim Hier in rows ##*
Technical Name	*Dim_Hier_in_rows##*

Exit Internet Explorer.

1-4 **Optional**: Switch the Sold To Hierarchy on and use ‘tiered’ key figures in the rows from the same query. (But do a ‘save as’ later)

Switch on the SOLD TO Hierarchy that expands to the 4th level.

1-4-1 Use tiered key figures (No. Document Items and Sales Volume) in the rows. Place the Key Figure structure between REGION and SOLD TO. Set ‘NO. DOCUMENT ITEMS’ and ‘SALES VOLUME’ a level down from ‘INVOICED QUANTITY’. Delete the filter on REGION.

Delete the 3 filter values on REGION by using the delete key > SAVE AS Query in your folder as:

Field Name or Data Type	Values
Description	*Key Fig in Rows ##*
Technical Name	*Key_Fig_Rows##*

View the results on the Web.

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Solutions

Unit: Tracking History & Hierarchies

Topic: Hierarchies

1-1 Review the hierarchy settings in the administrator workbench.

From the Server Easy Access Screen → SAP Menu → Modeling → Administrator Workbench: Modeling →

InfoObjects → Search for T_SOLD_TO → Right Mouse Click(RMC from here on) → Change (create a new task if require) → Hierarchies Tab

Search off the top node if necessary.

1-1-1 External Characteristics in Hierarchies for InfoObject T_SOLD_TO.

Note the settings for hierarchies including Time Dependency. Select the External Characteristics in Hierarchies button.

What InfoObject is selected to be used in the customer hierarchies? **0REGION.**

Close the pop-up.

1-1-2 Maintain Hierarchies

Select the Maintain Hierarchies button and double click on the first active hierarchy. Open up the hierarchy and note 0REGION in the nodes and note also the from/to dates.

1-2 Build a query with the T_SOLD_TO hierarchy and display results in Web.

1-2-1 Build Query from Cube ‘T_SDC03’ with a hierarchy in the rows.

From the ***SAP Easy Access Screen > Business Explorer > Analyzer > choose the ‘folder’ icon in the little menu bar > Queries > New > InfoAreas > Search for InfoCube ‘T_SDC03’.***

You can display the technical names of the InfoCubes by clicking on the wrench icon on top of the screen.

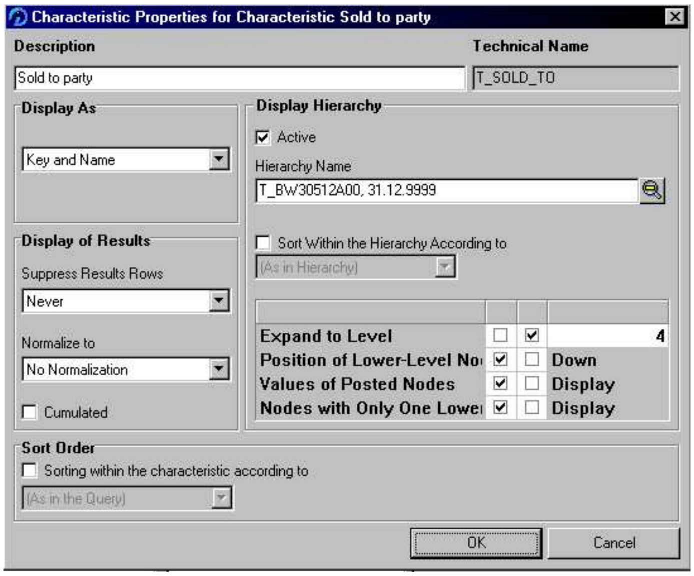
1-2-2 Choose Characteristics and Key Figures then display in Web.

Drag & Drop ‘SOLD TO PARTY’ from the Customer Dimension to the rows, add a hierarchy that expands to the 4th level.

RMC on ‘Sold To Party’ → Goto properties → Goto Hierarchy name values → Select the first hierarchy → Select OK → change the ‘Expand to level’ to 4 → Select OK >

Open up the key figures folder → Drag INVOICED QUANTITY to the columns → Save the Query in your folder as:

Field Name or Data Type	**Values**
Description	*Hier in rows ##*
Technical Name	*Hier_in_rows##*



View the results on the Web, you'll be asked for a user and password that you have been using to access the server.

Display query on the Web >

Enter your user id and password (based on what you are using in the server) and check the save box → Select Enter >

View the results →

Close Internet Explorer.

1-3 Build a query with a hierarchy based on dimension tables.

1-3-1 Build query from the 'Billing Cube' with INVOICED QUANTITY in the columns and REGION above SOLD TO in the rows. Move COUNTRY to 'Free Characteristics'.

From the Query Designer → Select the new query icon → double click on the Billing InfoCube from the history list → drag INVOICED QUANTITY from the key figures folder to the Columns →

Drag 'SOLD TO' from the Customer folder to the rows → Drag REGION to the rows above SOLD_TO → Move COUNTRY up to Free Characteristics.

You may have to pull SOLD_TO down below REGION.

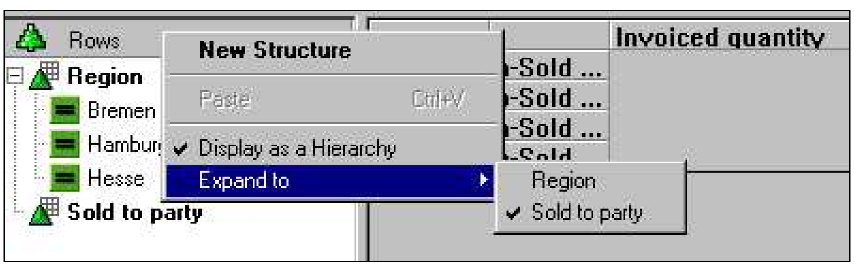
1-3-2 Restrict REGION to: Bremen, Hesse, and Hamburg.

RMC on REGION → Restrict → Click on the Description column header to sort the values → Double click on the 3 regions noted above → Select OK.

1-3-3 Set the dimension hierarchy in the rows and expand to Sold To.

RMC on 'rows' → Select Display as Hierarchy → RMC on rows again → Select Expand to SOLD TO PARTY → Save Query to your folder as:

Field Name or Data Type	**Values**
Description	*Dim Hier in rows ##*
Technical Name	*Dim_Hier_in_rows##*



Display Query on the Web → Follow same steps as before → In addition → Select the 'Swap Axis' icon to see the effect of hierarchical data in the columns →

Exit Internet Explorer.

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1-4 **Optional**: Switch the Sold To Hierarchy on and use ‘tiered’ key figures in the rows from the same query. (But do a ‘save as’ later)

1-4-1 Switch on the SOLD TO Hierarchy that expands to the 4th level.

RMC on SOLD TO PARTY → Goto properties → Goto Hierarchy name values → Select the first hierarchy → Select OK → change the ‘expand to level’ to 4 → hit OK.

1-4-2 Use tiered key figures (No. Document Items and Sales Volume) in the rows. Place the Key Figure structure between REGION and SOLD TO. Set ‘NO. DOCUMENT ITEMS’ and ‘SALES VOLUME’ a level down from ‘INVOICED QUANTITY’. Delete the filter on REGION.

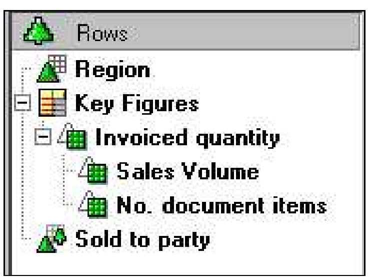
Drag the structure ‘Key Figures’ from the columns to the rows below REGION and above SOLD TO PARTY (when dragging > touch REGION → release) →

Add ‘NO. DOCUMENT ITEMS’ and ‘SALES VOLUME’(the 1st one) to the Key Figure structure below ‘INVOICED QUANTITY’ →

RMC on ‘SALES VOLUME’ → Level Down → RMC on ‘NO.DOCUMENT ITEMS’ → Level Down.

Delete the 3 filter values on REGION by using the delete key → SAVE AS Query in your folder as:

Field Name or Data Type	**Values**
Description	*Key Fig in Rows ##*
Technical Name	*Key_Fig_Rows##*



View the results on the Web.

Display Query on the Web → Follow same steps as before → Open a few of the nodes to see the effect → Exit Internet Explorer.

Modeling Key Figures

Contents

- Modeling Options for Key Figures
- Dynamic/Persistent Key Figures
- Factless Key Figures
- Fact or Attribute
- Transactions
- Exception Aggregation
- Cumulative vs. Non-Cumulatives
- Elimination of Internal Business Volume

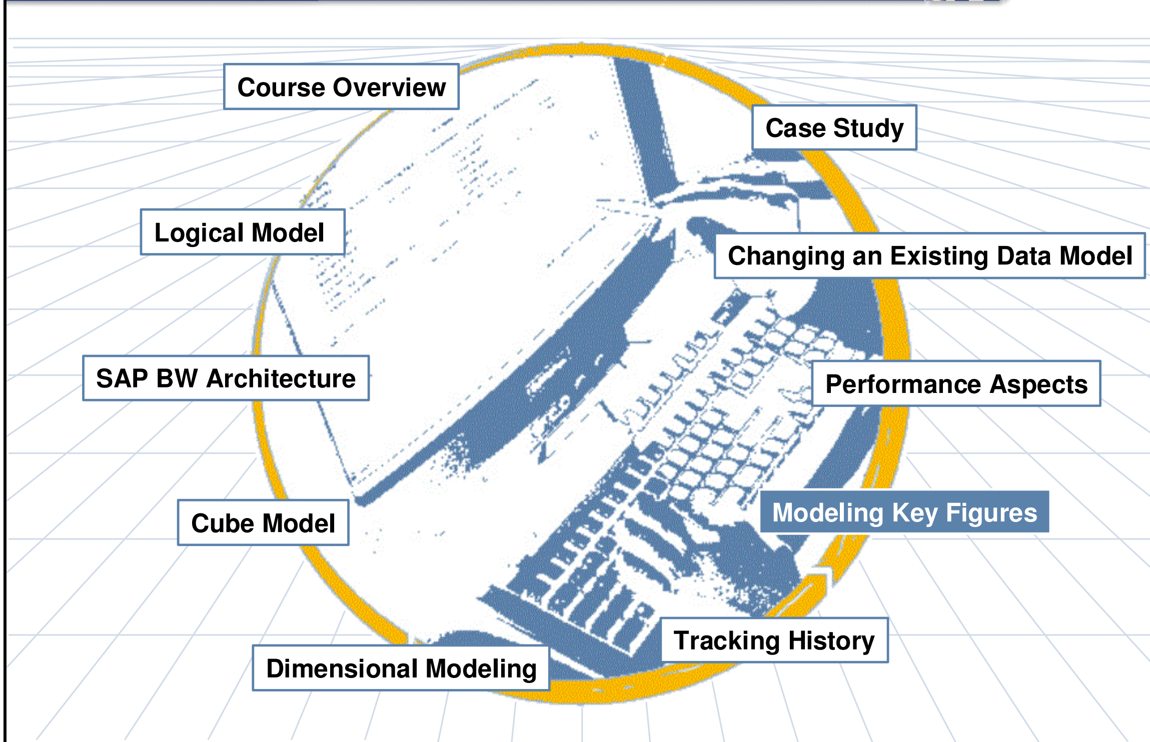
- The BW Data Model is designed to meet reporting requirements of a summarized nature.
- In order to maximize performance and meet the complex reporting needs of your business, you need to evaluate all InfoCube modeling options.

Modeling Key Figures: Unit Objectives

At the conclusion of this unit, you will be able to:

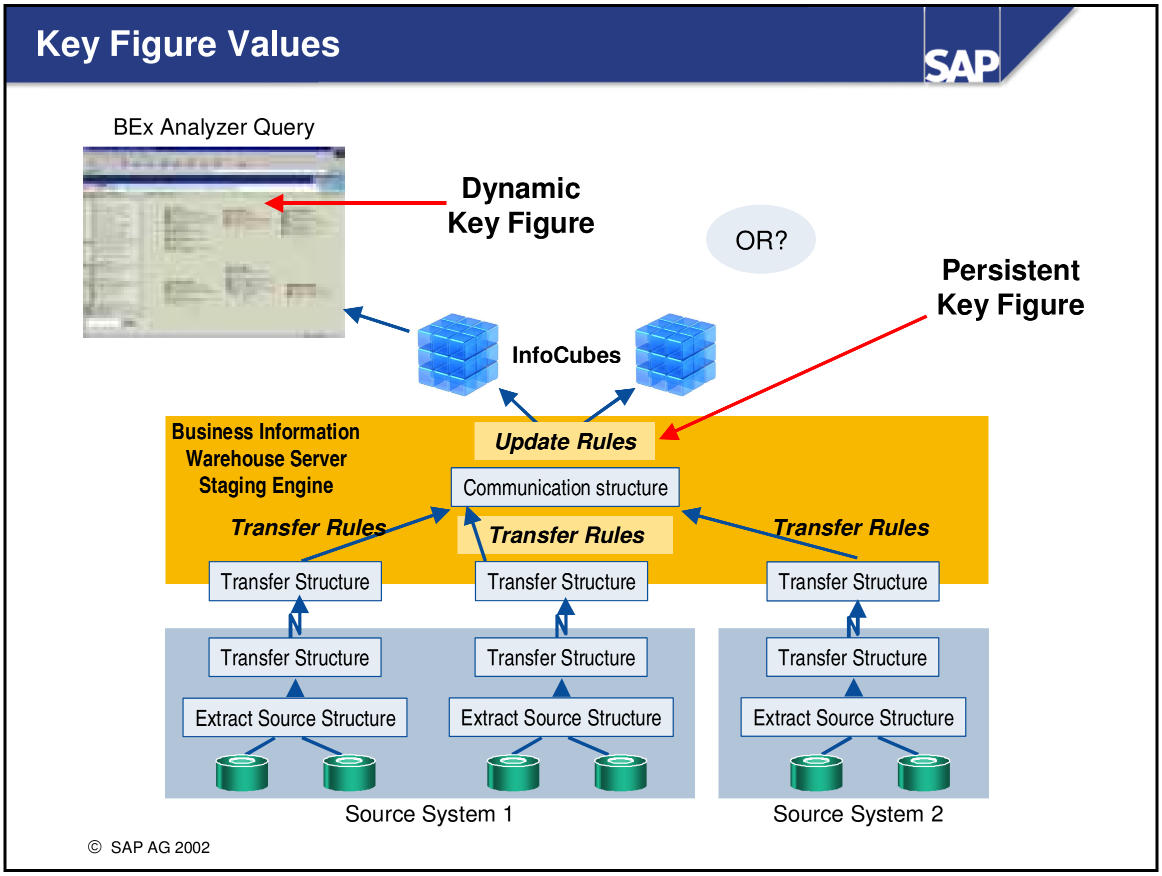
- Discuss a variety of key figure modeling techniques
- Discuss dynamic vs. persistent key figures
- Identify the solution “factless facts”
- Storing a key figure as an attribute
- Identify key figures with or without units
- Discuss the settings for exception aggregation
- Identify when to use Non-Cumulatives
- Explain Elimination of Internal Business Volume

Modeling Key Figures: Overview Diagram



Modeling Key Figures: Business Scenario

- **You want to check the various modeling options for key figures.**
- **You need additional information for exception aggregation and Non-Cumulative key figures.**



- Key Figures are loaded into the Fact Table of an InfoCube during data load and represent the results of transactions in the Source Systems.
- There are times when there is inherent meaning or additional information which can be gleaned from the explicit results loaded into the Data Model. This inherent meaning could be represented by a Key Figure, but is not supplied explicitly by the DataSource.
- For instance, a Source System could provide the Key Figures, order entry quantity and delivery quantity, explicitly and will be represented by specific Key Figure InfoObjects in BW. However, implicit in this data is the delivery fulfillment rate which can be expressed as the percentage delivery quantity represents of order entry quantity. This “fact” can be captured as a Calculated Key Figure in BW by means of a simple mathematical formula.
- The question is whether to model this Calculated Key Figure in the Data Model and load the data during load time (persistent) or in a query definition and calculate the “fact” at query run time (dynamic). The former option requires the Calculated Key Figure as part of the Data Model and Staging Engine with the calculation accomplished by routine in Update Rules. This makes the Fact Table larger over time. The latter option requires the definition of the Calculated Key Figure as part of the query definition. Calculation during query runtime degrades query performance depending upon the complexity of the Calculated Key Figure and how often the query is run.
- The decision point lies balancing query performance versus Fact Table size.

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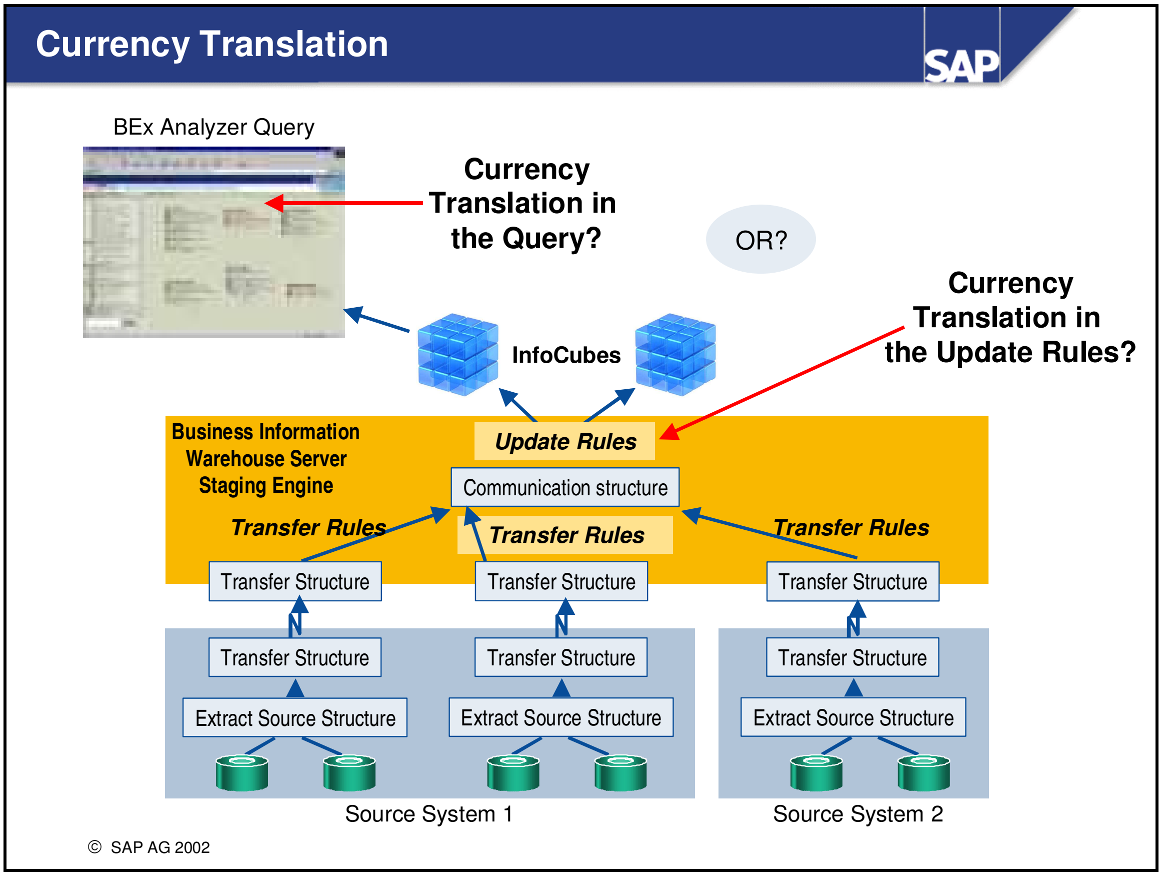


- Currency conversion can take place during the initial transaction data load and/or during query execution. The choice is guided by the benefits and drawbacks of each approach.
- When currencies are converted during data update, the converted values are stored physically with the chosen currency resulting in the faster processing of reports. However, the original value and currencies are lost.
- When currencies are converted during reporting analysis can be done for various target currencies. The original transaction currency is not lost. However, conversion has to be done repeatedly resulting in lower query performance.
- Three prerequisites exist that must be met before currency conversion can take place during data update:
  - There must be a Key Figure (data type AMOUNT) in the InfoSource with either a fixed or variable currency specified.
  - There must be a corresponding Key Figure (data type AMOUNT) in the InfoCube with either a fixed or variable currency specified.
  - There must be a *currency translation type* defined with the proper parameters for the conversion.
- For currency conversion done during reporting, only the last two prerequisites above must be met.

Factless Key Figures

Introducing artificial facts

- There might be a fact table without a "true" fact (intersection entity)
- Introduce an artificial fact to count the number of different products in an order. (Also possible using BEx Query Designer features)
- Examples:
  - A) Counting for attendance in a course

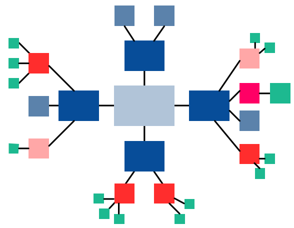
Month	Course	Student	Attendance
200209	TBW10	Smith	1
200209	TBW10	Jones	1

  - B) Count for number on invoice

Customer	Material	Order #	Count
1000	A	3745	1
1000	B	3745	1
1000	B	3746	1

- The values for these facts must be created during data staging with user-created code.
- It would be best to fill these values using routines in update rules.
- A key figure would be created in the data model to represent "attendance" or "count" as depicted above.
- The Update Rules for this new key figure would then load the fact related to each incoming record by means of a routine.

