SAP Business Information Warehouse-Based
Enterprise Data Warehouse - More Than a Vision

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SAP NetWeaver RIG, SAP AG

Learning Objectives

As a result of this workshop, you will be able to:

- Understand basic architecture aspects of a corporate BW implementation approach
- See the basic differences between a Data Mart driven BW implementation and a BW implementation based on a enterprise data warehousing strategy
- Examine an existing BW Landscape from a corporate point of view
## Agenda

- **Evolution of BW**
  - Enterprise Data Warehousing Basics
    - Controlled Redundancy
  - BW Architecture Aspects
    - Data Layer
    - Data Model
    - Landscape
  - Further Aspects of a Corporate BW Strategy
    - Data Integration
    - Application Development

- **Exercise**
- **Discussion**
- **Summary**

## Evolution of SAP BW

### Isolated BW Implementations
- BW1
- BW2
- BWn

### Strategic Corporate BW Implementations
- “Headquarter” Reporting Scenario
- Architected BW Landscape Scenario
- Enterprise BW
- Spoke BW
- BW Enterprise Data Warehouse Scenario

**Issues:**
- Synergy
- Integration
- Consistency
### Basic Corporate BW Landscape Strategies

- **Inside-Out**
  - BW Enterprise Data Warehouse
  - Enterprise BW
  - Spoke BW

- **Outside-IN**
  - Global BW
  - Local BW
  - Local BW
  - Local BW

- **Guarantee Consistency**
- **Reduce Costs**

### Agenda

- **Evolution of BW**
- **Enterprise Data Warehousing Basics**
  - Controlled Redundancy
- **BW Architecture Aspects**
  - Data Layer
  - Data Model
  - Landscape
- **Further Aspects of a Corporate BW Strategy**
  - Data Integration
  - Application Development
- **Exercise**
- **Discussion**
- **Summary**
Redundancy and Data Mart (Solution) Focus

Impacts of non-existing corporate BW guidelines:
- Redundant Data
- Redundant Extraction
- Redundant Transformation
- Redundant Business Rules
- Redundant Masterdata
*......

Successful Data Warehousing means ‘Controlled Redundancy’!

Redundancy and Multiple BW Landscape

Impacts of non-existing corporate BW guidelines:
- Redundant Data Flows
- Redundant Extraction
- Redundant Development
- Redundant Models
*......

Successful Data Warehousing means ‘Controlled Redundancy’!
Controlling Redundancy

- Data
- Extraction
- Staging Processes
  - Transfer rules
  - Update rules
- Data Model(s)
- Applications
- ...

Agenda

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  - Data Model
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- Discussion
- Summary
Aspects of an Enterprise Data Warehouse Architecture

- Data Store Architecture - Data Layer Architecture
  - Persistently stored data
  - Data schemas

- Data Architecture – Data Model Architecture
  - Objects and their relations
  - Relations between the models

- Data Warehouse Landscape Architecture
  - The instances and their roles

SAP BW Layer Architecture - Overview

SAP Business Information Warehouse

Data Acquisition
- Staging Area
- Cleansing
- Transform

Primary Data Management
- Data Warehouse
  - Master Reference Data
  - Transaction Data
  - ODS

Data Delivery
- Extended Star Schemas
- Architected Data Marts
  - Finance
  - Logistic

Flow Control

Meta Data

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Data Mart Implementation

Incremental, scope-specific

Real World

| Information Requirements (grouped to Scopes) |
| Modeling |
| InfoCubes |
| Business Rules |
| Transformation |
| Extraction |

Sources

---

BW Data Mart Layer: Extended Star Schema

Local Part of Material Dimension

Material Dimension

Material Master Table

Material Text Table

Material Hierarchy Table

Material Group

Shared, global Part of Material Dimension

InfoCube

Material Dimension Table

Material_Number

Gebiet 1

Gebiet 2

Gebiet 3

Gebiet 3a

Bezirk 1

Bezirk 2

Region 1

Region 2

Region 3

Vertriebsorganisation

Material_Hierarchy Table

Material_Number

Language Code

Material Name

Material Text Table

Material_Master Table

Material_Number

Material Type

Material Group

Material Dimension Table

Material Dimension_ID

Sales_Dimension_ID

Time_Dimension_ID

Customer_Dimension_ID

Sales_Amount

Quantity

FACT Table

BW Extended Star Schema
Horizontal Consistency – InfoObject Master Data is the Glue