Fact or Attribute

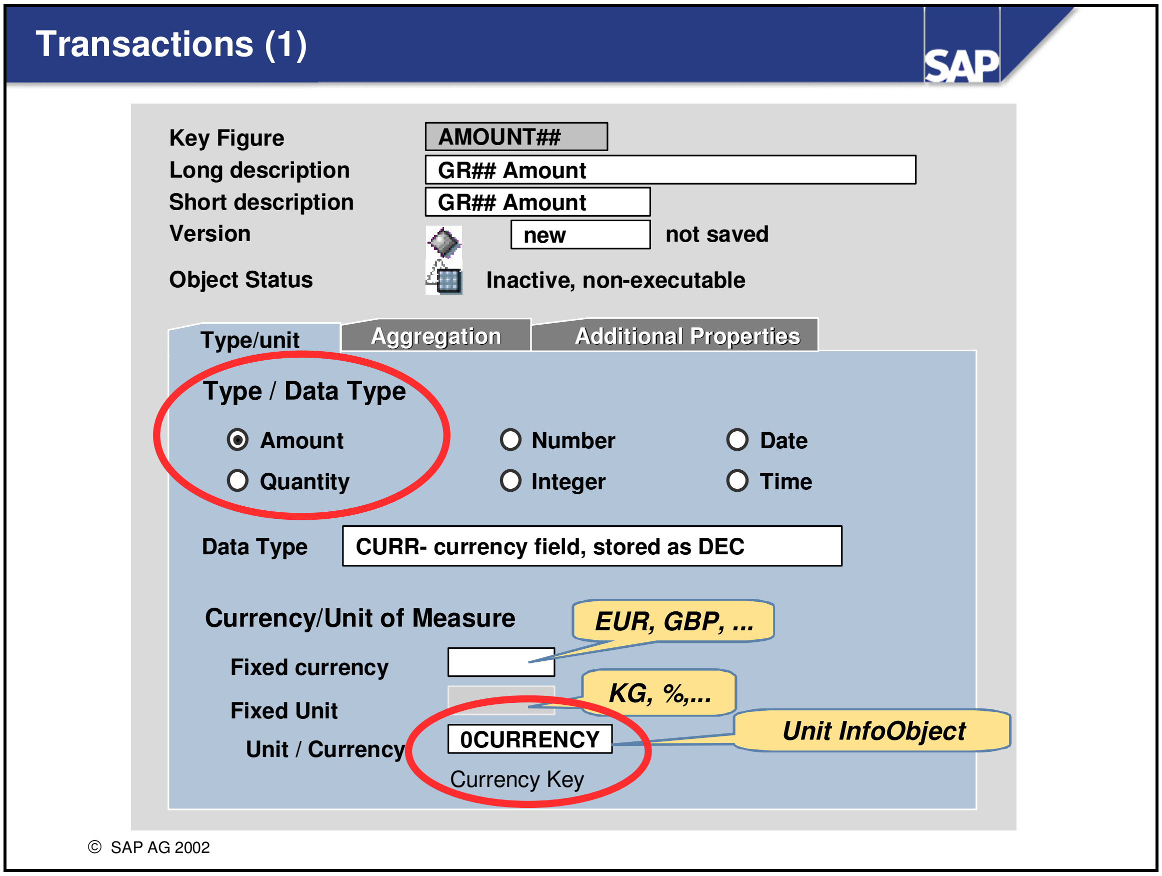


Business Explorer

Price as attribute in material master or key figure in the fact table

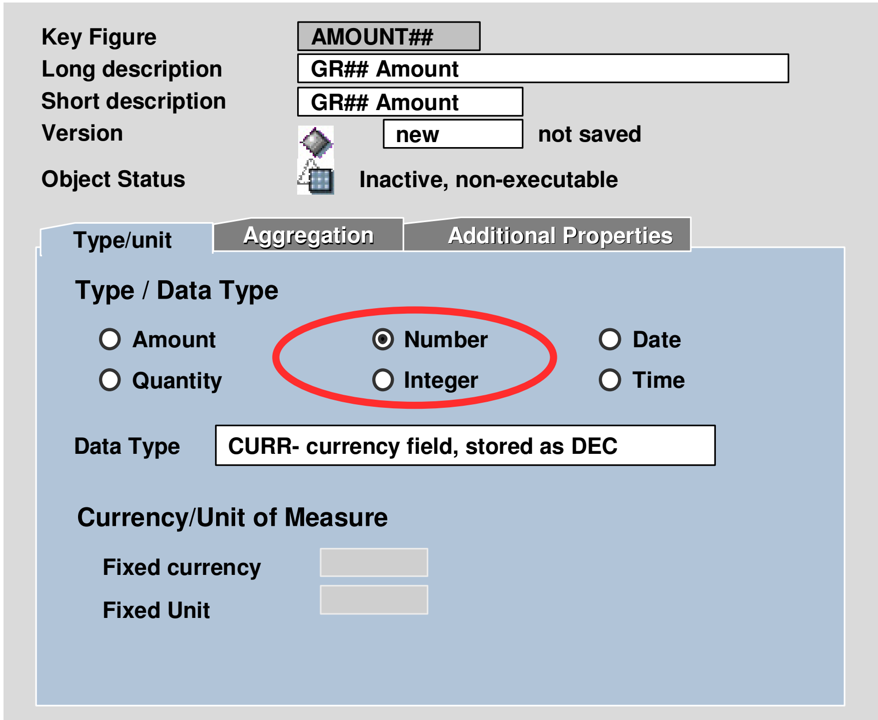
- Price as navigational attribute
  - If price changes rarely, mainly for reporting
  - In BW calculate with attributes you can use a formula variable
- Price as a fact
  - Use amount and number sold
  - No aggregation
  - Automatically tracks price changes
  - Calculation

- Usually it is quite obvious how to distinguish *attributes* and *facts*. But there will be some attributes that will be confusing. Prices are a good example. From one perspective, price describes the article as the manufacturer attribute does and therefore it seems that it should be in the master data table.
- In this case, model “price” as an attribute in a master data table.
- Using a formula variable with ‘replacement path,’ the price navigational attribute can be used to calculate “net sales = price * number of pieces sold,” for example. This allows calculations within queries using this formula variable.
- From another perspective the price is continuous over time which means it doesn’t make sense to calculate discounts on the basis of sales amount and quantity in a fact record using the actual price from the master data table with fact records that are, for example, one year old. In this case the discount has to be calculated during load time in an update rule using a lookup for the actual price from the master data table.
- A time dependent navigational attribute would be acceptable to use if price changed only occasionally.
- Also consider a categorical dimension ‘high or low or medium’ price, if it is to be used for analysis.
- If promotion analysis is a necessity, then do not have price as a navigational attribute.



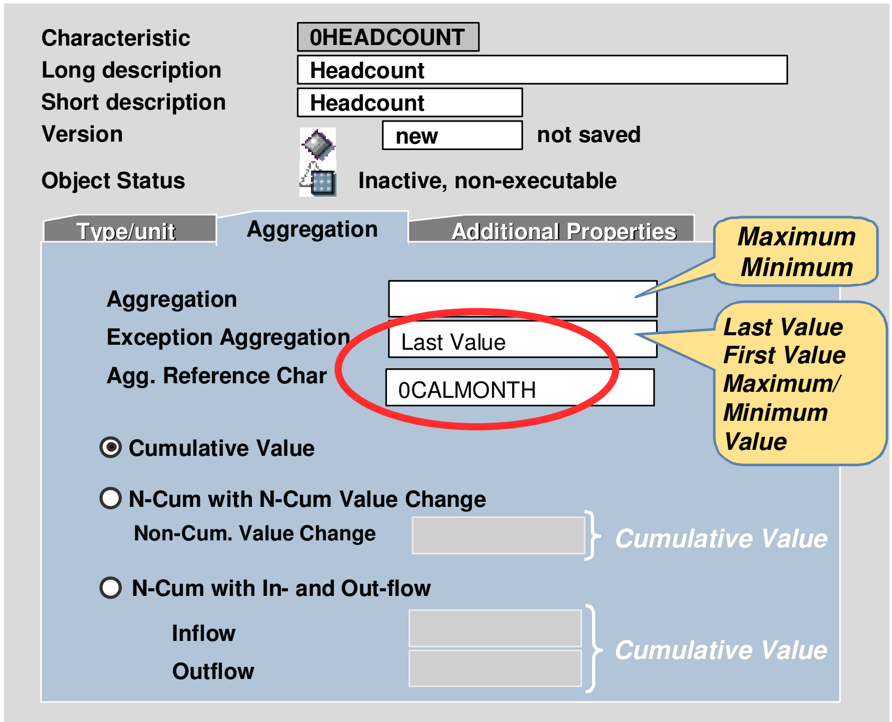
- You select the characteristics for a new InfoObject from a series of tabstrips.
- These settings have a big influence on the capabilities of the InfoObject and how it is used in BW.
- These settings also form the metadata for the InfoObjects. They are stored in the metadata repository.
- Query performance will be better if key figures are stored as NUMBER or INTEGER data types instead of amount/quantity fields that are stored as CHAR data type fields on the database.
- Remember: using amount and quantity key figures requires accessing the UNIT dimension table.

Transactions (2)



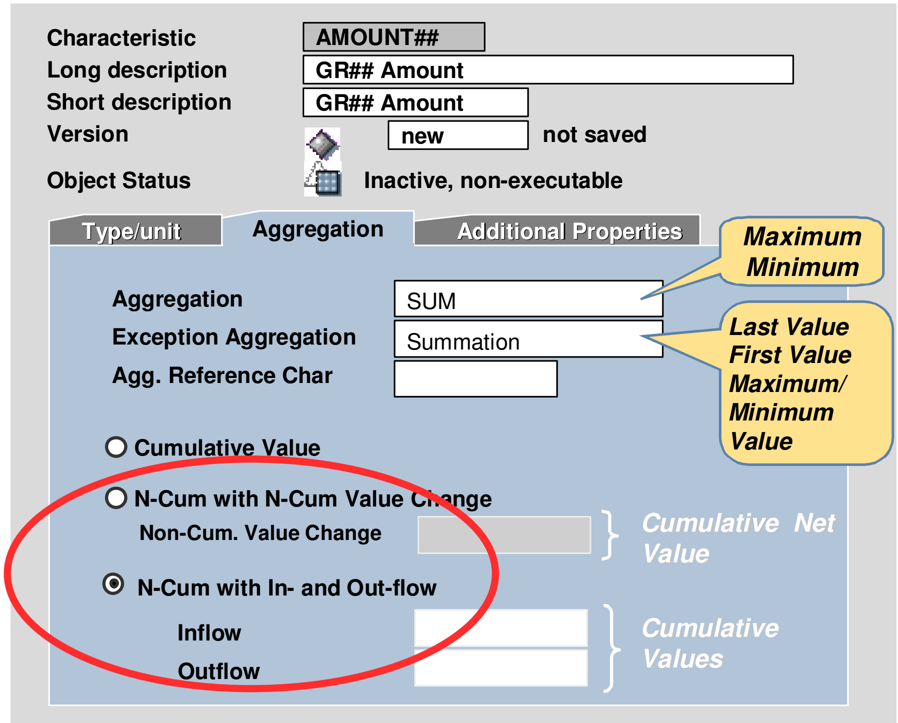
- Query performance will be better if key figures are stored as NUMBER or INTEGER data types instead of amount/quantity fields that are stored as CHAR data type fields on the database.
- Remember: using amount and quantity key figures requires accessing the UNIT dimension table.
- Use key figure InfoObjects of type NUMBER or INTEGER whenever possible.

Exception Aggregation



- You select the characteristics for a new InfoObject from a series of tabstrips.
- These settings have a big influence on the capabilities of the InfoObject and how it is used in BW.
- Non-cumulatives are evaluated by non-cumulative values. Non-cumulative values are special key figures that are different from other key figures (cumulative values) in data transfers and saving, as well as in aggregational behavior.
- Non-cumulative values are those key figures that are measured in relation to a period in time; that is to say, they cannot be meaningfully cumulated over time. Non-cumulative values are summarized over time using exception aggregation.
- Non-cumulative values such as ‘number of employees’, are cumulated using characteristics such as ‘cost center’. It does not make any sense, however, to cumulate the number of employees using different periods. The result at the end of any particular period would be the sum total of number of Employees for each posting during the period. This would, of course, be wrong.
- Instead, the aggregation of the key figure can be defined as exception aggregation wherein an additional reference characterisitc is ultilized to tell BW which value to use during the period, in this case, 0CALMONTH is used, in the above example, to indicate that only the last value of 0HEADCOUNT, updated by costcenter, is to be taken for any calendar year and month.

Cumulative vs. Non-Cumulatives



- The purpose of non-cumulatives is to optimize the data transfer in BW, the data retention and the database access. The data transfer from OLTP to BW is minimized and only the meaningful data is saved and processed.
- It is recommended that you use non-cumulative values for areas that don't change frequently such as warehouse stock or number of employees.
- Non-cumulatives are modeled in BW using a non-cumulative value with the fields belonging to it for storing the non-cumulative or for inflows or outflows.
- Non-cumulative values are stored with special key figures that differ in terms of data transfers and aggregational behavior.

Cumulative & Non-Cumulatives Definition

Cumulative values are those key figures that are cumulated using all characteristics, thus also using time.

Example: Sales revenue, Quantity, ...

Non-cumulative values are those key figures that are measured in relation to a period in time; they cannot be meaningfully cumulated over time. Non-cumulative values are summarized over time using so-called exception aggregation.

Examples: Number of employees, Inventory, Stock prices, Account balance, ...

- Features of Non-Cumulative Values: Transferring and Saving Data:
  - Non-cumulative values are mapped using one key figure for non-cumulative changes or two key figures for inflows and outflows.
  - Non-cumulatives are transferred in an initialization run and the change runs that follow (initialization can also be omitted here).
  - A non-cumulative value always has a time-related exception aggregation.

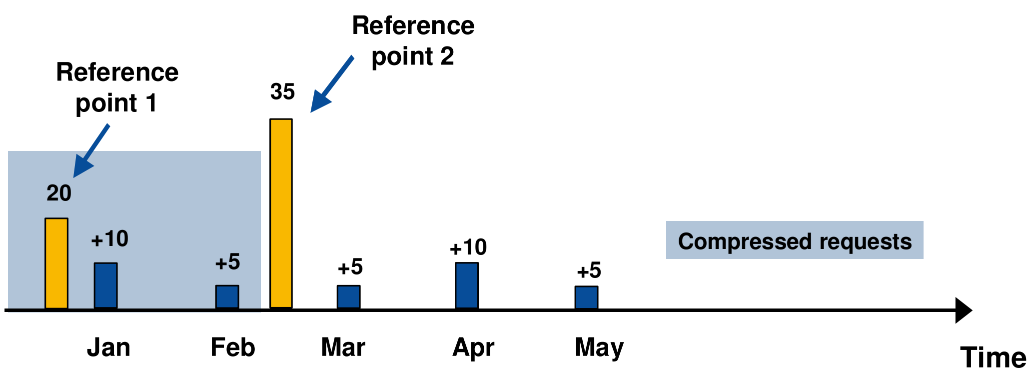
Inventory Handling Principles in BW

Reference point

Starting point for all calculations – when building an inventory scenario the first reference point might be the opening balance.

Technically, the reference point is the value per characteristic combination after having compressed your Info Cube.

When compressing an InfoCube containing non-cumulatives, the reference point is (per default) updated.



- **Opening balance:**
  - The opening balance can also be loaded to BW using a Flat file (flag in transfer rules).
  - No opening balance is created (Creation of reference point when compressing).
  - The opening balance can be loaded to BW via a specific R/3 DataSource (UPDMODE = B).
- Queries for the current non-cumulative can be answered very swiftly since the current non-cumulative is created as a directly accessible value. There is only one marker that is always updated when the non-cumulative InfoCube is compressed. So that access to queries is as quick as possible, compress the non-cumulative InfoCubes regularly to keep the markers up to date.
- For example, in month 3 the marker is read with three non-cumulative changes for a query. In month 4, the marker is updated so that the current marker has to be read with ony one non-cumulative change for a query in month 5. If the marker is not updated, it still has four non-cumulative changes to read.
- The technical storage of non-cumulatives takes place using a **marker** for the current time (current non-cumulative) and the storage of non-cumulative changes, or inflows and outflows. The current, valid end non-cumulative (to 31.12.9999) is stored in the marker. You can determine the current balance from non-cumulative values or you can take last periods balance and sum up the changes.

Validity Tables

Drill-down according to a validity object is now well defined; that means the result is independent of the drilling history.

Validity interval

Sample:

	Jan	Feb	Mar	Apr	May	ref. point
Plant A:						100
Plant B:						30
Plant C:						50

With validity object:

	Jan	Feb	Mar	Apr	May	LAST
Plant A:	30	30	50	90	100	100
Plant B:			10	30	30	30
Plant C:				20	50	50
SUM:	30	30	60	140	180	180

- Only the current non-cumulative value and the non-cumulative changes are stored on the database.
- To be able to evaluate the non-cumulative (for example, to calculate mean values or to execute a drilldown by period) it is necessary that you know for which time interval you can calculate the non-cumulative. Otherwise, a non-cumulative from 1/1/1000 to 12/31/999 is displayed.
- The time based validity of non-cumulatives is mapped using a validity period. This describes the time period non-cumulatives have been managed.
- A non-cumulative InfoCube has to contain a time reference characteristic. This means that the system has to be able to convert all time characteristics of the non-cumulative InfoCube automatically from this time characteristic.
- If you use a user-specific validity table, the table is adjusted when you load it.
- Other characteristics can be used to determine validity as well. Characteristics that specify which source system the non-cumulative belongs to, or which value type that is relevant. It is recommended to use validity-determining characteristics only in special situations.

Elimination of Internal Business Volume

The elimination functionality provides ad hoc eliminations similar to accounting consolidations.

SAP BW eliminates the Key Figure value; this is different from legal consolidation, which is provided in SEM-BCS and R/3-ECCS.

Prerequisite:

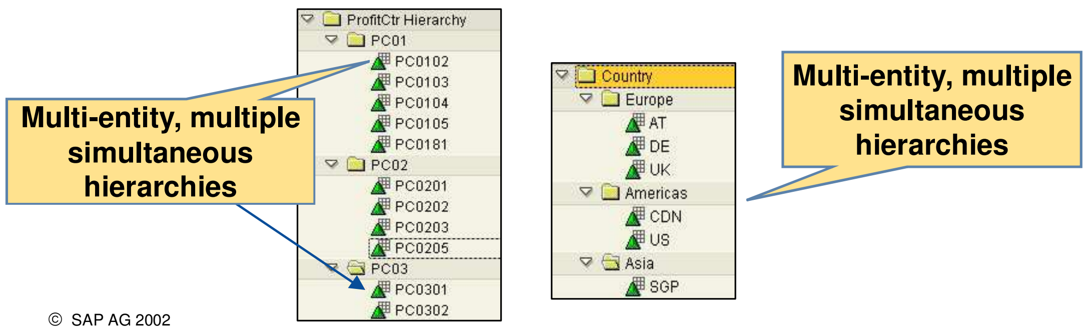
- Two InfoObjects: Sender and Receiver, sharing the same Master Data and in the same hierarchy node
  - e.g., Sending Cost Center ←→ Receiving Cost Center
    Business Area ←→ Partner Business Area
- A special reference Key Figure
  - Stores the result after elimination
  - Is set up with reference
  - Is added to the InfoCube, but not stored in database

- With this function you can eliminate the internal business volume by executing a BEx query. Internal business volume is then no longer displayed in the report.
- This solution is new as of version 3.0a and provides a unique opportunity to do eliminations between partner objects in BW for example. As part of an OLAP scenario, this ad hoc consolidation is very flexible.
- BCS stands for Business Consolidation System and is essentially the same as ECCS(Enterprise Controlling Consolidation System) up to version 4.0 of SEM (Strategic Enterprise Management). The 4.0 release of BCS will provide full OLAP functionality to do consolidations.

Elimination of Internal Business Volume – Example

Example: Profit Center PC0301(UK) has internal revenue of $50.00 from Partner Profit Center PC0102 (DE). This revenue must be eliminated for the European rollup.

Record Number	PartnerProfit Center	Profit Center	Country	Partner Country	Revenue
1	PC0102	PC0181	DE	DE	$ 100.00
2	PC0103	PC0203	DE	DE	$ 200.00
3	PC0102	PC0301	UK	DE	$ 50.00
4	#	PC0201	DE	AT	$ 100.00
5	PC0301	PC0201	DE	UK	$ 300.00
6	PC0201	PC0201	DE	CDN	$ 200.00
7	PC0203	PC0302	UK	US	$ 250.00
8	PC0203	PC0302	SGP	DE	$ 150.00
9	#	PC0201	DE	US	$ 80.00
10	PC0201	PC0201	DE	AT	$ 500.00
Overall Result	**Result**	**Result**	**Result**	**Result**	**$ 1,930.00**



- Eliminations are performed when both the object and partner object belong to the same node of the hierarchy. In our example for the profit center PC0301 and partner profit center PC0102 internal revenue shown in record #3.
- Based on the profit center hierarchy, revenue must be eliminated at the “ProfitCtr Hierarchy” profit center node.
- Based on the region hierarchy, revenue must be eliminated at the “Europe” node and the “Country” node.

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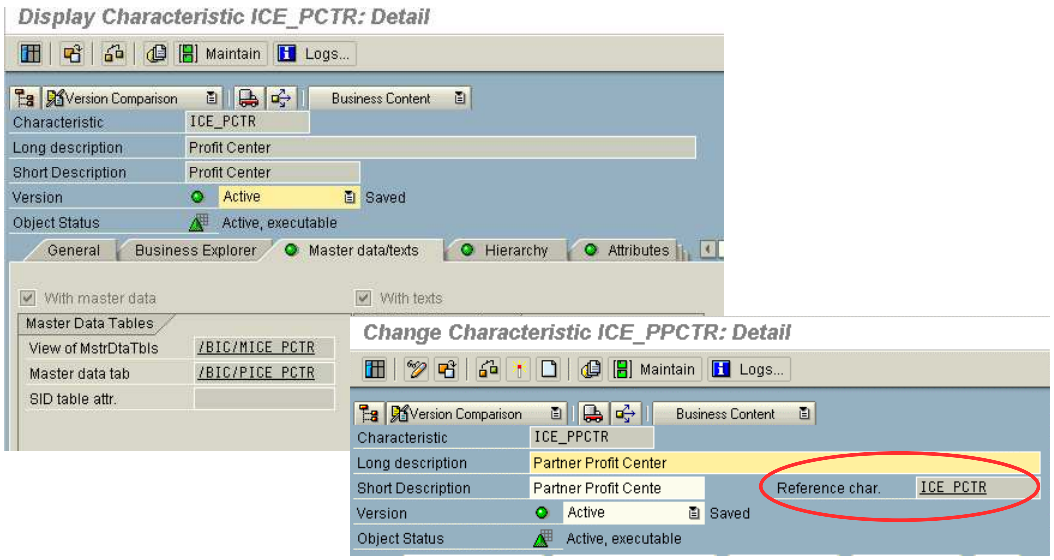
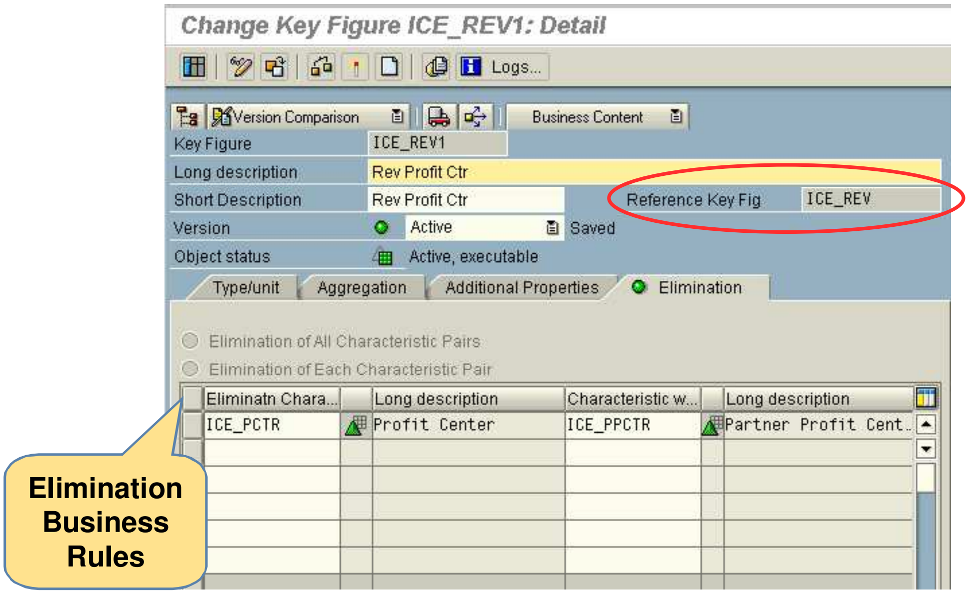
Reference Characteristics



- You have an InfoProvider that contains two InfoObjects (sender and receiver) that have the same master data.

Reference Key Figures



- To eliminate internal business volume in an InfoProvider, you have to create a key figure with a reference. You then include these in the InfoProvider.
- When creating a key figure, you can also select *Key Figure with Reference*. In the InfoObject maintenance you have an additional tab page, *Elimination*. Enter one or more characteristic pairs here regarding the key figure to be eliminated. The characteristics of such a pair must have the same reference characteristic. You can also enter the names of the navigation attributes here.
- You can display permitted characteristics for an elimination characteristic by using the input help.
- If several characteristic pairs are maintained, you still have to specify one of the following, using the selection buttons:
  - all characteristic pairs need to be eliminated (then the key figure value is only eliminated if the elimination condition described above is fulfilled for all characteristic pairs) => AND
  - each individual characteristic pair needs to be eliminated (then the key figure value is already eliminated as soon as the elimination condition for a characteristic pair is fulfilled) => OR

Elimination Business Rule

Table RSDICE – Logic for Elimination of Internal Business Volume

KYFNM	OBJVERS	POSIT	IOBJNM1	IOBJNM2	BOOLEOP	BOOLEOP2
ICE_REV1	A	0001	ICE_PCTR	ICE_PPCTR		

KYFNM	OBJVERS	POSIT	IOBJNM1	IOBJNM2	BOOLEOP	BOOLEOP2
ICE_REV2	A	0001	ICE_CTRY	ICE_PCTRY		

KYFNM	OBJVERS	POSIT	IOBJNM1	IOBJNM2	BOOLEOP	BOOLEOP2
ICE_REV3	A	0001	ICE_PCTR	ICE_PPCTR	OR	
ICE_REV3	A	0002	ICE_CTRY	ICE_PCTRY		

KYFNM	OBJVERS	POSIT	IOBJNM1	IOBJNM2	BOOLEOP	BOOLEOP2
ICE_REV4	A	0001	ICE_PCTR	ICE_PPCTR	AND	
ICE_REV4	A	0002	ICE_CTRY	ICE_PCTRY		

Table RSDICE contains the business rules for performing the elimination on the special key figures:

- **The characteristic senders and receivers included in the elimination.**
- **The appropriate Boolean operator (e.g., AND/OR).**

- In this example, four eliminations are being performed:
  - ICE_REV1 eliminates revenue between a profit center/partner profit center that are assigned to the same node of the profit center hierarchy.
  - ICE_REV2 eliminates revenue between a country/partner country that are assigned to the same node of the country hierarchy.
  - ICE_REV3 eliminates revenue between a profit center/partner profit center where EITHER the profit centers are assigned to the same node of the profit center hierarchy OR the countries are assigned to the same node of the country hierarchy.
  - ICE_REV4 eliminates revenue between a profit center/partner profit center where BOTH the profit centers are assigned to the same node of the profit center hierarchy AND the countries are assigned to the same node of the country hierarchy.

Elimination InfoCube Data Model

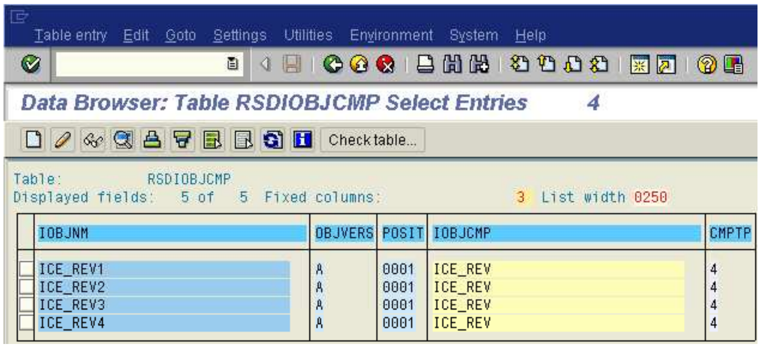
InfoCube data model	Techn.name
Elimination of Internal Business Volume	ICE
Technical	ICE1
Country	ICE2
ProfitCtr	ICE3
Time	ICET
DataPackage	ICEP
Key figures	1KYFNM
Revenue	ICE_REV
Rev Profit Ctr	ICE_REV1
Rev Country	ICE_REV2
Rev Profit Ctr OR Country	ICE_REV3
Rev Profit Ctr AND Country	ICE_REV4

InfoCube ICE is used to reflect the elimination of internal business volume for profit centers.

- The last step is to add the special key figure to the InfoCube. In this way, it is included in the data model, but not in the database table.
- To see the data model: Goto the Administrator Workbench (RSA1) > InfoProviders > Search for the ICE InfoCube > Right Mouse Click > Display Data Model.
- To confirm that only the basic key figure ICE_REV in the fact table, goto transaction LISTSCHEMA > Enter B for type if InfoCube > Enter ICE for the InfoCube name and Execute > Display table contents for the fact table.

Establishing Elimination Key Figure

Table RSDIOBJCMP



This is a control table for InfoCube maintenance; the key figure will be part of the data model, but not the database table.

The special key figure InfoObjects are inserted into table RSDIOBJCMP with type Referenced Key Figure.

- Use SE16 to view the table RSDIOBJCMP as well as the fact table for the ICE InfoCube.(You will NOT see any of the artificial key figures!)
- ICE_REV1-4 are artificial key figures referenced to ICE_REV and use business logic to eliminate transactions between partners for example.
- The values for ICE_REV1-4 are not stored in the db but are calculated by the query.

Elimination of Internal Business Volume in Query

ICE_QUERY1

Profit Center	Revenue	Rev Profit Ctr
▽ ProfitCtr Hierarchy	$ 50,00	
▽ PC03	$ 50,00	$ 50,00
PC0301	$ 50,00	$ 50,00

ICE_QUERY2

Country	Revenue	Rev Country
▽ Country	$ 50,00	
▽ Europe	$ 50,00	
UK	$ 50,00	$ 50,00

ICE_QUERY3

Country	Profit Center	Revenue	Rev PCtr OR Ctry
▽ Country	▽ ProfitCtr Hierarchy	$ 50,00	
	▽ PC03	$ 50,00	
	PC0301	$ 50,00	
▽ Europe	▽ ProfitCtr Hierarchy	$ 50,00	
	▽ PC03	$ 50,00	
	PC0301	$ 50,00	
UK	▽ ProfitCtr Hierarchy	$ 50,00	
	▽ PC03	$ 50,00	$ 50,00
	PC0301	$ 50,00	$ 50,00

ICE_QUERY4

Country	Profit Center	Revenue	Rev PCtr AND Ctry
▽ Country	▽ ProfitCtr Hierarchy	$ 50,00	
	▽ PC03	$ 50,00	$ 50,00
	PC0301	$ 50,00	$ 50,00
▽ Europe	▽ ProfitCtr Hierarchy	$ 50,00	
	▽ PC03	$ 50,00	$ 50,00
	PC0301	$ 50,00	$ 50,00
UK	▽ ProfitCtr Hierarchy	$ 50,00	$ 50,00
	▽ PC03	$ 50,00	$ 50,00
	PC0301	$ 50,00	$ 50,00

- The elimination is performed when the query is run with the special key figures. The queries above illustrate:
  - ICE_QUERY1: "Rev Profit Ctr" is eliminated at the first common node for profit center PC0301 and partner profit center PC0102, which is the ProfitCtr Hierarchy node.
  - ICE_QUERY2: "Rev Country" is eliminated at the first common node for country UK and partner country DE, which is the Europe node, and all higher level nodes (Country).
  - ICE_QUERY3: "Rev PCtr OR Ctry" is eliminated if EITHER the "profit center" or "country" rule applies.
  - ICE_QUERY4: "Rev PCtr AND Ctry" is eliminated if BOTH the "profit center" and "country" rules apply.

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Modeling Key Figures: Unit Summary

Now you will be able to:

- Discuss a variety of key figure modeling techniques
- Discuss dynamic vs. persistent key figures
- Identify the solution “factless facts”
- Storing a key figure as an attribute
- Identify key figures with or without units
- Discuss the settings for exception aggregation
- Identify when to use Non-Cumulative key figures
- Explain Elimination of Internal Business Volume

Exercises

Unit: Modeling Key Figures

At the conclusion of this exercise, you will be able to:

- Create a basic Key Figure.
- Create a Key Figure with Exception Aggregation.
- Analyze the configuration and data for a non-cumulative Inventory example.

Your company has decided to use an InfoCube to meet reporting requirements of a summarized nature. First of all, you need to consider some of the master data settings for a characteristic to see how they will affect data modeling. In addition, you are interested in the settings required to correctly store and report Inventory values.

1 Create an InfoObject in an InfoCatalog within your InfoArea **BW330 Group ## (T_BW330_GR##)**.

1-1 In your InfoArea create an InfoObject Catalog for key figures with name **T_BW330K##** and description, **GR## InfoObject catalog key**.

2 Create two key figure InfoObjects.

2-1 Create one key figure InfoObject in your InfoObject catalog for Key Figures, **T_BW330K##**:

Create a Key Figure with name **T_AMNT##** and description **Amount GR##.** On the Type/Unit tab enter **AMOUNT** for the Type/data type, and **CURR** for the data type. Under ‘currency/unit of measure’ enter **0CURRENCY**.

On the tab **Aggregation**, ensure that the entries for the fields **Aggregation** and **Exception Aggregate** both contain the value **SUM (Summation)**.

Check, save and activate your key figure.

While in InfoObject maintenance, select the icon **Overview list** and make note of the entries in the various columns.

Return to the Administrator Workbench.

2-2 Create a second key figure InfoObject in your InfoObject catalog for Key Figures, **T_BW330K##.**

Create an Info Object with name **T_HDCNT##** and description **Headcount GR##.**

Under the Type/Unit tab enter **QUANTITY** for the *Type/data type*, and **QUAN** for the data type. For *Fixed Unit of Meas* enter **PER**.

On the tab Aggregation, enter **SUMMATION** in the Aggregation field and **LAST (Last value)** for the field Aggregation.

In the field *Agg.referen.char* enter the value **0CALMONTH**.

Check, save, and activate your key figure.

While in InfoObject maintenance, select the icon **Overview list** and make note of the entries in the various columns.

Return to the Administrator Workbench.

3 Non-Cumulative Configuration for Inventory Values

3-1 Goto InfoSource TR_OPENING_BALANCE_GR00 and confirm that "Opening Balance" is flagged in the Transfer Structure. Note that the source system is I_EXTERN (flat file) and field sequence as follows:

0MATERIAL

0PLANT

0VTYPE

0VALSTCKQTY

0BASE_UOM

0CALDAY

3-2 Goto InfoSource TR_MAT_MOVEMENTS_GR00 and confirm that "Opening Balance" is NOT flagged in the Transfer Structure. Note that the source system is I_EXTERN (flat file) and field sequence as follows:

0MATERIAL

0PLANT

0VTYPE

0RECVALSTCK

0ISSVALSTCK

0BASE_UOM

0CALDAY

3-3 Goto InfoCube TR_C00 and find out which key figures are included:

0ISSVALSTCK	Quantity issued from valuated stock
0RECVALSTC	Quantity received into valuated stock
0VALSTCKQTY	Quantity of valuated stock

Note: The quantity of valuated stock is a "virtual" key figure that is not physically contained in the DB tables of the InfoCube. It will be calculated during reporting based on the two other key figures representing the inflow and outflow of material movements.

3-4 While in the InfoCube, look at the definition of the validity table to see if 0CALDAY is included. If an InfoCube contains non-cumulative values, a validity table is created in which the time interval is stored, for which the non-cumulative values are valid.

3-5 Use transaction code SE16 to view table RSDIOBJCMP for InfoObject 0VALSTCKQTY version A.

Note how this virtual key figure is mapped to the 'real' key figures 0ISSVALSTCK and 0RECVALSTCK.

3-6 Goto the InfoCube and display the data model. Do you see 0VALSCKQTY?

____

3-7 Go to transaction LISTSCHEMA for a basic InfoCube and TR_C00. Browse the Fact Table. Do you see 0VALSCKQTY?

____

How many key figures do you see?

____

3-8 Investigate the InfoPackage used to load the opening balance.

Is 'Generate Initial Status' checked?

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4 Display the results in the InfoCube and a Query.

4-1 In the InfoCube TR_C00, select *Manage* from the context menu and note the two requests that have been loaded: Material Movements and Opening Balance.

4-2 Display the contents. Select characteristics Material, Plant, Calendar Day along with both key figures for output. Note that only the goods issues and receipts Key Figure values are stored in the fact table.

4-3 Go to the Business Explorer Analyzer. Find query 'Inventory Gr00' with technical name 'TR_INVENTORY_GR00' and go into change mode to see the query definition. Note the key figure is the virtual VALUATED STOCK QTY. Quit and Use the query to see the results.

Note the key figure in the columns.

Are there beginning inventory values?

Solutions

Unit: Modeling Key Figures

1 Create an InfoObject in an InfoCatalog within your InfoArea **BW330 Group ## (T_BW330_GR##)**.

1-1 In your InfoArea create an InfoObject Catalog for key figures with name **T_BW330K##** and description, **GR## InfoObject catalog key**.

Administrator Workbench → Modeling → InfoObjects → BW Training → BW Customer Training → BW330 Data Warehousing → BW330## → **BW330 Group ##**

Select your InfoArea and right click on it to open the context menu.

From the context menu, select Create InfoObject Catalog.

In the field InfoObjCat enter T_BW330K## and description GR## InfoObject catalog key.

Select the radio button Key Figure for InfoObject Type.

Select the Create button and Activate your InfoObject Catalog.
Go back (F3).

2 Create two key figure InfoObjects.

2-1 Create one key figure InfoObject in your InfoObject catalog for Key Figures, **T_BW330K##**:

Create a Key Figure with name **T_AMNT##** and description **Amount GR##.** On the Type/Unit tab enter **AMOUNT** for the Type/data type, and **CURR** for the data type. Under 'currency/unit of measure' enter **0CURRENCY**.

Select your InfoObject catalog T_BW330K##: and right click to open the context menu.

From the context menu, select Create InfoObject.

In the field KeyFig enter T_AMNT## as name and description Amount GR##.

Select Continue.

On the Type/Unit tab enter AMOUNT for the Type/data type, and CURR for the data type. Under 'currency/unit of measure enter 0CURRENCY.

On the tab **Aggregation**, ensure that the entries for the fields **Aggregation** and **Exception Aggregat** both contain the value **SUM** (**Summation**).

Go to the Aggregation tab.

Ensure that the entries for the fields Aggregation and Exception Aggregate both contain the value SUM.

Check, save and activate your key figure.

While in InfoObject maintenance, select the icon **Overview list** and make note of the entries in the various columns.

Return to the Administrator Workbench.

2-2 Create a second key figure InfoObject in your InfoObject catalog for Key Figures, **T_BW330K##.**

Create an Info Object with name **T_HDCNT##** and description **Headcount GR##.**

Under the Type/Unit tab enter **QUANTITY** for the *Type/data type*, and **QUAN** for the data type. For *Fixed Unit of Meas* enter **PER**.

Select your InfoObject catalog T_BW330K##: and right click to open the context menu.

From the context menu, select Create InfoObject.

In the field KeyFig enter T_HDNT## as name and description Headcount GR##.

Select Continue.

On the Type/Unit tab enter QUANTITY for the Type/data type, and QUAN for the data type. For Fixed Unit of Meas enter PER.

On the tab Aggregation, enter SUMMATION in the Aggregation field and LAS (Last value) for the field Aggregation.

Go to the Aggregation tab.

Enter in field Aggregation the value SUMMATION and for the field Exception Aggregate enter the value LAST VALUE.

In the field *Agg.referen.char* enter the value **0CALMONTH**.

Check, save, and activate your key figure.

While in InfoObject maintenance, select the icon **Overview list** and make note of the entries in the various columns.

Return to the Administrator Workbench.

3 Non-Cumulative Configuration for Inventory Values

3-1 Goto InfoSource TR_OPENING_BALANCE_GR00 and confirm that “Opening Balance” is flagged in the Transfer Structure. Note that the source system is I_EXTERN (flat file) and field sequence as follows:

0MATERIAL

0PLANT

0VTYPE

0VALSTCKQTY

0BASE_UOM

0CALDAY

Administrator Workbench →Modeling → InfoSources →Search for TR_OPENING_BALANCE_GR00 →Right Mouse Click (RMC) →Change → DataSource / Transfer Structure.

3-2 Goto InfoSource TR_MAT_MOVEMENTS_GR00 and confirm that “Opening Balance” is NOT flagged in the Transfer Structure. Note that the source system is I_EXTERN (flat file) and field sequence as follows:

0MATERIAL

0PLANT

0VTYPE

0RECVALSTCK

0ISSVALSTCK

0BASE_UOM

0CALDAY

Administrator Workbench →Modeling →InfoSources →Search for TR_ MAT_MOVEMENTS _GR00 →Right Mouse Click (RMC) →Change → Transfer Structure.

3-3 Goto InfoCube TR_C00 and find out which key figures are included:

0ISSVALSTCK	Quantity issued from valuated stock
0RECVALSTC	Quantity received into valuated stock
0VALSTCKQTY	Quantity of valuated stock

Note: The quantity of valuated stock is a “virtual” key figure that is not physically contained in the DB tables of the InfoCube. It will be calculated during reporting based on the two other key figures representing the inflow and outflow of material movements.

Administrator Workbench →Modeling →InfoProvider →Search for TR_C00 →RMC →Change →Key Figures Tab.

3-4 While in the InfoCube, look at the definition of the validity table to see if 0CALDAY is included. If an InfoCube contains non-cumulative values, a validity table is created in which the time interval is stored, for which the non-cumulative values are valid.

Extras → Maintain Non-Cumulative Values → Read the Help.

3-5 Use transaction code SE16 on table RSDIOBJCMP for InfoObject 0VALSTCKQTY version A.

Note how this virtual key figure is mapped to the 'real' key figures 0ISSVALSTCK and 0RECVALSTCK.