Horizontal Consistency: Conformed Structures
- BW InfoObjects
- Master data

---

BW Data Mart Support of Different Historical Views

Constellation 09/1998
- Customer Mother-Company
  - AAA X
  - BBB Y

Customer Date Revenue
- AAA 09/1998 100
- BBB 09/1998 100
- AAA 10/1998 100
- BBB 10/1998 100

Fact Table

‘Slowly Changing Dimensions’ and Reporting Results:

I) Report using today’s (10/98) constellation
- Mother-Comp Rev 09/98 Rev 10/98
- X 200 200
- Y 0 0

II) Report using 09/98 constellation
- Mother-Comp Rev 09/98 Rev 10/98
- X 100 100
- Y 100 100

III) Report showing historical truth
- Mother-Comp Rev 09/98 Rev 10/98
- X 100 200
- Y 100 0

IV) Report showing comparable results
- Mother-Comp Rev 09/98 Rev 10/98
- X 100 100
- Y 0 0
History of Master Data (Slowly Changing Dimensions) – Architected Data Marts

Master Data History and BW Architected Data Marts
- The InfoObject master data tables are designed to form the Conformed Dimensions of the Architected data marts
- The BW Architected data marts allow handling all relevant historical views of master data.
  - For most scopes, storing the actual relationships in the master data table is sufficient
  - Validity periods of relationships offered by the source application may be stored using the ‘time dependent’ feature.

Avoid storing historical versions of master data relationships using the ‘time-dependent’ feature as this corrupts query performance

It is normally not the task of this layer to handle complete historical master data versions!

Information Completeness and Data Mart Layer (I)- Transaction Data Processing

<table>
<thead>
<tr>
<th>Sourcesystem</th>
<th>Customer</th>
<th>Time</th>
<th>DocNo</th>
<th>Pos</th>
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<td>New booking</td>
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</tbody>
</table>
**Information Completeness and Data Mart Layer (II)- Master Data Processing**

BW Architected Data Marts (ADM) means:

- Aggregation
- Overwriting
- Manipulation

As the ADM layer is reporting driven we lose information, if the information does not support the data mart scope.

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**A Matter of Consistency and Reliability – The BW Data Warehouse (Layer)**

SAP Business Information Warehouse

Data Acquisition
- Staging Area
- Cleansing
- Transform

Primary Data Management
- Master Reference Data
- Transaction Data

Data Delivery
- Extended Star Schemas
- Architectured Data Marts

Any Source
- Extraction/Open Staging
- Flow Control
- Meta Data

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Introducing a BW Data Warehouse Layer

- It is not the task of the scope oriented Data Mart Layer to anticipate any kind of future arising needs – this would overload the schemas and corrupt performance.
- It cannot be expected that the data mart project teams have the 360° corporate view to guarantee:
  - extract once deploy many
  - controlled redundancy
  - single point of truth
  - flexible structures

Make the result of the data transformation and cleansing process persistent in a way that is:

- Subject oriented
- Integrated
- Granular
- Non-volatile (historical)
- Not (application) flavored

⇒ BW Data Warehouse Layer

Transaction Data Processing in the BW DWH Layer

Sourcesystem

BW Data Warehouse Layer

BW Architectured Data Mart Layer

InfoCube

Customer Dimension

Material Dimension

- Subject oriented
- Integrated
- Granular
- Non-volatile (historical)
- Not (application) flavored

New booking
Correction booking
New booking
Master Data Processing in the BW DWH Layer

Data Processing in the BW DWH Layer

DWH layer data processing means:

- All data has to pass this layer on its path from the source to the Architected Data Marts
- The data is not aggregated.
- The data is not manipulated to please specific project scopes
- Old versions are not overwritten or changed but useful information may be added
- Data is integrated as far as possible
- The data is normally not the primary target for reporting and analysis
- Data is extracted only once and deployed many times