Enter /OSE16 in Command Field → Enter → Enter table RSDIOBJCMP → Table Contents → Enter 0VALSTCKQTY in the IOBJNM field and 'A' in the Version Field → Execute.

3-6 Go to the InfoCube and display the data model. Do you see 0VALSCKQTY? **Yes, because it is included in the InfoCube.**

Administrator Workbench → Modeling → InfoProvider → Search for TR_C00 → RMC → Display Data Model → Open the Key Figures Folder.

3-7 Go to transaction LISTSCHEMA for a basic InfoCube and TR_C00. Browse the Fact Table. Do you see 0VALSCKQTY?

Enter 'B' for Basic InfoCube and TR_C00 → Execute → Select the Fact Table (/BIC/FTR_C00) → Call up Transaction SE16.

How many key figures do you see?

Only two! 0VALSCKQTY does not reside in the database, it is a virtual key figure whose values are calculated during reporting.

3-8 Investigate the InfoPackage used to load the opening balance.

Administrator Workbench → Modeling → InfoSources → Search for TR_OPENING_BALANCE_GR00 → Open up any Folders if Necessary → RMC on the InfoPackage 'Opening Balance Gr00' → Change → Go to the Update Tab.

Is 'Generate Initial Status' checked?

Yes, because non-cumulative key figures for a particular time unit are transferred for constructing the start non-cumulative from the Extractor. The time unit is determined by the smallest time unit of the InfoSource.

4 Display the results in the InfoCube and a Query.

4-1 In the InfoCube TR_C00, select *Manage* from the context menu and note the two requests that have been loaded: Material Movements and Opening Balance.

Administrator Workbench → Modeling → InfoProvider → Search for TR_C00 → RMC → Manage → Look under the Requests Tab.

4-2 Display the contents. Select characteristics Material, Plant, Calendar Day along with both key figures for output. Note that only the goods issues and receipts Key Figure values are stored in the fact table.

Go to Contents Tab → Press the InfoCube Content Button → Press the Fld Selectn for Output Button → Check off Material, Plant, Calendar Day → Execute → Execute.

4-3 Go to the Business Explorer Analyzer. Find query 'Inventory Gr00' with technical name 'TR_INVENTORY_GR00' and go into change mode to see the query definition. Note the key figure is the virtual VALUATED STOCK QTY. Quit and Use the query to see the results.

From the SAP Easy Access Screen → Business Explorer → Analyzer → choose the 'folder' icon in the little menu bar → Queries → InfoAreas → Search with the Binoculars → Type in 'TR_INVENTORY_GR00' into the search string → Find → Select the Query → Change.

Note the key figure in the columns.

Press the 'Wrench' Icon to see the technical names.

Press the Green Check-mark to 'Quit and Use' the query.

Are there beginning inventory values?

Yes, the virtual key figure provided those when the query ran.

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Performance Aspects

Contents

- Granularity
- BW Aggregates
- Partitioning
- Performance in General

- Decisions on the level of granularity are the single most important drivers of performance.
- Aggregates are the best way to manage large fact tables.
- However, the technique of partitioning and other methods can be used as well.

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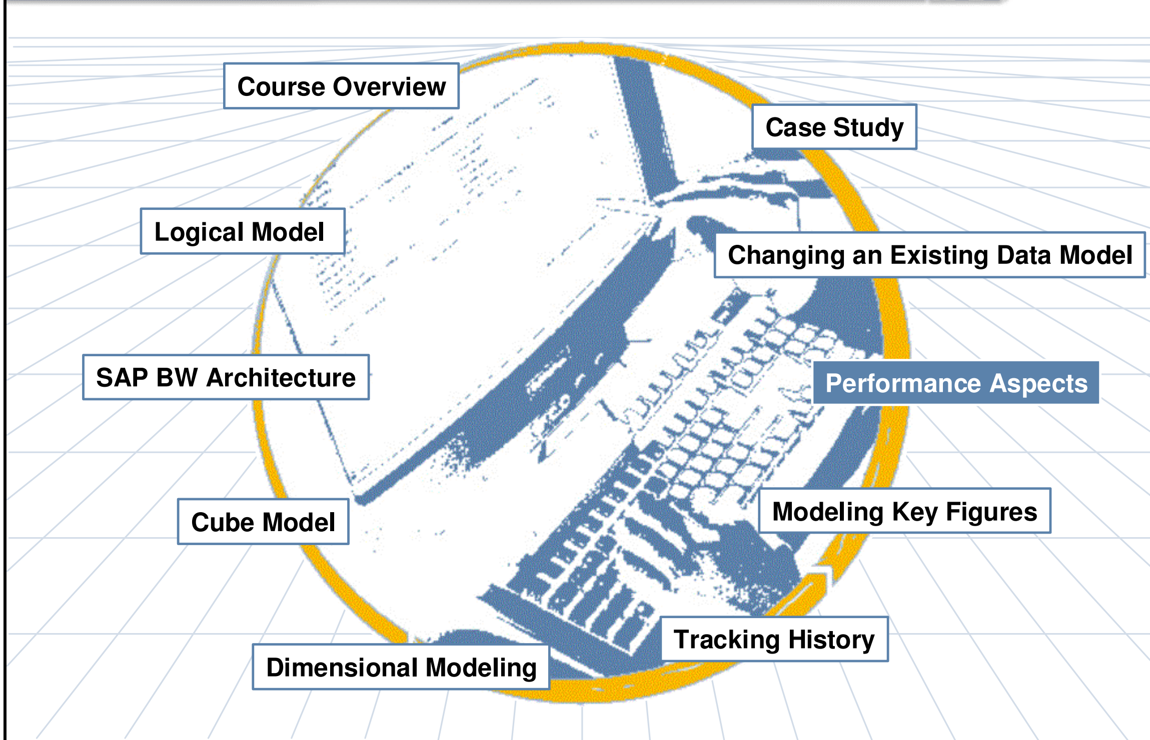
Performance Aspects: Unit Objectives

At the conclusion of this unit, you will be able to:

- Explain what aggregates are and how they are used in BW
- Create suitable aggregates using the tools provided by BW
- Understand how Aggregates are used to make reporting faster
- Discuss the maintenance and table space of aggregates as a cost of faster reports
- Discuss other performance enhancement options

- The BW360 class covers performance in more detail.

Performance Aspects: Overview Diagram



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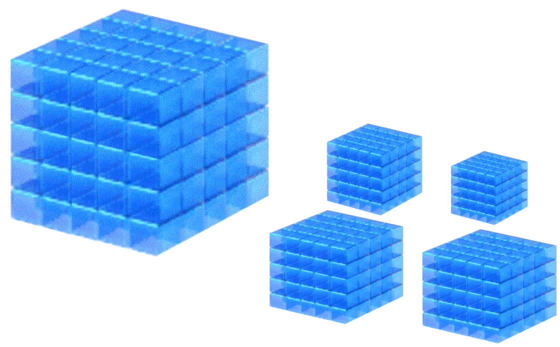
Performance Aspects: Business Scenario

- Aggregates are used to make reporting faster.
- On the other hand maintenance of aggregates is itself a performance issue.
- Enhancements improving performance of aggregate usage in queries as well as aggregate maintenance are crucial.

Steps in the Design Process

Choose a business process to model
Choose the grain of the process
Choose the dimensions that apply to each fact table record
Choose the measured facts that will populate each fact table
Record



Per Ralph Kimball, The Data Warehouse Toolkit.

- Depending on the amount of history required, ODS Objects should be considered. For example, use an ODS to capture the last 3 months of line item detail but use an InfoCube to store the aggregated 5 year view.
- The first step is to model a business process such as cost center accounting, sales orders, HR, or purchase orders. Typically, several InfoCubes would be used for each process,
- Then, decide on what system users should to go for line item detail vs. summarized data such as BW or R/3. Archiving strategies can be a factor in this decision.
- For each InfoCube, decide on the 13 freely defined dimensions and which characteristics to put in each one. Keep in mind that any InfoObject in a dimension will then be updated via transaction data loads. And, that data will reflect characteristic relationships that exist in that data or are generated in the update rules. This is discussed in detail in the Tracking History Unit.
- The measured facts are the KPI's (key performance indicators) that are relevant for the business process. For example, 0QUANTITY and 0AMOUNT for the sales order process. These are also referred to as key figures and statistics.

Granularity of Data

The granularity of data is the level of detail on the database - the characteristics that describe our key figures

- Most detailed level of data displayed
- Broken down by (according to) - for example, sales by customer or sales by material

The granularity of the data determines how far you can drilldown on the data

Example: Granularity of time

- Day versus month
- A customer buys the same product 2 to 3 times a month
- A time granularity of day results in 2 or 3 entries in the fact table
- A time granularity of month results in 1 record being added to the fact table, but also in a loss of information (namely the number of orders for each day of the week)

- Granularity is a term that describes how detailed a database is in a data warehousing context.
- Data that is "highly granular" or has "high granularity" is very detailed data, meaning that there are a large number of characteristics describing the key figures.
- For example, a 'by customer' level of granularity is less detailed than 'by customer, by material'.
- Granularity is the fundamental criteria that determines the extent to which you are able to drilldown on the data.
- Granularity also affects the size of the database. Data that is stored 'by customer, by month' is much more summarized than 'by customer, by material, by day'. The quantity of data that is generated over the course of a year for the first case is much less than for the second case.

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Aggregates ...

... are like InfoCubes,

... summarize ("aggregate") data of the originating InfoCube,

... contain redundant information, but

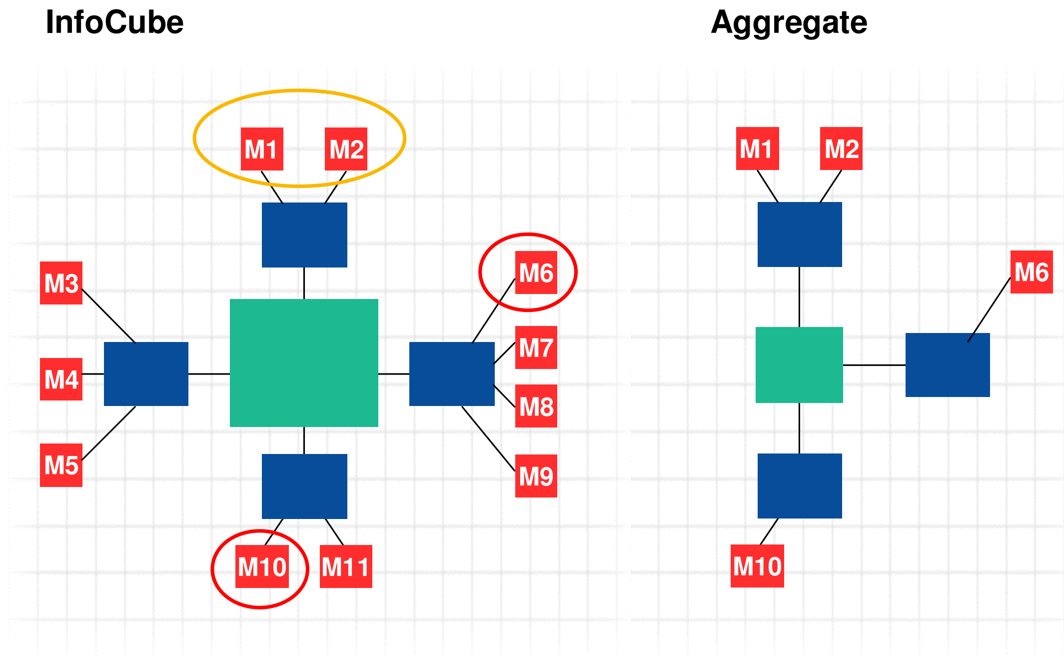
... accelerate the access to that information,

... are for InfoCubes what DB indexes are for DB tables,

... are performance-enhancing features.

- Like a query, an aggregate constitutes a subset of the star schema of the related InfoCube. However, it uses its own private fact table and possibly its own dimension tables.
- In this example, aggregates can discard certain levels of details, such as "day" and "city" or the sales organization and keep data on a summarized level.
- Obviously, an aggregate does not contain all the detailed information of the original InfoCube and as such cannot replace that InfoCube. However, a handful of well-defined aggregates can substantially improve the performance of the standard queries that users will be executing.
- Aggregate functions happen in the background. They are not visible to the end-user. The system automatically uses an aggregate for the InfoCube that the query is written against.
- If exception aggregation is used, reference characteristics are added automatically to every aggregate.
- If a time characteristic delivered by SAP is the reference characteristic, all time characteristics that can be derived from it are added automatically.

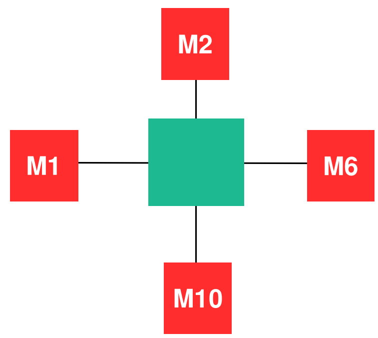
InfoCube / Aggregate Structure



- This example show the structure of an InfoCube and an Aggregate built on combination of characteristics M1, M2, M6 and M10.
- In the result the aggregate is built with a smaller multidimensional structure than the InfoCube.

Flat Aggregates

- If an aggregate has less then 15 components, each component is put into a separate dimension ("Flat Aggregates").
- The dimensions (except the package and unit) are marked as "Line Item" dimensions.



(Package and Unit Dimension not displayed)

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Aggregates – Properties

SAP

Aggregates Can Be Created:

- For Basic Cubes
- On dimension characteristics
- On navigational attributes
- On hierarchy levels
- On time-dependent navigational attributes
- On hierarchy levels where the structure is time-dependent

Aggregates Other Comments:

- Stored as a new, separate, transparent InfoCube which holds the aggregated data.
- Used to reduce the volume of data read while querying.
- Data for one query-step may be read out of several aggregates.

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- Aggregates cannot be created for MultiProviders, RemoteCubes or ODS-Objects.
- Technically speaking, an aggregate is a separate InfoCube with its own fact table and dimension tables. When an aggregate is created, it is given a 6-digit number <1NNNNN> that starts with a "1". The table name for an aggregate is derived in the same way from this number as InfoCube table names.
- For example, if an aggregate has the technical name 100001, its fact tables are called /BIC/E100001 and /BIC/F100001. Its dimensions have the table names /BIC/D100001P, /BIC/D100001T, and so on.
- Dimension tables can be shared between an InfoCube and an aggregate. In this example, dimension 2 (the country dimension) is shared between the InfoCube and the aggregate. It is not necessary to create a new dimension table. A link to this dimension table is created in the aggregate fact table.
- Dimensions are only shared if all characteristics of the InfoCube-dimension are also used in the aggregate. Otherwise, a new dimension table is created for the aggregate.
- There is no longer a link from the new aggregate to the dimension customer (dimension 1), since the aggregate does not contain any information about the customer.

Creating Aggregates with Time-Dependent Components

Aggregates with a time-dependent component (navigational attribute or hierarchy) are calculated for a keydate (corresponding to the keydate of a query).

The keydate can be determined by:

- A BEx variable which is filled via an SAP or User Exit.
- A fixed date.

This date is retrieved when the aggregate is filled.

Only for this keydate are the aggregate values calculated.

- The aggregate with a time-dependent component only contains data for a snapshot of the InfoCube/Master Data. This snapshot is determined by the keydate.

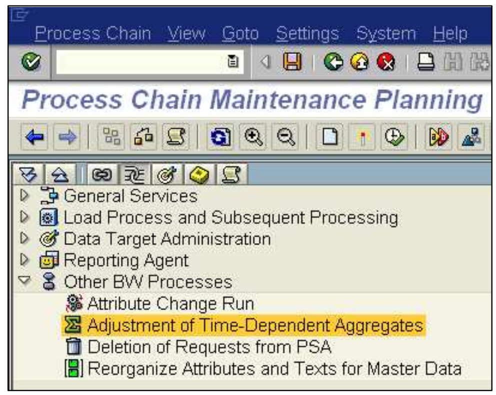
Using Time-dependent Aggregates in Queries

- If time-dependent components are used, queries can only use aggregates with the same keydate.
- Important for the use of aggregates is not the variable but the processed keydate because only data for this keydate is available in the aggregate.

- The variables used in aggregates can be the same variables used in queries for the keydate
- Example: A query uses time-dependent attributes and if the keydate is the variable "Current Date" (0DAT) then the aggregate with time-dependent attributes can also be defined with the variable "Current Date" (0DAT).

Adjustment of Time-dependent Aggregates

- **Since the keydates are subject to change, the time-dependent aggregates need to be updated regularly.**
- **Process *"Adjustment of Time-Dependent Aggregates"* adjusts data of all aggregates with variables for the keydate to the changes of the keydate.**
- **This process is available in the process chains.**
- **Only aggregates are recalculated for which the keydate changes.**
- **This adjustment can be an expensive process.**



- Working with Process Chains is discussed in the BW360 Administration class.
- Changes in the master data means changes of navigation attributes or hierarchies, too. It is therefore recommended that you adjust the data in the aggregates after you load the master data. So that reporting delivers consistent results, the master data and hierarchies are in two versions:
  - The active version, where you can see the query
  - A modified version, which at some point becomes the active version
- The change run (also called the hierarchy-attribute realignment run) adjusts the data in the aggregates and turns the modified version of the navigation attributes and hierarchies into an active version. In almost every phase of the change run, you can carry out reporting on old master data and hierarchies.
- If there are any changes to master data, they are not available for reporting until the change run is executed and finished.
- During a change run, no rollup at all is possible. Even aggregates that are not affected by the change run are locked.

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Aggregates – Example Using Master Data

Master Data Table: Country

Country	Valid from	Valid to	Sales Person
Austria	1/1/2000	3/31/2000	Huber
Austria	4/1/2001	12/31/2001	Meyer
Germany	1/1/2000	03/31/2000	Meyer
Germany	4/1/2000	12/31/2001	Huber
USA	1/1/2000	12/31/9999	Smith

Fact Table: Sales Data

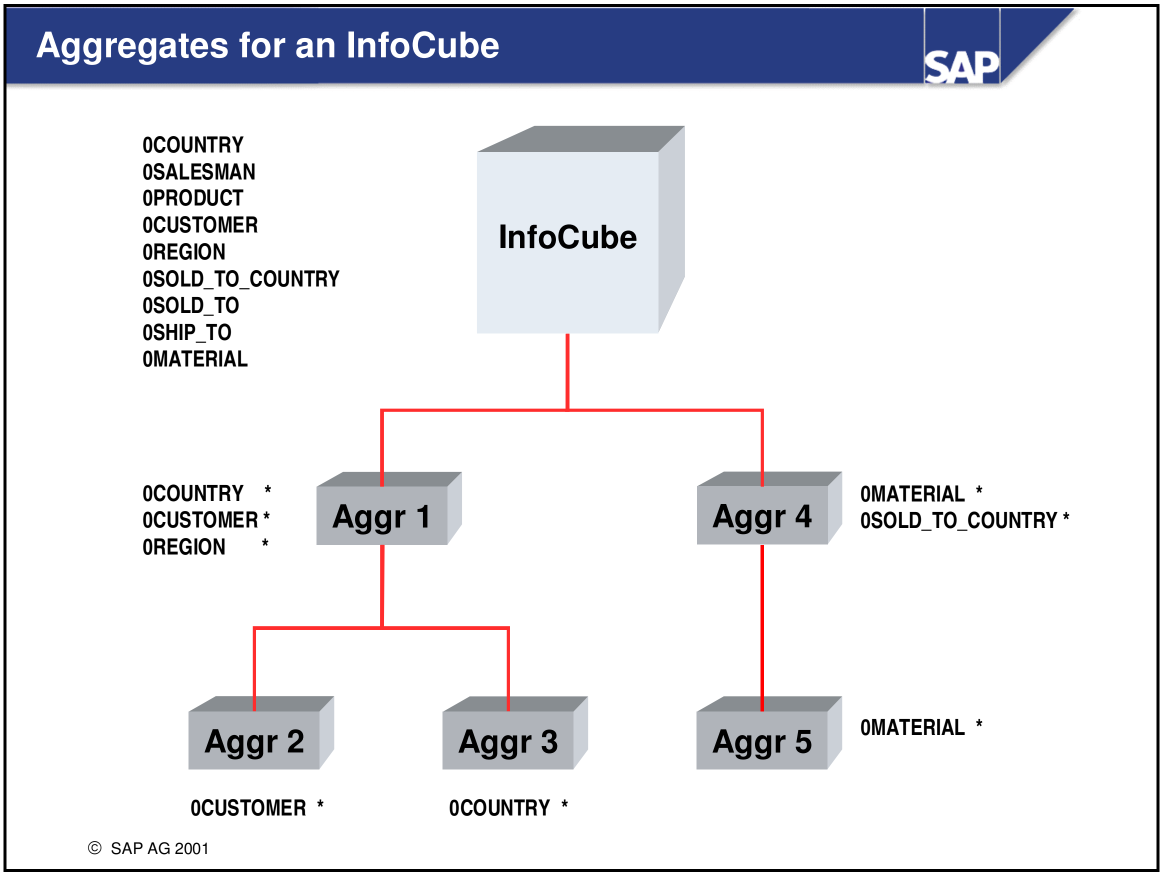
Country	Customer	Revenue
USA	Buggy Soft Inc.	10
Germany	Ocean Networks	15
USA	Funny Duds Inc.	5
Austria	Ocean Networks	10
Austria	Thor Industries	10
Germany	Funny Duds Inc.	20
USA	Buggy Soft Inc.	25

Aggregate Tables: Sales Data

Sales Person *(all)
Keydate 9/1/2001

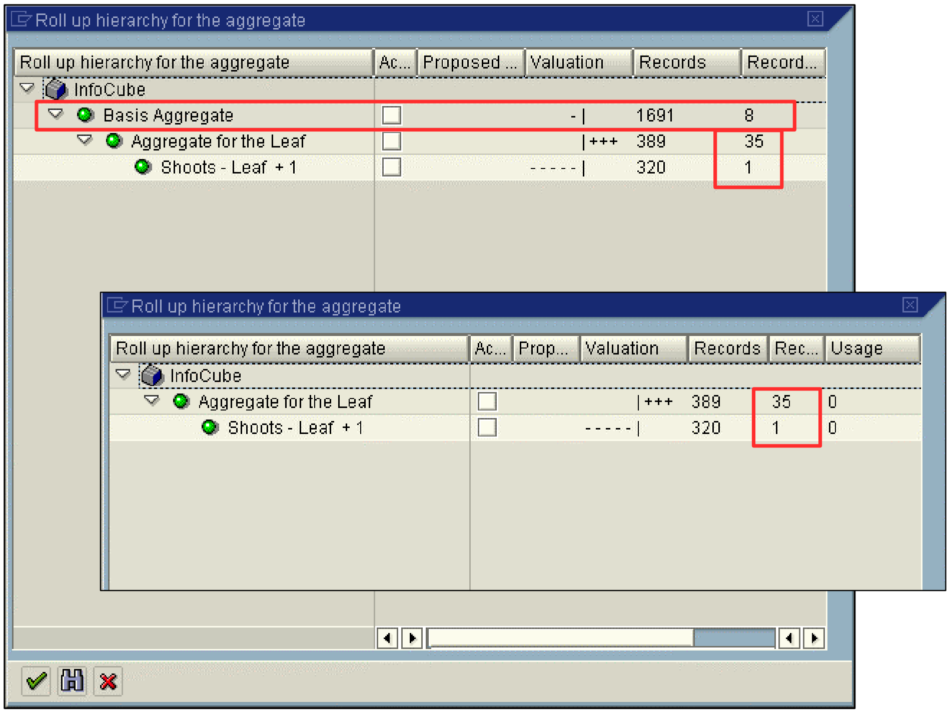
Sales Person	Revenue
Huber	35
Meyer	20
Smith	40

- Data for queries like "revenue of sales person 'Huber' for keydate 9/1/2001", can be read out of this aggregate.



- The graphic shows an existing set of aggregates for an InfoCube.
- A child aggregate can be built or rolled up from its parent aggregate.
- Example: aggregate 1 can be used to roll up aggregate 3, or to recreate aggregate 3 during a change run.

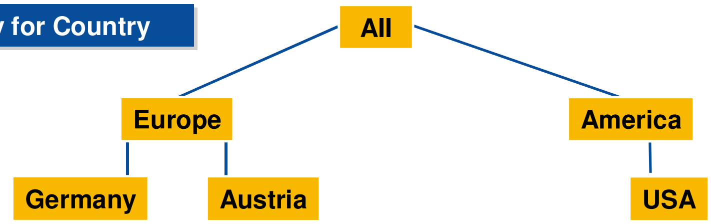
Rollup Hierarchy



- This screen displays the hierarchy of all existing aggregates created for InfoCube 0SD_C03.
- The aggregate *Basis Aggregate* was created last, but BW has dynamically mapped it as the parent to all child aggregates. From now on, the child *Aggregate for the Leaf* rolls up data from *Basis Aggregate* instead of from the InfoCube.
- Although a third aggregate was created which is in the hierarchy located on top of both aggregates, the value for summarized records is still the same. This value is always the value at the time when the aggregate was created or recreated.

Aggregates – Example using Hierarchies

Hierarchy for Country



Fact Table: Sales Data

Country	Customer	Sales
USA	Mega Soft Inc.	10
Germany	Ocean Networks	15
USA	Funny Duds Inc.	5
Austria	Ocean Networks	10
Austria	Thor Industries	10
Germany	Funny Duds Inc.	20
USA	Mega Soft Inc.	25

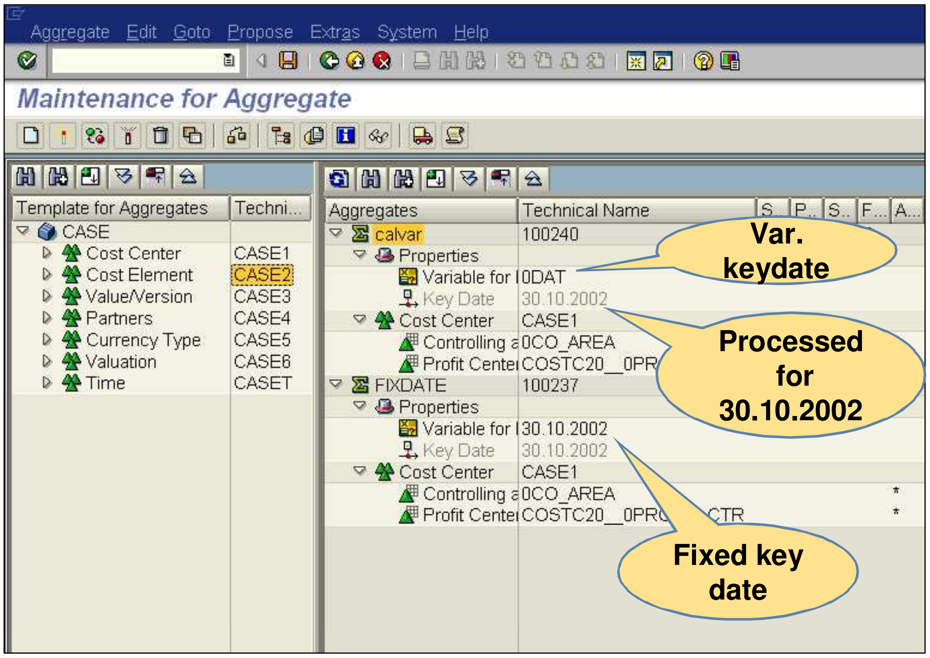
Aggregate Tables: Sales Data

Country H, Level 2

Country	Sales
America	40
Europe	55

- Queries like "sales for Europe", "sales for ALL", "overall sales", or "sales for all countries ordered by the country hierarchy up to level 1 or 2" may use the aggregate (country H Level 2).
- Aggregates with a hierarchy are useful for queries which use nodes of the hierarchy as a filter or which use the hierarchy as a presentation hierarchy. (Refer to SAP note 198568 for exceptions.)
- The level of the desired nodes must be less than or equal to the level in the aggregate.

Maintenance of Aggregates

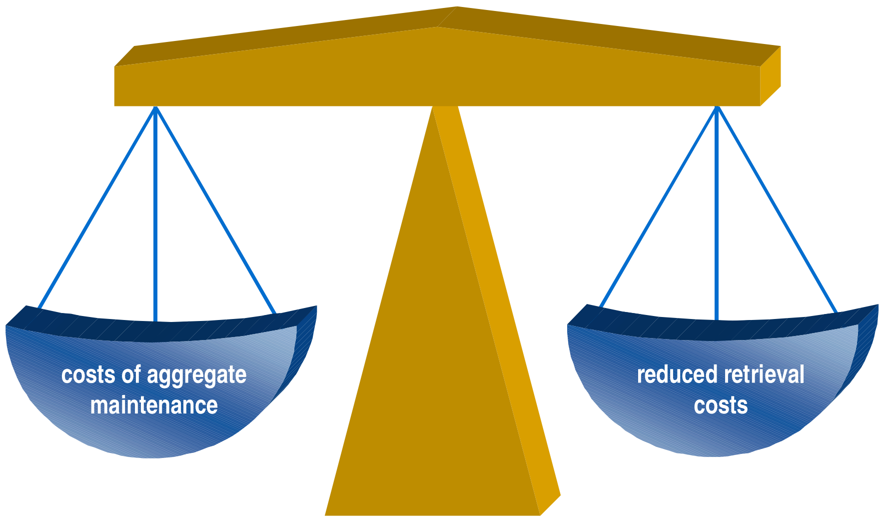


- Menu path: *Admin-Workbench* > *InfoProviders* > *right mouse click on InfoCube* > *Maintain aggregates*, or use transaction RSDDV.
- When adding the first time-dependent component (attribute or hierarchy) to an aggregate, the user is asked for a keydate.
- A fixed date (<Calendar>) or a variable can be chosen.
- The date/variable can be changed via the context menu.
- The field “Keydate” is filled only for filled aggregates.

Query Performance vs. Aggregate Maintenance

Tradeoff: improved query performance vs. aggregate maintenance

BW provides tools to find that tradeoff → BW Statistics



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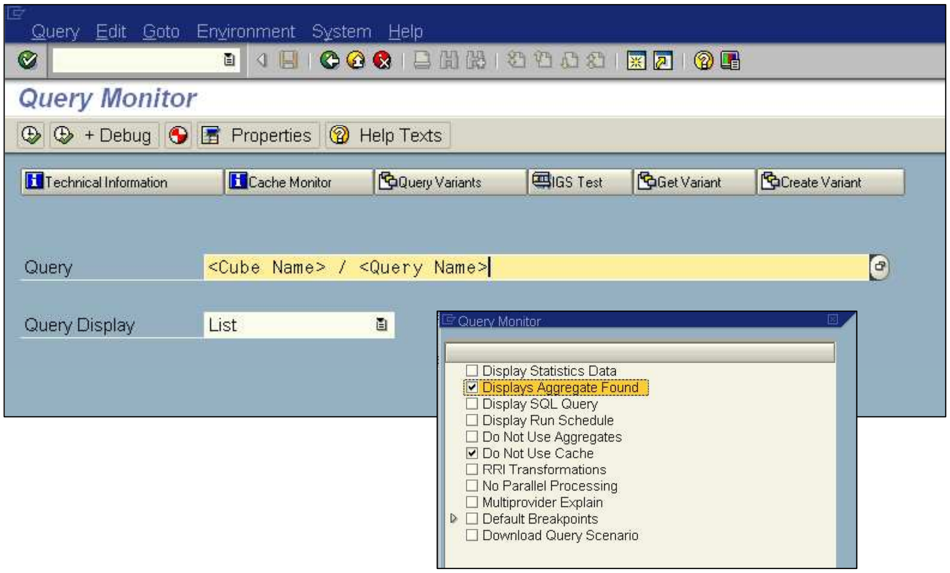
- Whenever data is loaded, the InfoCube's aggregates have to be updated as well in order to keep them in sync with the InfoCube.
- A significant overhead in updating aggregates is generated. When new data is loaded this results in an aggregate rollup needing to take place. Changes to master data and hierarchies require that all dependent aggregates be recalculated by calculating the differences/delta or by rebuilding.
- Factors involved:

  1. Frequency of changes that will cause recalculation
  2. Availability of time to run the recalculation: no rollup, no master data updates, no hierarchy updates can take place during re-calculation.
- Also, changed aggregate data is not available via query until recalculation is complete. Reporting on the old master data and hierarchies is possible.
- BW provides tools to determine aggregates required for improving your specific queries, and analyzing existing queries in order to identify those aggregates that are rarely used or not used at all.

Query Analysis (1)

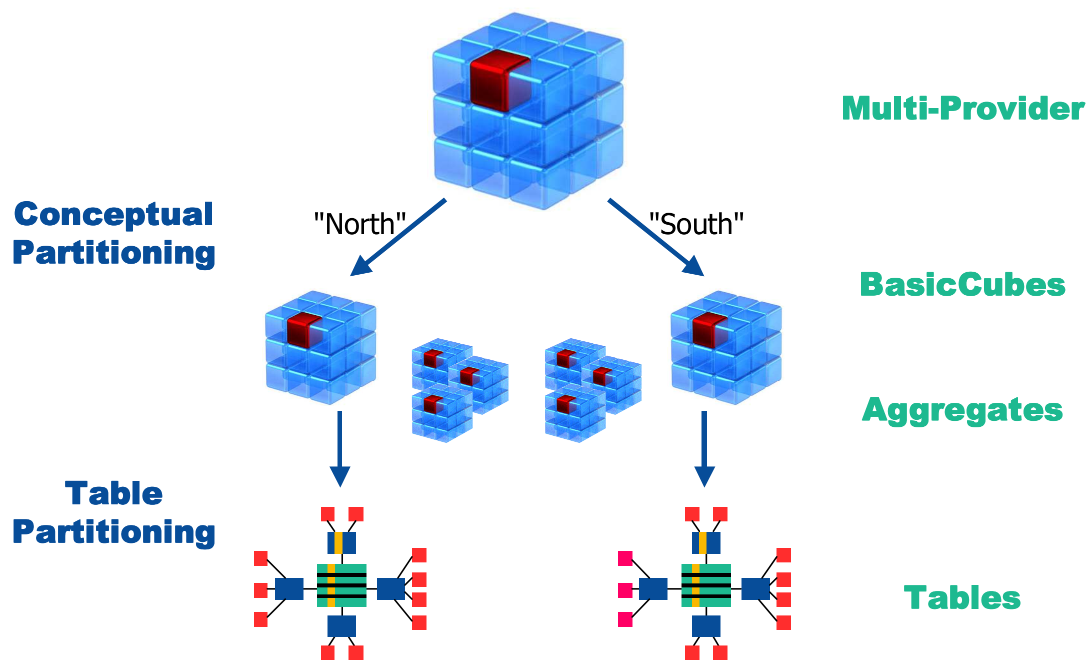
Query Analyzing Tool:

Query monitor – Transaction RSRT



- Tools for analyzing queries: Query monitor (Transaction RSRT > execute & debug)
- With this monitor you can analyze the first selection of the query. There is no possibility of analyzing the navigational steps. You can use the transaction RSRTRACE for that.

Partitioning



- This is a simple example of how a reporting scenario can be partitioned using both partitioning concepts.
- Multi-Provider Partitioning: You might want to report your sales data using one InfoCube. That InfoCube could be built as a MultiProvider which is based on two identical basic InfoCubes. The latter contain disjoint sets of data, for example, one from southern sales regions and another from northern regions (as shown here on this slide). This scenario results in more efficient dense InfoCubes as opposed to combining the southern and northern region into one sparse InfoCube.
- Table Partitioning: Each of the two basic InfoCubes could be partitioned on the database level. That means that the fact tables inside the respective star schema (which physically represents an infocube) are partitioned. This is indicated by those horizontal lines splitting the fact tables into various partitions/fragments.

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Other Ways to Manage Performance

Compression

Secondary Indexes

Load master data before transaction data

Run selective queries

Set queries to ‘read on demand’

Line item dimensions

- Compressing the ‘F’ into the ‘E’ table packs records from multiple request IDs and results in more efficient storage and retrieval of data. This database function should be carried out when the request ID is not needed for data deletions.
- Secondary indexes are based on database statistics and result in more efficient read performance.
- Master data is normally loaded first so that the more time consuming transaction data load is slowed by having to create SID IDs.
- Running queries that are appropriately filtered is essential. In addition, reporting strategy should be to read summarized data first and detail second.
- The recommended default RSRT setting is ‘read on demand’.
- Line Item dimensions are appropriate for InfoCubes with line item detail such as order number.

Performance Aspects: Unit Summary

Now you will be able to:

- Explain what aggregates are and how they are used in BW
- Create suitable aggregates using the tools provided by BW
- Roll-up InfoCubes
- Discuss other ways to improve performance

Exercises

Unit: Performance Aspects

Topic: Aggregates

At the conclusion of this exercise, you will be able to:

- Create an aggregate based on time dependent attributes
- Maintain aggregates

Your company has decided to use aggregates to speed up reporting performance. First of all, you need to consider some of mechanics related to aggregates, especially ones based on time dependent attributes.

1-1 Create an Aggregate based on your knowledge of reporting demands.

1-1-1 Aggregate Maintenance

On the popup: ‘Proposals for aggregates’ choose to create aggregates “By Yourself”.

1-1-2 Define an aggregate for your InfoCube ‘T_330GR##’.
Expand the characteristics and dimensions on the left hand side of the screen by selecting your InfoCube name at the top and then the ‘Expand all’ button.

Select: ‘**GR00 Cost Center 13**’ and “Drag & Drop” it to the right hand side of the screen. A pop up will appear asking you to provide a name for the aggregate you are defining.

For the descriptions enter:

Field Name or Data Type	Values
Short Description	*Cost Yr Agg ##*
Long Description	*Cost Ctr Year Aggregate ##*

Then Drag & Drop: ‘**Fiscal Year**’ to your new aggregate. You will notice that compounded InfoObjects such as Controlling Area and Fiscal Year Variant move into the aggregates automatically.

Repeat the same procedure again for another aggregate however just for InfoObject ‘GR00 Cost Center 13’.

For the descriptions enter:

Field Name or Data Type	Values
Short Description	*Cost Agg ##*
Long Description	*Cost Aggregate ##*

1-1-3 Activate and fill your aggregate.

Highlight multiple aggregates that are to be activated and filled. (Use the Ctrl key.)

After all of the aggregates are selected, click on the ‘Activate and Fill’ (candle icon from the icon selections at the top of the screen).

Once the activation process is complete, a pop-up will appear asking whether you want to fill the aggregates. Confirm that you do by pressing the green checkmark and the ‘Now’ button and the system will proceed with filling the aggregate fact table.

Use the refresh icon until both jobs disappear then close the pop-up using the blue X. The activate and fill status lights should both be green.

Note: If you receive an “R3TR Message” > ignore it.

1-1-4 Information about the number of rows contained in the aggregate and the number of summarized records will appear. Make note of your summarization ratios.

1-1-5 Remain in the ‘Maintenance for Aggregates’ screen.

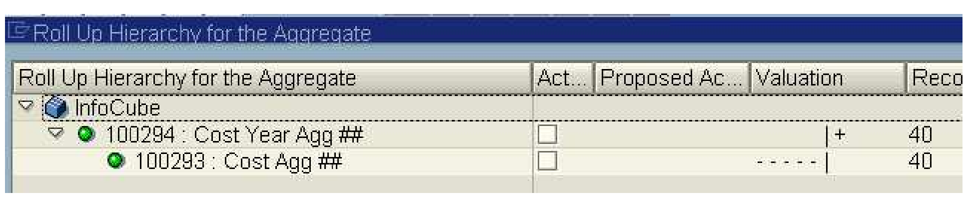
1-2 Use the aggregate hierarchy analysis tool.

1-2-1 View the aggregates being used by other aggregates

In the ‘Maintenance for Aggregates’ screen, view the aggregate hierarchy for your InfoCube.

Click on the ‘Roll-Up hierarchy’ icon from the row of icons at the top of the aggregate maintenance screen.

Drill down to see the aggregates and their relationship to one another. You can see that aggregate ‘*Cost Agg ##*’ can be loaded from aggregate ‘*Cost Yr Agg ##*’.



NOTE: *If you extract new data into the InfoCube you have to roll up this new data in the aggregate as well. Otherwise the new data is not available for reporting!*

1-3 Define a query in which you use aggregate Cost Agg ##.

1-3-1 Create a query

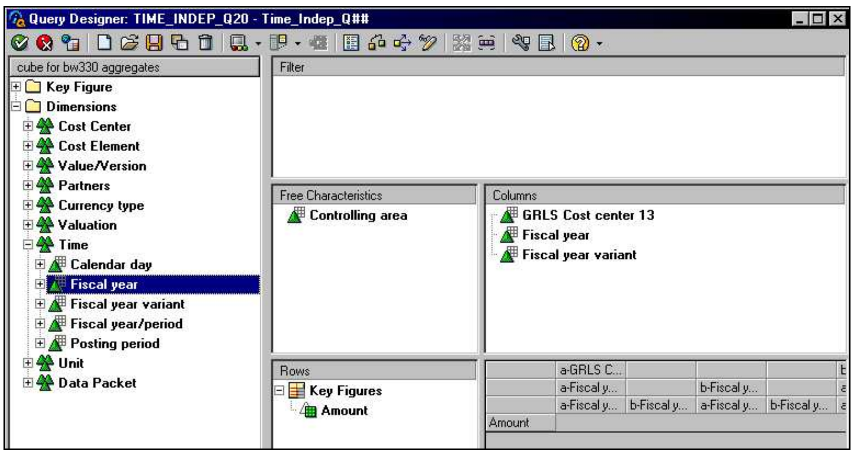
You can display the technical names of the InfoCubes by clicking on the wrench icon on top of the screen.

1-3-2 Choose Characteristics and Key Figures

Drag & Drop: 'GR00 Cost Center 13', 'Fiscal Year' into the columns, 'Controlling Area' in free characteristics and 'Amount' in rows. You can find: 'Amount' below the folder: 'Key figure'.

Confirm your selection. Once you have defined your query, you can save it to your favorites as:

Field Name or Data Type	**Values**
Description	*Time Independ Query ##*
Technical Name	*Time_Indep_Q##*



Analyze the result in the workbook by choosing: 'Quit and Use Query' (the green checkmark on the upper left).

Note: Use the pencil icon in global mode to change your query definition if necessary.

1-3-3 Check the use of your aggregates using the Query Monitor.

Return to the BW Server and open up another session for transaction: 'RSRT'. Once in the 'Query Monitor' use the "F4 help" to search for your Query 'Time_Indep_Q##'.

What aggregate is being used by the query? (answer will vary)

Compare Requested/Found Aggregates

D...	Aggregate/	InfoObject	InfoObject	S:...	S: Hierarchy	...	S: ...	S: Fixed Value
1	100294	0CO_AREA	Controlling area		0			
		0FISCVARNT	Fiscal year va...	*	0			0
		0FISCYEAR	Fiscal year	*	0			0
		COSTCLS	GRLS Cost c...	*	0			0
		COSTCLS__0P...	Profit Center		0			

Use the yellow arrow up icon to exit the RSRT ‘output test’ screen.

Then from the Administrator Workbench go into the: ‘Maintenance for Aggregate’ screen for the InfoCube: ‘T_330GR##’ and check to see if any aggregates have been called up under: ‘Usage’.

Refresh the screen if necessary.

1-4 Use a time dependent navigational attribute

1-4-1 Confirm that InfoObject ‘GR00 Cost center 13’ (technical name T_COSTC330) is time dependent and attribute ‘Business Area’ is navigational.

Is 0PROFIT_CTR time dependent and navigational?

____

1-4-2 Confirm that the navigational attribute is used in the InfoCube.

1-4-3 Create an aggregate based on a time dependent navigational attribute with a variable using an <u>‘exit’ replacement path</u>.

Drag the time dependent navigational attribute ‘Business Area’ into the aggregate work area. Name the aggregate:

Field Name or Data Type	Values
Short Description	*Exit Agg ##*
Long Description	*Exit Aggregate ##*

The system will prompt you for a variable, select the ‘**Current Calendar Day**’ **(0DAT)** variable > Transfer Selections. Open up the aggregate properties node and note the time variable. Remain in the Maintenance for Aggregates screen.

1-4-4 Create an aggregate with a time dependent navigational attribute based on a fixed date.

Drag the time dependent navigational attribute 'Business Area' into the aggregate work area.

Name the aggregate:

Field Name or Data Type	Values
Short Description	*Fixed Date Agg ##*
Long Description	*Fixed Date Aggregate ##*

The system will prompt for a variable (or date), page down and select the 'Calendar' → Transfer Selections → enter current date.

Open up the aggregate properties node and note the fixed date.

Activate and fill your new aggregates.

Highlight the two new aggregates that are to be activated and filled. (Use the Ctrl key.)

After all of the aggregates are selected, click on the 'Activate and Fill' (candle icon from the icon selections at the top of the screen).

Once the activation process is complete, a pop-up will appear asking whether you want to fill the aggregates. Confirm that you do by pressing the green checkmark and the 'Now' button and the system will proceed with filling the aggregate fact table.

Use the refresh icon until both jobs disappear then close the pop-up using the blue X.

The activate and fill status lights should both be green.

1-4-5 Create a query with the navigational attribute 'Business Area' in the rows and 'Amount' in the columns.

Create your query as noted above and save to your folder:

Field Name or Data Type	Values
Long Description	*Time Dependent Query ##*
Technical Name	*Time_Dep_Q##*

1-4-6 Run transaction code RSRT to see which aggregate is being used.

1-4-7 Switch the Fixed Date aggregate to inactive and re-run RSRT. Note that the 'Exit Agg ##' aggregate is being used!

Switch the Fixed Date aggregate to inactive

Goto RSRT and run the Execute and Debug on the Time_Dep_Q## to confirm the use of the 'Exit Agg ##' Aggregate.

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Unit: Performance Aspects

Topic: Aggregates

1-1 Create an Aggregate based on your knowledge of reporting demands.

1-1-1 Aggregate Maintenance

BW Administration → Administrator Workbench → InfoProviders

Search for your INFOCUBE 'T_330GR##' using the binoculars → Right Mouse Click on T_330GR## → Maintain Aggregates.

Search off the top node if necessary.

On the popup: 'Proposals for aggregates' choose to create aggregates "By Yourself".

1-1-2 Define an aggregate for your InfoCube 'T_330GR##'.
Expand the characteristics and dimensions on the left hand side of the screen by selecting your InfoCube name at the top and then the 'Expand all' button.

Select: '**GR00 Cost Center 13**' and "Drag & Drop" it to the right hand side of the screen. A pop up will appear asking you to provide a name for the aggregate you are defining.

For the descriptions enter:

Field Name or Data Type	Values
Short Description	*Cost Yr Agg ##*
Long Description	*Cost Ctr Year Aggregate ##*

Then Drag & Drop: '**Fiscal Year**' to your new aggregate. You will notice that compounded InfoObjects such as Controlling Area and Fiscal Year Variant move into the aggregates automatically.

Repeat the same procedure again for another aggregate however just for InfoObject 'GR00 Cost Center 13'.

Drag & Drop 'GR00 Cost Center 13'' not again to 'Cost Yr Agg ##' but to the free space below 'Aggregates' on the right hand side of the screen).

For the descriptions enter:

Field Name or Data Type	Values
Short Description	*Cost Agg ##*
Long Description	*Cost Aggregate ##*

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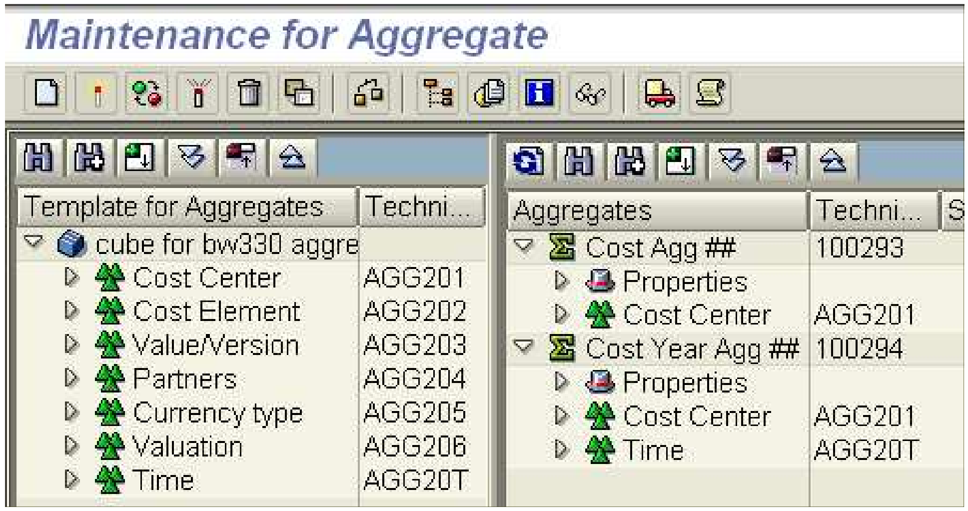

1-1-3 Activate and fill your aggregate.

Highlight multiple aggregates that are to be activated and filled. (Use the Ctrl key.)

After all of the aggregates are selected, click on the 'Activate and Fill' (candle icon from the icon selections at the top of the screen).

Once the activation process is complete, a pop-up will appear asking whether you want to fill the aggregates. Confirm that you do by pressing the green checkmark and the 'Now' button and the system will proceed with filling the aggregate fact table.

Use the refresh icon until both jobs disappear then close the pop-up using the blue X. The activate and fill status lights should both be green.

Note: If you receive an "R3TR Message" > ignore it.

1-1-4 Information about the number of rows contained in the aggregate and the number of summarized records will appear. Make note of your summarization ratios.

1-1-5 Remain in the 'Maintenance for Aggregates' screen.

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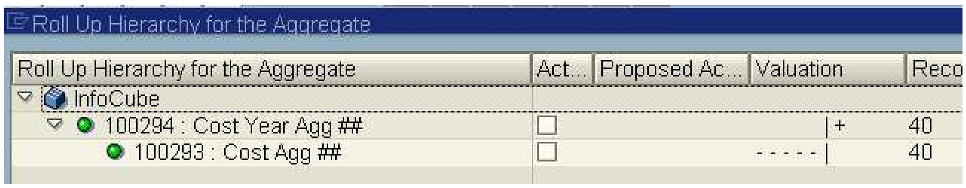
1-2 Use the aggregate hierarchy analysis tool.

1-2-1 View the aggregates being used by other aggregates

In the 'Maintenance for Aggregates' screen, view the aggregate hierarchy for your InfoCube.

Click on the 'Roll-Up hierarchy' icon from the row of icons at the top of the aggregate maintenance screen.

Drill down to see the aggregates and their relationship to one another. You can see that aggregate '*Cost Agg ##*' can be loaded from aggregate '*Cost Yr Agg ##*'.



NOTE: *If you extract new data into the InfoCube you have to roll up this new data in the aggregate as well. Otherwise the new data is not available for reporting!*

1-3 Define a query in which you use aggregate Cost Agg ##.

1-3-1 Create a query

From the ***SAP Easy Access Screen → Business Explorer → Analyzer → choose the 'folder' icon in the little menu bar → Queries → New → InfoAreas →***

Search for your InfoCube T_330GR## by using Description/Technical Name box at the bottom of the pop-up.

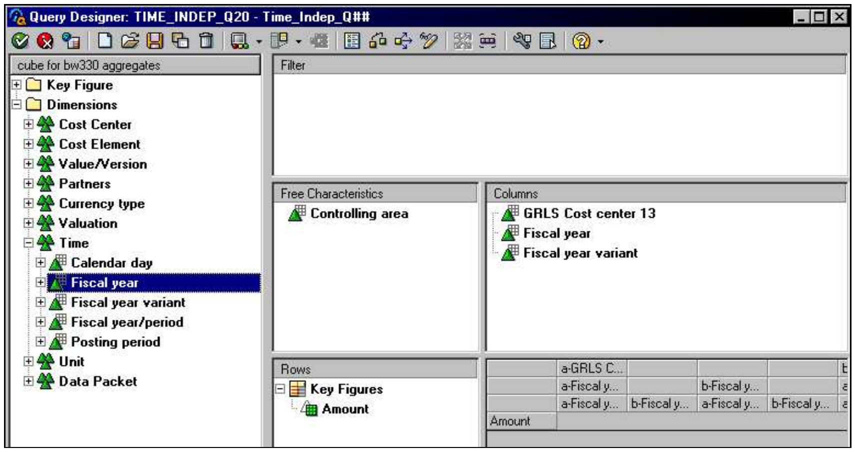
You can display the technical names of the InfoCubes by clicking on the wrench icon on top of the screen.

1-3-2 Choose Characteristics and Key Figures

Drag & Drop: 'GR00 Cost Center 13' and 'Fiscal Year' into the columns, 'Controlling Area' in free characteristics and 'Amount' in rows. You can find: 'Amount' below the folder: 'Key figure'.

Confirm your selection. Once you have defined your query, you can save it to your favorites as:

Field Name or Data Type	**Values**
Description	*Time Independ Query ##*
Technical Name	*Time_Indep_Q##*



Analyze the result in the workbook by choosing: ‘Quit and Use Query’ (the green checkmark on the upper left).

Note: Use the pencil icon in global mode to change your query definition if necessary.

1-3-3 Check the use of your aggregates using the Query Monitor.

Return to the BW Server and open up another session for transaction: ‘RSRT’. Once in the ‘Query Monitor’ use the “F4 help” to search for your Query ‘Time_Indep_Q##’.

Once found → click on it → Execute & debug → Check ‘display aggregates found’ → Continue.

What aggregate is being used by the query? (answer will vary)

Compare Requested/Found Aggregates

D...	Aggregate/	InfoObject	InfoObject	S:...	S: Hierarchy	...	S: ...	S: Fixed Value
1	100294	0CO_AREA	Controlling area		0			
		0FISCVARNT	Fiscal year va...	*	0			0
		0FISCYEAR	Fiscal year	*	0			0
		COSTCLS	GRLS Cost c...	*	0			0
		COSTCLS__0P...	Profit Center		0			

Use the yellow arrow up icon to exit the RSRT ‘output test’ screen.

Then from the Administrator Workbench go into the: ‘Maintenance for Aggregate’ screen for the InfoCube: ‘T_330GR##’ and check to see if any aggregates have been called up under: ‘Usage’.

Refresh the screen if necessary.

1-4 Use a time dependent navigational attribute

1-4-1 Confirm that InfoObject ‘GR00 Cost center 13’ (technical name T_COSTC330) is time dependent and attribute ‘Business Area’ is navigational.

Modeling → Administrator Workbench: Modeling → InfoObjects → Right Mouse Click on the InfoObject ‘T_COSTC330’ → Change → Go to Attributes Tab → Press the ‘Detail Navigation Attributes’ Button (if necessary).

Is 0PROFIT_CTR time dependent and navigational?

Yes!

1-4-2 Confirm that the navigational attribute is used in the InfoCube.

Modeling → Administrator Workbench: Modeling → InfoProviders → Right Mouse Click on InfoCube ‘T_330GR##’ → Change → Press the ‘Nav. Attributes’ Button → Confirm that the Navigational Attribute is Checked for ‘Business Area’. (If not → check the box → activate)

1-4-3 Create an aggregate based on a time dependent navigational attribute with a variable using an ‘exit’ replacement path.

Modeling → Administrator Workbench: Modeling → InfoProviders → Right Mouse Click on InfoCube T_330GR## → Maintain Aggregates.

Drag the time dependent navigational attribute ‘Business Area’ into the aggregate work area. Name the aggregate:

Field Name or Data Type	Values
Short Description	*Exit Agg ##*
Long Description	*Exit Aggregate ##*

The system will prompt you for a variable, select the ‘**Current Calendar Day**’ **(0DAT)** variable → Transfer Selections. Open up the aggregate properties node and note the time variable. Remain in the Maintenance for Aggregates screen.

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1-4-4 Create an aggregate with a time dependent navigational attribute based on a fixed date.

Drag the time dependent navigational attribute 'Business Area' into the aggregate work area.

Name the aggregate:

Field Name or Data Type	Values
Short Description	*Fixed Date Agg ##*
Long Description	*Fixed Date Aggregate ##*

The system will prompt for a variable (or date), page down and select the 'Calendar' → Transfer Selections → enter current date.

Open up the aggregate properties node and note the fixed date.

Activate and fill your new aggregates.

Highlight the two new aggregates that are to be activated and filled. (Use the Ctrl key.)

After all of the aggregates are selected, click on the 'Activate and Fill' (candle icon from the icon selections at the top of the screen).

Once the activation process is complete, a pop-up will appear asking whether you want to fill the aggregates. Confirm that you do by pressing the green checkmark and the 'Now' button and the system will proceed with filling the aggregate fact table.

Use the refresh icon until both jobs disappear then close the pop-up using the blue X.

The activate and fill status lights should both be green.

1-4-5 Create a query with the navigational attribute 'Business Area' in the rows and 'Amount' in the columns.

From the SAP Easy Access Screen → Business Explorer → Analyzer

Open → Queries → New → Select your InfoCube from the History → Ok.

Create your query as noted above and save to your folder:

Field Name or Data Type	Values
Long Description	*Time Dependent Query ##*
Technical Name	*Time_Dep_Q##*

1-4-6 Run transaction code RSRT to see which aggregate is being used.

In RSRT → Select your query Time_Dep_Q## using the F4 key → Execute + Debug → Select 'Display Aggregates Found' → Continue →

Note that the Fixed Date aggregate is being used.

1-4-7 Switch the Fixed Date aggregate to inactive and re-run RSRT. Note that the 'Exit Agg ##' aggregate is being used!

Modeling → Administrator Workbench: Modeling → InfoProviders → Right Mouse Click → Maintain Aggregates.

Switch the Fixed Date aggregate to inactive

Goto RSRT and run the Execute and Debug on the Time_Dep_Q## to confirm the use of the 'Exit Agg ##' Aggregate.

Changing an Existing Data Model

Contents

- Changing an InfoCube
- Changing Master Data

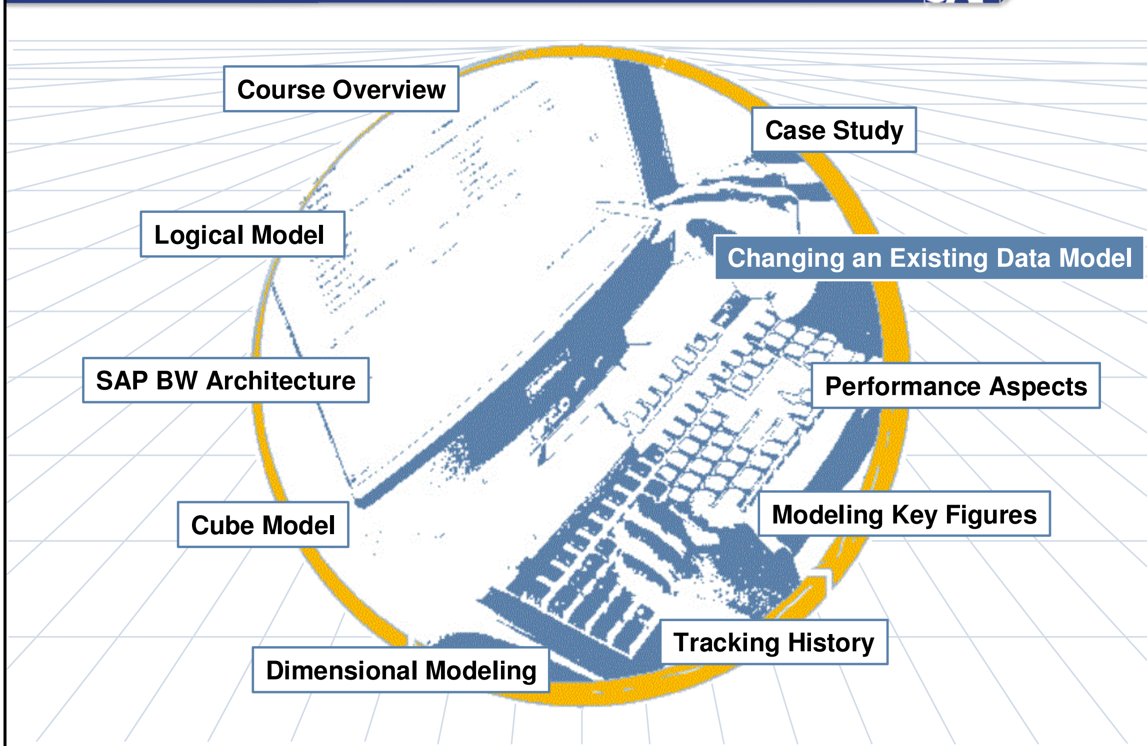
- The BW Data Model is designed to meet reporting requirements of a summarized nature.
- In order to maximize performance and meet the complex reporting needs of your business, you need to evaluate all InfoCube modeling options.

Changing an Existing Data Model: Unit Objectives

At the conclusion of this unit, you will be able to:

- Identify the options if an attribute needs to be added
- Discuss the options to add a characteristic to a Dimension Table
- Discuss the options to add a key figure to an InfoCube

Changing an Existing Data Model: Overview Diagram



Changing an Existing Data Model: Business Scenario

- **After the first period of working with the existing data model, new reporting requirements are discovered.**
- **You are asked to assess the impact of changes on existing data and queries.**

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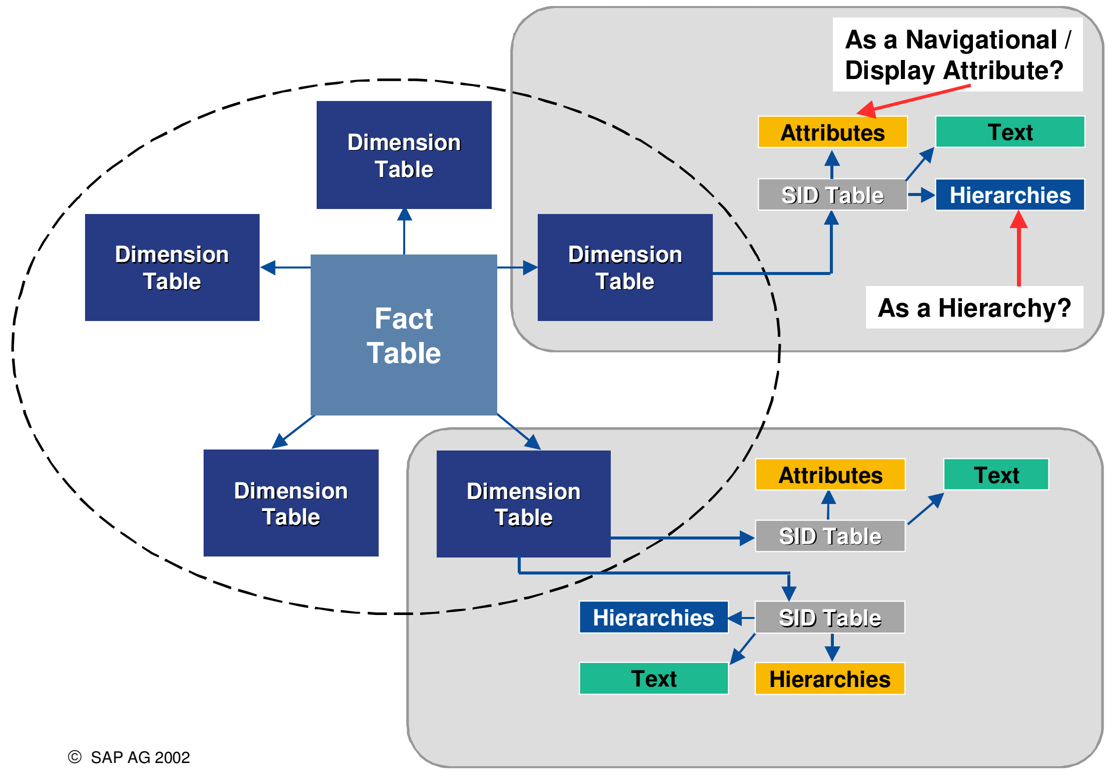
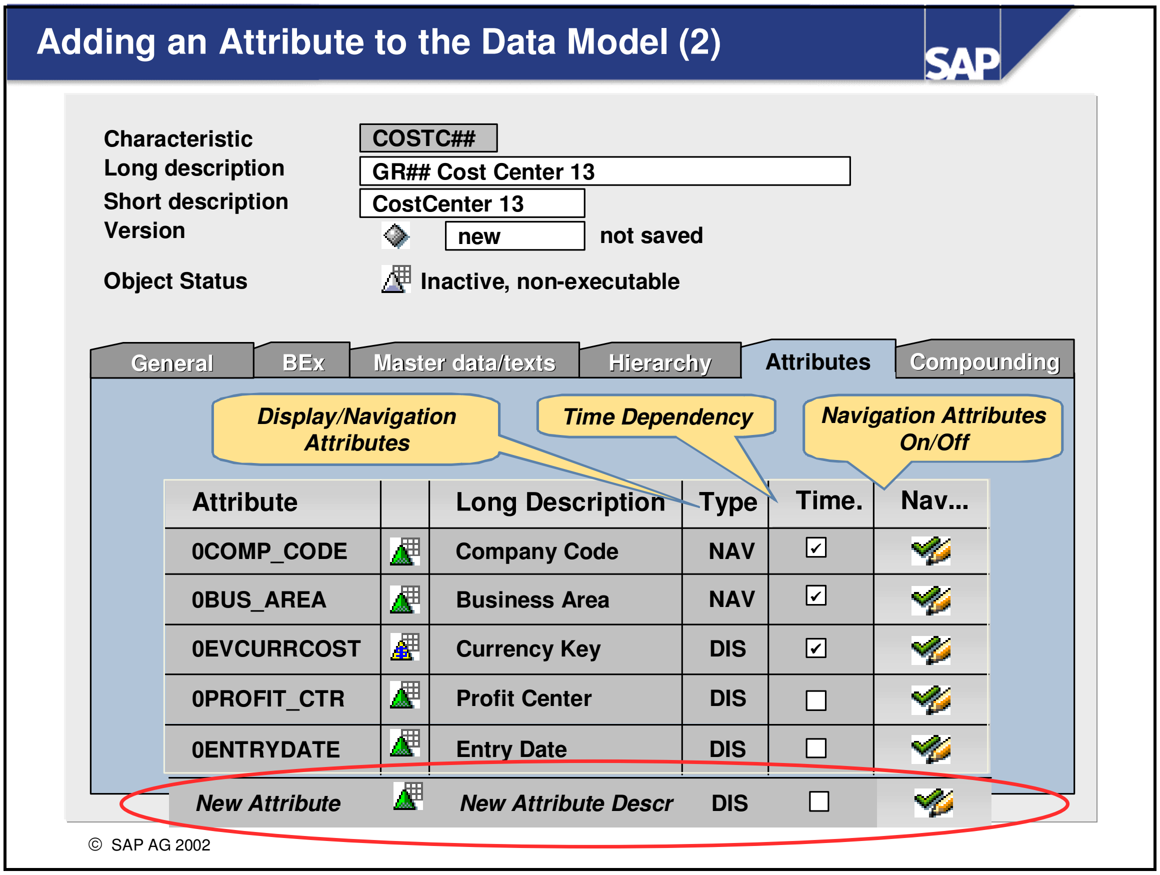
Adding an Attribute to the Data Model (1)

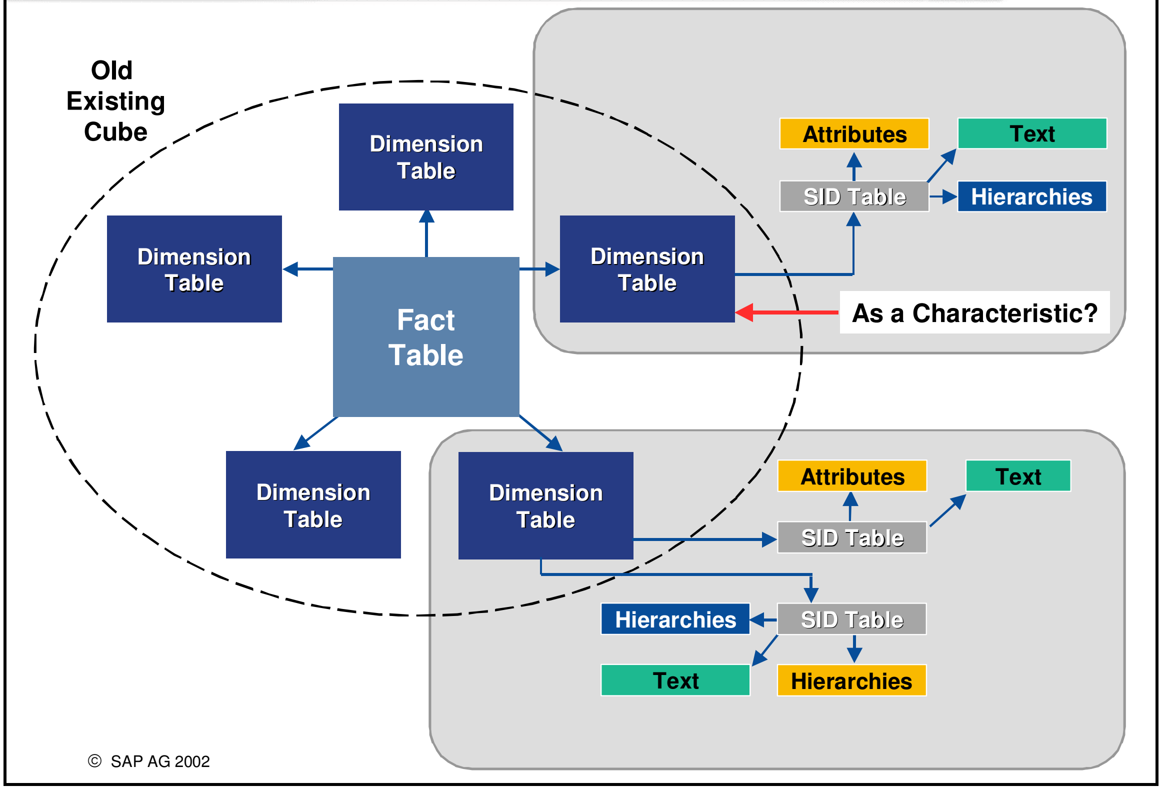


- The dependent attributes of the characteristics (e.g. material group as a dependent attribute of the characteristic material) can reside in different locations of a BW Schema Dimension.
- For example, if it was determined that the Material–Material Group relationship was not initially designed into the Data Model based on an investigation of reporting requirements. However, reporting requirements have subsequently changed.
- What are the options for inserting the Material--Material Group relationship? If Material Group is not always needed as a drill-down requirement in reporting, then the options are:
  - Model it as an attribute (a member of the Material Master Data Table),
  - Or as a node of the Material Hierarchy Table,
  - Or as both of the above options.
- If the attribute is to be added to the Master Data Table, then two options present themselves:
  - Model Material Group, for example, as a display attribute of Material, if drill-down on Material Group in reporting is never needed,
  - Or model Material Group as a navigational attribute of Material, if occasional drill-down on Material Group in reporting is needed.
  - Time dependency can be added to either of the above options.



- To accomplish adding the additional Attribute:
  - Change the Master Data Table of the InfoObject to include the new Attribute
  - Active the InfoObject
  - Modify and activate the Communication Structure of the InfoSource containing the InfoObject
  - Modify and activate the Transfer Rules.
  - Modify and activate the Update Rules, if a flexible InfoSource is utilized.
  - Reload the master data from the appropriate Source System.
- If the Attribute has already been loaded and needs to be changed from Display to Navigational, proceed as follows:
  - Enter into Change mode for the InfoObject
  - Change the Attribute from Display to Navigational
  - Add description of the Attribute as a Navigational Attribute to distinguish it from the Attribute's display role in reporting
  - Activate the InfoObject
  - Access the InfoCube where the Attribute is to be used as Navigational
  - Switch on the Navigational Attribute and Activate the InfoCube.

Adding a Characteristic to the Data Model (1)



- The dependent attributes of the characteristics (e.g. material group as a dependent attribute of the characteristic material) can reside in different locations of a SAP BW Schema Dimension.
- For example, it may be determined that the Material–Material Group relationship was not initially designed into the Data Model based on an investigation of reporting requirements. However, reporting requirements have subsequently changed.
- What are the options for inserting the Material--Material Group relationship? One option is to determine if Material Group is always needed as a drill-down requirement in reporting. Then the options are:
  - Model it as a Navigational Attribute
  - Or model it as a Characteristic in the Dimension Table of the Data Model.
- To add the Attribute as a Navigational Attribute after the Attribute values have been loaded into the Master Data Table, then proceed as outlined in the previous slide.

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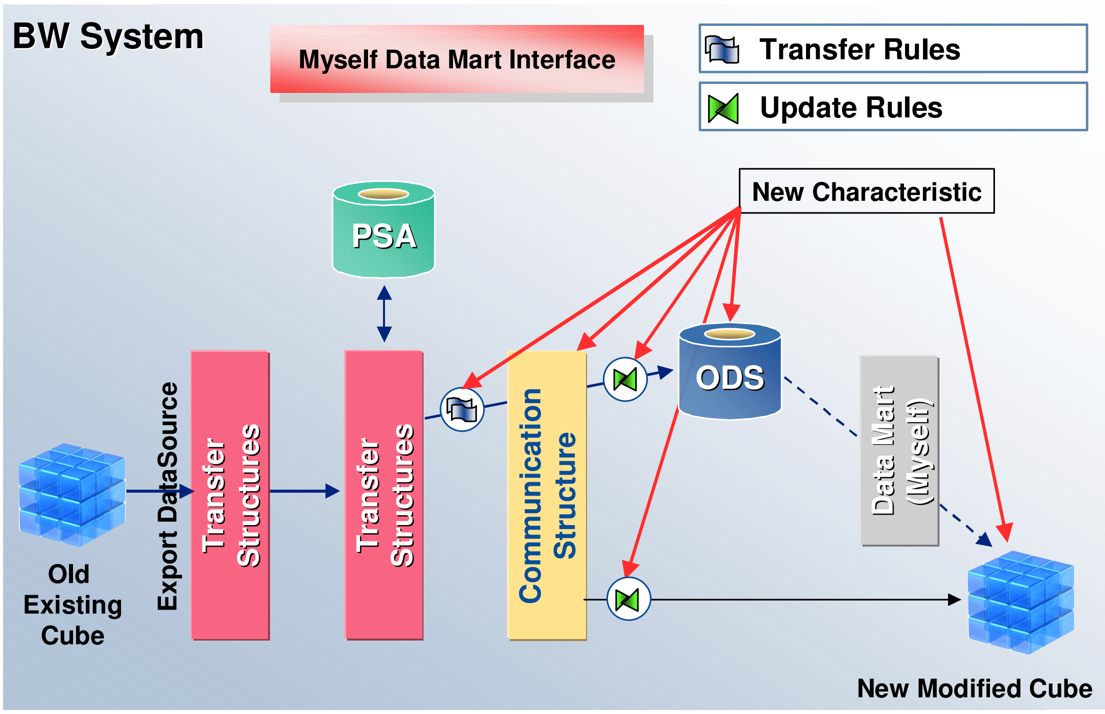
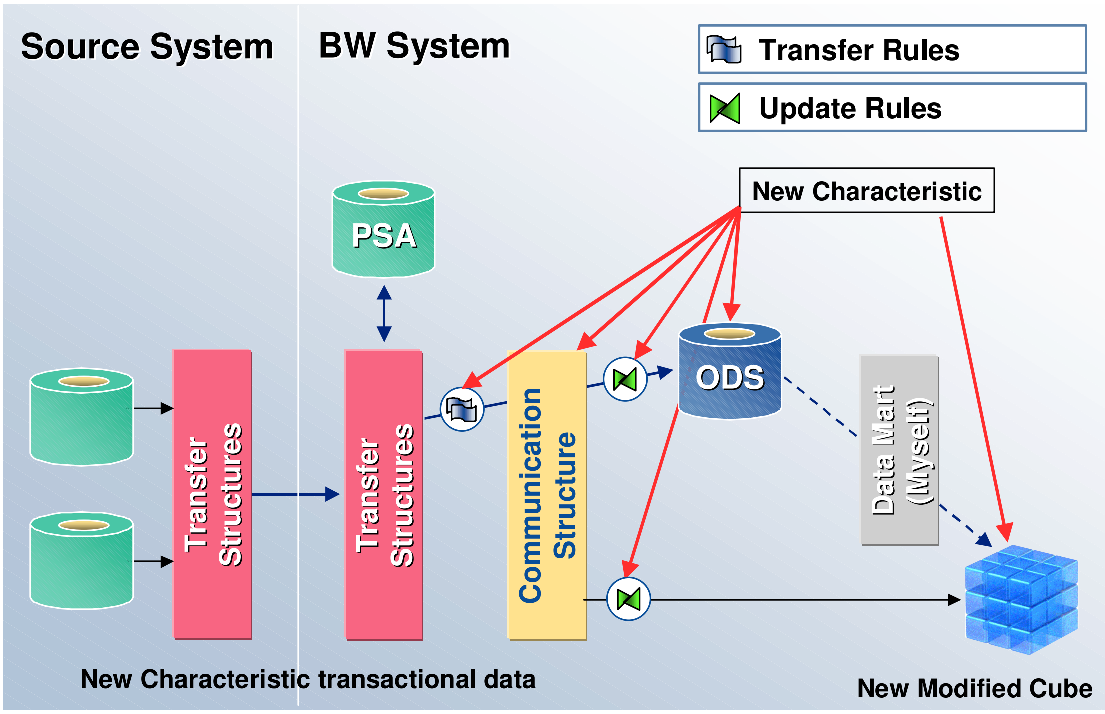
Adding a Characteristic to the Data Model (2)



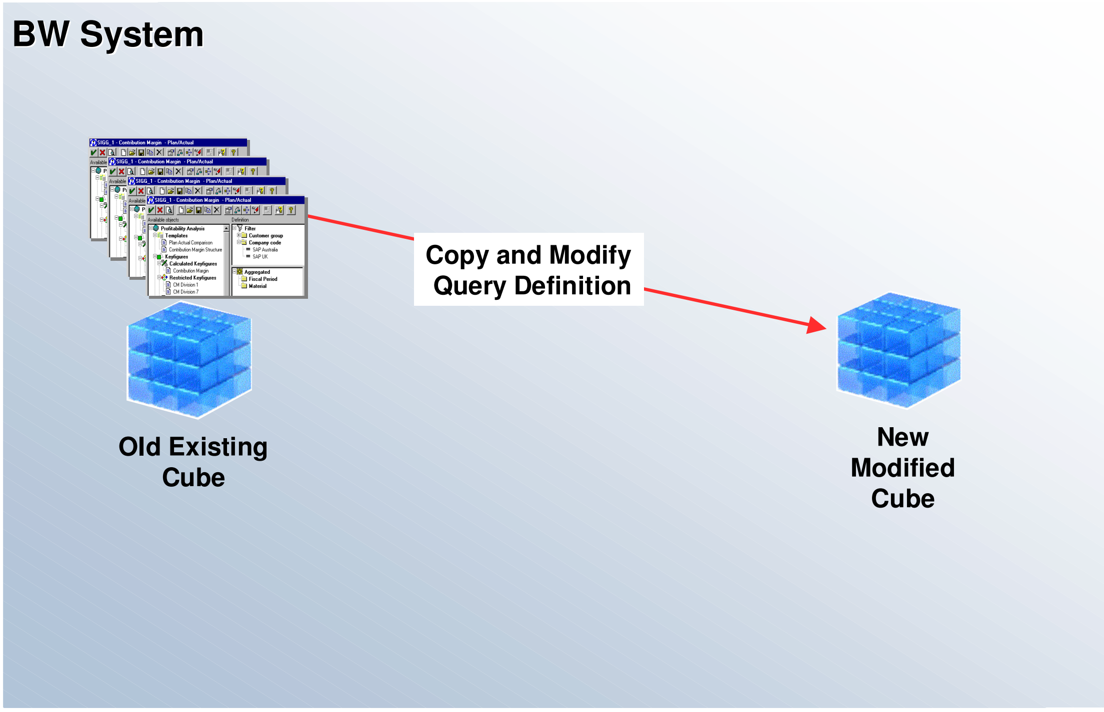
- The dependent attributes of the characteristics (e.g. material group as a dependent attribute of the characteristic material) can reside in different locations of a BW Schema Dimension.
- For example, it may be determined that the Material–Material Group relationship was not initially designed into the Data Model based on an investigation of reporting requirements. However, reporting requirements have subsequently changed.
- What are the options for inserting the Material--Material Group relationship? Another option is to add the Attribute as a Characteristic in the Dimension Table. This requires a restructuring of the Data Model and a reloading of the data.
- To accomplish this, proceed as follows:
  - Build a new InfoCube and include the additional Characteristic into the desired Dimension Table.
  - In the original InfoCube, create an Export DataSource and replicate it with the Myself Source System.
  - Create and activate an InfoSource which includes the additional Characteristic.
  - Modify and activate Transfer Rules between the Export DataSource and the InfoSource.
  - Create Update Rules as the link between the InfoSource and the new, modified InfoCube.
  - Create and schedule an InfoPackage to move the data into the new InfoCube. This will move the historical data into the new, modified InfoCube.

Adding a Characteristic to the Data Model (3)

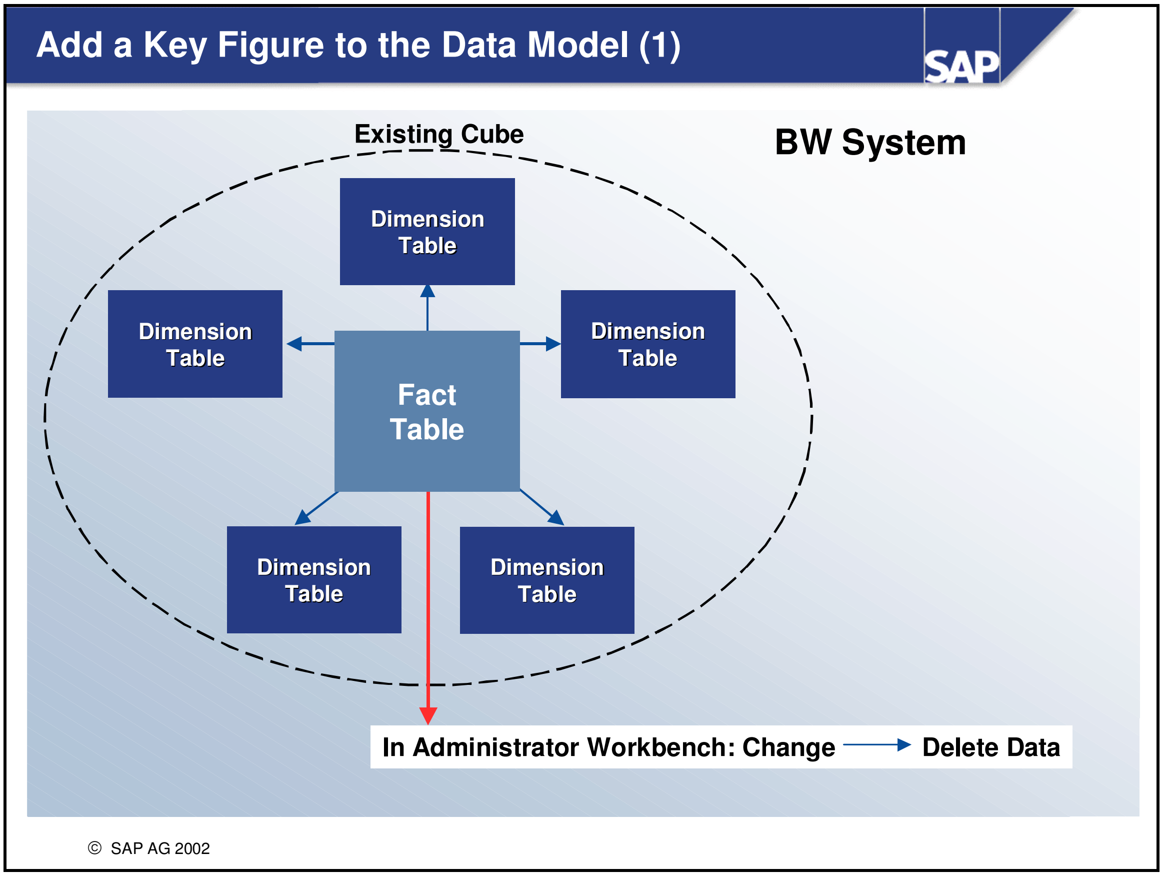


- To continue adding a new Characteristic to the Data Model, the new Characteristic must be part of data staging for the new, modified InfoCube.
  - Load transactional data for the new Characteristic into the new, modified InfoCube.
  - Then the data in the old, existing InfoCube can be deleted.
  - Once the data has been deleted, then the old, existing InfoCube structure can be deleted.

Adding a Characteristic to the Data Model (4): Copy and Modify Query Definition

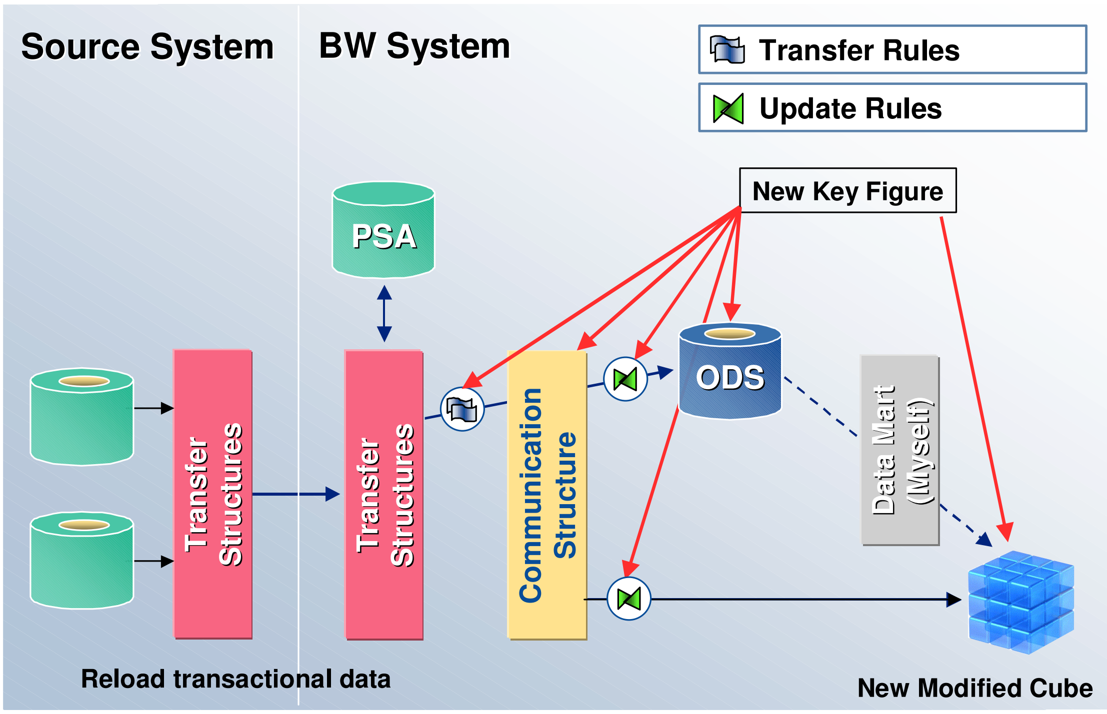


- The new InfoCube can be used for reporting after queries written against the old, existing InfoCube are copied to the new, modified InfoCube and subsequently modified.
- Alternatively to avoid copying existing queries:
  - Data can be deleted from the old, existing InfoCube.
  - Modify the structure of the old, existing InfoCube to include the new Characteristic.
  - Change and activate existing Transfer Rules, InfoSources and Update Rules for the old, existing InfoCube including the new Characteristic.
  - Reload all the historical data in the old, existing InfoCube including the new Characteristic from the Source Systems.
  - Or load only historical transactional data for the new Characteristic and then reload existing historical data from the new, modified InfoCube into the old, existing InfoCube. The queries written against the old, existing InfoCube can then be modified to include the new Characteristic.



- Key figures are loaded into the Fact Table of the InfoCube having Characteristics as keys for the data.
- If it has been determined that the data model needs additional Key Figures, then the InfoCube has to be restructured.
- To add a key figure to an existing InfoCube involves:
  - The deletion of the historical data from the existing InfoCube.
  - Creating a new and modified InfoCube using the old, existing InfoCube as a template.
  - Further modify the new InfoCube to include the new Key Figure.

Add a Key Figure to the Data Model (2)



- If it has been determined that the data model needs additional Key Figures, then the InfoCube has to be restructured.
- Once a new InfoCube has been created with includes the new Key Figure:
  - Insure that the old, existing DataSource contains the new Key Figure.
    - If it does not, then modify the DataSource and replicate.
  - Modify and activate the existing InfoSource and Transfer Rules or create new objects.
  - Connect the new and modified InfoCube to the InfoSource with Update Rules.
  - Reload historical transactional data from the appropriate Source System.

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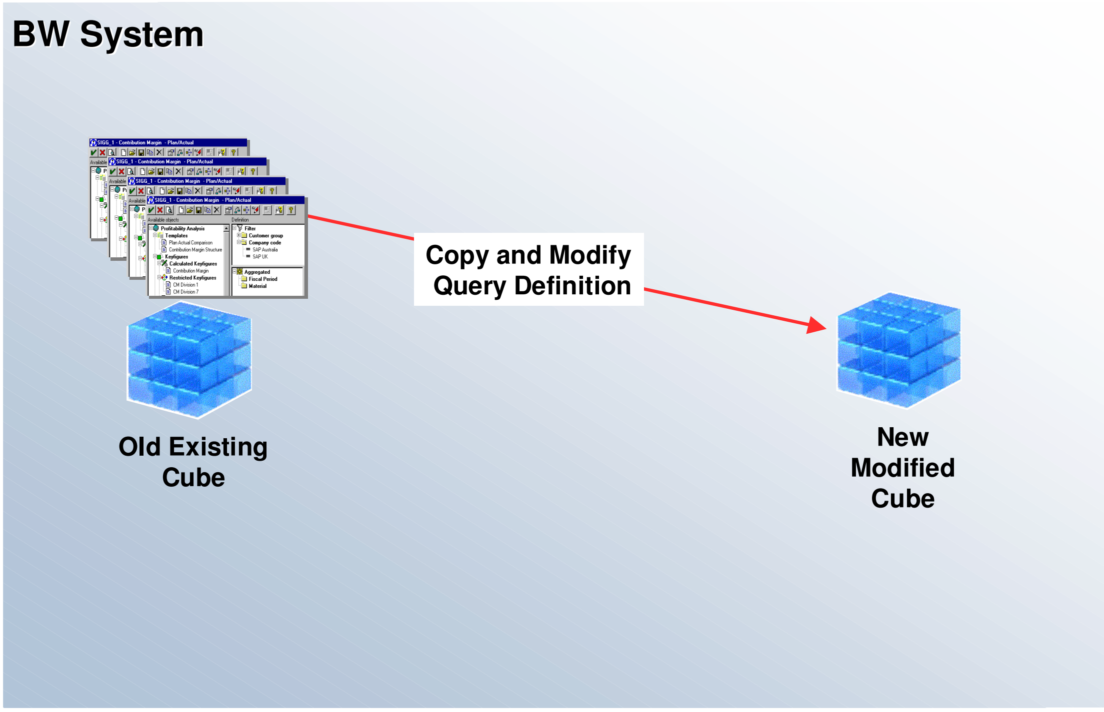
Adding Key Figure to the Data Model (3): Copy and Modify Query Definition



- If it has been determined that the data model needs additional Key Figures, then the InfoCube has to be restructured.
- The new InfoCube can be used for reporting after queries written against the old, existing InfoCube are copied to the new, modified InfoCube.
  - Load transactional data for the new Characteristic into the new, modified InfoCube.
  - Copy queries to the new,modified InfoCube and modify them.

Changing an Existing Data Model: Unit Summary

SAP

Now you will be able to:

- Identify the options if an attribute needs to be added
- Discuss the options to add a characteristic to a Dimension Table
- Discuss the options to add a key figure to an InfoCube

Exercises

Unit: Changing an Existing Data Model

At the conclusion of this exercise, you will be able to:

- Discuss the options for adding a Characteristic to a Dimension table of an InfoCube.
- List the steps for adding a Characteristic to a Dimension table of an InfoCube.

Your company has decided to use an InfoCube to meet reporting requirements of a summarized nature. Now it is time to change the structure of the InfoCube and you must assess the possibility of doing so.

1 As part of your initial implementation of the Business Information Warehouse, your company has designed and successfully built and loaded a data model to support your reporting requirements. After a period of time, you have received an approved request to change the structure of one of your InfoCubes. To support new reporting requirements, you have been asked to add Characteristic 0PROFIT_CTR to one of the Dimension tables and to delete the partner dimension.

Together with your partner or team, list the necessary steps to add and to delete Characteristics in an InfoCube Dimension.

1-1 First create a new target InfoCube by using the source InfoCube as a template. This target InfoCube will be used to hold the historical data already loaded into the source InfoCube.

1-1-1 Enter a technical name (T_330CH##) and description (BW330 GR## Copy) for the target InfoCube.

1-1-2 In the Copy From field, enter the name of the source InfoCube. (T_330GR##)

1-1-3 Check, save and activate the target InfoCube.

1-2 Create a data flow to move the historical data from the source InfoCube to the target InfoCube.

1-2-1 Create an Export DataSource for the source InfoCube.

1-2-2 Select the target InfoCube and right click on it to open the context menu.

1-2-3 From the context menu choose Generate Export DataSource.

1-2-4 Replicate the export DataSource to the MetaData Repository.

1-2-5 Assign the export DataSource to the InfoSource used to populate the InfoCube. Activate the transfer rules.

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1-2-6 Create and activate Update Rules from your new copied InfoCube to target InfoCube T_330GR## using the new Export DataSource.

1-2-7 Create and schedule an InfoPackage to load data into the target InfoCube.
Use Full Update only into data targets (No PSA).
Note: You may have to refresh your InfoSource tree.

1-3 Delete the data in the source InfoCube **T_330GR##** and modify it.
Be careful. Delete the Data, not the InfoCube!
Select the correct InfoCube!
Delete data from both, F-Table and Dimension tables. Do not delete the request entries.

1-3-1 Once the data has been deleted from the source InfoCube **T_330GR##**, then change it by deleting all characteristics of the Partner Dimension in the desired Dimension table and add Characteristic **0PROFIT_CTR** to dimension Cost Center.

1-4 Then to move the data from the target InfoCube back to the modified source InfoCube, follow the steps given in 1-2 above. Now the source InfoCube is the copied InfoCube containing data and the target InfoCube is the modified source InfoCube.

1-4-1 Create a data flow to move the historical data from the source InfoCube to the target InfoCube.

1-4-2 Create and replicate an Extract DataSource for the InfoCube **T_330CH##**.

1-4-3 Create and activate Update Rules to target InfoCube **T_330GR##** using the new Export DataSource.

Goto Update Rules: Detail for key figure Quantity.

On tab Characteristics you find the for Profit Center (0PROFIT_CTR) initial.

Select Master Data Attributes of GR00 Costcenter 13 (T_05C00) as source.
The attribute, that you would like to read on demand, is time-dependent. You can choose a time characteristic (CALDAY, 0CALMONTH, 0CALQUARTER or 0CALYEAR) or another characteristic of the communication structure, that has the data type DATS, in order to determine for which data the master data should be read on demand. You can only choose those characteristics that are contained in the communication structure.

If you choose 'Start' then the first calendar day of the entered time period is used, if you choose 'End' it is the last day. Thus it makes no difference for the characteristic 0CALDAY as well as for characteristics of type DATS whether you choose 'Start' or 'End'.

As there are no time characteristics in the communication structure you have to use **Current day**.

1-4-4 Create and schedule an InfoPackage to load data into the target InfoCube.

Solutions

Unit: Changing an Existing Data Model

1 As part of your initial implementation of the Business Information Warehouse, your company has designed and successfully built and loaded a data model to support your reporting requirements. After a period of time, you have received an approved request to change the structure of one of your InfoCubes. To support new reporting requirements, you have been asked to add Characteristic 0PROFIT_CTR to one of the Dimension tables and to delete the partner dimension.

Together with your partner or team, list the necessary steps to add and to delete Characteristics in an InfoCube Dimension.

1-1 First create a new target InfoCube by using the source InfoCube as a template. This target InfoCube will be used to hold the historical data already loaded into the source InfoCube.

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → Create InfoCube

1-1-1 Enter a technical name (T_330CH##) and description (BW330 GR## Copy) for the target InfoCube.

1-1-2 In the Copy From field, enter the name of the source InfoCube.

1-1-3 (T_330GR##)

1-1-4 Check, save and activate the target InfoCube.

1-2 Create a data flow to move the historical data from the source InfoCube to the target InfoCube.

1-2-1 Create an Export DataSource for the source InfoCube.

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → Group ## → T_330GR##

1-2-2 Select the target InfoCube and right click on it to open the context menu.

1-2-3 From the context menu choose Generate Export DataSource.

1-2-4 Replicate the Export Data Source

1-2-5 Activate the transfer rules.

1-2-6 Create *and activate Update Rules form your new copied InfoCube to target InfoCube T_330GR## using the new Export DataSource.*

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → T_330CH## → Create Update Rules.
Source InfoCube T_330GR##.

1-2-7 Create and schedule an InfoPackage to load data into the target InfoCube
Use Full Update only into data targets (No PSA).
Note: You may have to refresh your InfoSource tree.

Administrator Workbench → InfoSources → SAP SAP Application Components → Data Marts → 8T_330GR## → Create InfoPackage.

1-3 Delete the data in the source InfoCube **T_330GR##** and modify it.
Be careful. Delete the Data, not the InfoCube!
Select the correct InfoCube!
Delete data from both the F-Table and Dimension tables. Do not delete the request entries.

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → T_330GR## → Delete data

For "Delete F-Table and Dimension tables", select Don't Delete.

1-3-1 Once the data has been deleted from the source InfoCube **T_330GR##**, then change it by deleting all characteristics of the Partner Dimension in the desired Dimension table and add Characteristic **0PROFIT_CTR** to dimension Cost Center.

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → source InfoCube → Change

On the Characteristic tab, highlight all the following InfoObjects:

0PIOBJSV

0PIOVALUE

0PART_CCTR

0PART_COORD

0PART_WBSEL

0PART_ABCPR

0PART_ACTTY

Use the right arrow button to remove the InfoObjects from the structure.

Click on button Dimensions, highlight the Dimension 'Partner' and press delete.

Search for characteristic 0PROFIT_CTR and assign it to Dimension Cost Center.

Check the InfoCube definition.

Activate the InfoCube.

1-4 Then to move the data from the target InfoCube back to the modified source InfoCube, follow the steps given in 1-2 above. Now the source InfoCube is the copied InfoCube containing data and the target InfoCube is the modified source InfoCube.

1-4-1 Create a data flow to move the historical data from the source InfoCube to the target InfoCube.

1-4-2 Create and replicate an Extract DataSource for the InfoCube **T_330CH##**.

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → Group ## → T_330CH##

Select the target InfoCube and right click on it to open the context menu.

From the context menu choose ***Generate Export DataSource****.*

From the DataSource Overview on the Source Systems window, replicate the DataSources for the Data Marts folder.

1-4-3 Create and activate Update Rules to target InfoCube **T_330GR##** using the new Export DataSource.

Administrator Workbench → DataProviders → BW Training → BW Customer Training → BW330 Modeling → Target InfoCube → Create Update Rules

Go to Update Rules: Detail for key figure Quantity.

On tab Characteristics you find the for Profit Center (0PROFIT_CTR) initial.

Select Master Data Attributes of GR00Costcenter 13 (T_05C00) as source.
The attribute, that you would like to read on demand, is time-dependent. You can choose a time characteristic (CALDAY, 0CALMONTH, 0CALQUARTER or 0CALYEAR) or another characteristic of the communication structure, that has the data type DATS, in order to determine for which data the master data should be read on demand. You can only choose those characteristics that are contained in the communication structure.

If you choose 'Start' then the first calendar day of the entered time period is used, if you choose 'End' it is the last day. Thus it makes no difference for the characteristic 0CALDAY as well as for characteristics of type DATS whether you choose 'Start' or 'End'.

As there are no time characteristics in the communication structure you have to use **Current day**.

Select transfer.

Activate your update rules.

1-4-4 Create and schedule an InfoPackage to load data into the target InfoCube.

Administrator Workbench → InfoSources → SAP SAP Application Components → Data Marts → 8T_330CH## → Create InfoPackage

Save and start your InfoPackage

BW330 – BW Modeling Case Study

Part 1: Requirements Analysis and Logical Design

At the conclusion of Part 1 of this Case Study, you will have prepared and delivered certain required documents for a Steering Committee meeting.

Your company wants to improve performance on the SAP R/3 system. One of the solutions suggested by IT Staff/Consultants is to off load the processing and storage of data for several critical reports from SAP R/3 to SAP BW.

Because of your BW data modeling expertise, you have been asked to lead this project.

So far, you have been working with the **Sales/Delivery Manager.** This manager is the business process owner for the sales area and is the primary decision maker. You have conducted two interviews with her, the results of which are contained later in the case study. Additionally, you have interviewed a number of other business managers, among them the **Purchasing Manager.** Both of these managers have a concern about the increasing level of **returned goods** in the company.

You, the Sales/Delivery Manager and the Purchasing Manager are to have a meeting with Mr. CIO to update him before he attends the Steering Committee meeting. Mr. CIO has asked for the following deliverables:

Presentation to Steering committee

1. GAP Analysis with SAP BW Standard Delivered Content
2. Proposed Logical Design of the Data Model
3. Data Flow Diagram
4. List of InfoObjects needed, both new and Business Content
5. List of additional information needed

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Interview with Sales/Deliver Manager

You have had an interview with the Sales/Delivery Manager, Ms. Deal, and some of her staff. Ms. Deal has outlined some basic areas of sales and delivery reporting that must be delivered by BW. These performance indicators are the basic statistics by which the Sales/Delivery group measures their processes.

- Order value, order quantity, delivery value, delivery quantity, return value, return quantity
- Each of these measurements needs to be reported by sales organization, distribution channel, division, sold-to party, ship-to party, country, sales region, sales office, sales person, material, material group, and material type
- Sales and delivery results are tracked on a weekly and monthly basis.

The current reporting system on R/3 provides a long list of standard reports, but Ms. Deal's employees have been asking for even more types of reports to help track a rapidly expanding business.

Of particular concern lately is the escalating return rate on some product lines. Initially suspecting product quality problems, Ms. Deal has come to believe that certain customers are abusing the return process. But right now, there is no method available to track returns by customer and material to determine if it is a material problem, a customer problem or both.

Adding to the complexity, Ms. Deal must also handle periodic reorganizations of her sales force. This has been more common lately as the company has acquired a number of smaller competitors, along with their sales forces, and as the product lines have been changed to appeal to new markets. The reorganization process usually requires that customers be assigned to new sales regions and/or new sales persons.

When these reorganizations take place, it is critical that orders and deliveries that have taken place in the past can now be categorized and reported as if they had taken place under the new sales force alignment simply by supplying the proper date for the report. This flexibility is something that Ms. Deal does not have in R/3, but that she is adamant about having in the new system.

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Interview with Purchasing Manager

At first you didn't plan on looking at the Purchasing processes of the company, but the visibility of an increasing return rate for your products has elevated the search for a solution to the highest levels of the company.

Mr. Whittle, the Purchasing Manager for the company, has said that he can easily determine with the existing R/3 system which vendors are the chief suppliers for any specific procured product. But after discussions with Ms. Deal, it is proving difficult to analyze if the returned materials supplied by a particular vendor are being returned by just a few customers or by the entire customer base. This is due to the lack of integration between the sales and purchasing reporting systems. The two managers have asked for an integrated reporting system that would allow the consolidated analysis of returned products by both customer and vendor.

Interview with Internal Auditing department

Because of the sensitivity of the data and its impact on company performance, you are required to meet several guidelines set by your Internal Auditing department. One in particular has caused some concern. As quoted in your company's *Internal Auditing Guidelines,* "It is a requirement that for corporate transactional reporting systems, each transaction shall be recorded for the values of any company-defined classifying characteristics as of the time of the transaction. Subsequent reorganizations to the company's classification criteria shall not hinder the possibility of analyzing that transaction under its original classification".

Given the frequent changes in sales region and sales person alignments (a company-defined classification criteria), you must find a way to report both historically and currently on the same database.

Additional Information

Some additional facts from your interviews should be considered in any decisions that you may make:

1. The number of customers and products in your company is very large.
2. Budget constraints in IT make it necessary to design any new systems as efficiently as possible with regards to disk space, systems and personnel.
3. A BW 3.x system is available for this project and has already been used successfully for other projects.

Part 2: Implementing the Logical Design

At the conclusion of Part 2 of this Case Study, you will have created a physical implementation of your logical data model on the BW system.

Based on the deliverables from Part 1 of the case study, you must now implement the model on your assigned BW system.

Important points:

- Do not modify any Business Content. Other groups may be relying on the same objects. Instead, for any objects that you need to change, make a copy of the original object, using your group number in the technical name and description of the new object.
- You should be able to implement the complete data flow required to populate your data targets. It is not imperative that you actually load data to all data targets, only that you demonstrate that data could be loaded if necessary by having complete and active transfer rules and update rules. You may load data if you have time.

Part 3: Additional Modeling Requirements

At the conclusion of Part 3 of this Case Study, you will have assessed the impact of changes requested by users for the existing model and planned how these requests would be addressed.

While you have been working on the implementation of the data model, additional analysis requirements have been communicated from various groups. These have been collected and are listed below.

Additional Analysis Requirements

1. The Internal Auditing group has stated that they need to be able to navigate and select sales, delivery and return data by both Company Code and Company. This requirement applies to data at an aggregated level, not to document level data.
2. Ms. Deal and Mr. Whittle have stated that they need to be able to show the specific sales orders and purchase orders involved for returned goods. This capability needs to be available on any report where returns are reported by customer, vendor or material.
3. Ms. Deal also is requesting that on a weekly and monthly basis, sales and delivery information be shown in a regional hierarchical arrangement, since she is holding each Regional Sales Manager responsible for results in their region. Customers are assigned to a Region and Regions are assigned to a Country with all countries rolling up to a corporate level.

As you review this list, you wonder at the impact these changes will have on your BW Data Model. If you have already loaded data, you must also consider the impact of any changes on the existing data.

Deliverables for Part 3

1. For each new requirement, describe the required changes to your data model.
2. List for each requirement any additional data that is required before being able to make the needed changes.