Define BW Data Warehouse Layer General Guidelines
Corporate Guidelines must be set up and an administrator must be established to achieve benefits from a BW Data Warehouse layer.
Benefits of a BW DWH Layer

- **Flexibility**
  - Create new analysis data marts without extracting data once again
  - A potential fall back line to cover single time unexpected end-user needs (kind of basic ad hoc reporting/analysis)

- **Reliability, Audit Trail**
  - A Single Point of Truth
  - All data from the source systems have to pass this layer on their way to the end-user

- **Complete History/ Versions**

- **Consistency, Controlled Redundancy**
  - Data is extracted only once and deployed many times
  - Redundant staging processes are avoided
  - Realization of the corporate integration strategy is not a matter of a departmental project team

- **Integration**
  - semantical
  - common coding

The BW Data Warehouse Layer is the corporate memory, the corporate information repository

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Vertical Consistency

- **Real World**
  - Information Requirements (grouped to Scopes)
  - Modelling
  - InfoCubes
  - Business Rules

- **BW Application Project Team**
  - EDW Admin
  - EDW Transformation
  - Extraction

- **Sources**

- **Controlled Redundancy**
  - Extract once – Deploy many
  - Single Point of Truth
The central role of the BW DWH

If BW Data Warehouse layer functionality is established at corporate level you can think of the BW Data Warehouse as your corporate memory, your corporation's information repository. This is the reason that this layer is often called the Enterprise Data Warehouse.

BW Persistent Staging Area (PSA)

Makes a BW DWH Layer the PSA obsolete?
The answer is: just partly

1. Backup for 'non-mature' applications
2. Uncouple extraction from BW processing

Best Practice: Reduce Space Requirements Introducing a PSA Lifecycle Concept

The role of the PSA as backup is limited if a BW Data Warehouse layer is used. For backup purposes of mature applications, the PSA is no longer needed. Thus, PSA-element entries could be deleted normally after 2 to 4 weeks. Not deleting the entries may lead after short time to significant disk space usage.
Near Real Time Data Warehousing (BW Vers. 4) – BW Operational Data Store

SAP Business Information Warehouse

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- Cleansing Area
- Transform

Primary Data Management
- Data Warehouse
- Master Reference Data
- Transaction Data

Data Delivery
- Architectured Data Marts
- Extended Star Schemas

Meta-Data

A Matter of Information Perspective – Classic Data Warehousing and Operational Reporting

Information Perspective:
Strategic – Tactical - Operational

An information perspective can be classified by:
- Granularity
- Historical background
- Latency or Load Frequency
- Reliability (Auditing)
- Target group
- Information Retrieval Behavior
Classic Data Warehousing and Operational Reporting

The classic data warehousing approach:
- Dedicated load and staging processes
- High quality
- Optimized retrieval structures
- Reduce workload on OLTP systems

Data Warehouse
- Master Reference Data
- Transaction Data

Architected Data Marts
- Data Mart
  - Finance
- Data Mart
  - Logistic

Tactical / Strategic

Question: And how do I handle my operational reporting in BW?

Operational Reporting in BW I

In most of the cases operational reporting needs can be supported in BW using the classic data warehouse process

Data Warehouse
- Master Reference Data
- Transaction Data

Architected Data Marts/
- ODS-Objects
  - Data Mart
    - Finance
  - Data Mart
    - Logistic
- ODS-Object
  - Sales Orders

Tactical / Strategic / Operational

`..most of the cases..`: classical data warehousing has its limits
- if we want to provide event-level or close to event-level operational reporting (near real time reporting) and/ or
- if we are confronted with huge data volumes for operational reporting
Operational Reporting and Classic DWH – Issues I

Be careful using the same InfoCube for operational and tactical reporting:
- if the transactional volume is high
- if you want to report on atomic data

Solution A:
- Operational reporting could be done on the DWH-ODS-Object if just list reporting is desired.
- Tactical reporting is done on the InfoCube, which keeps aggregated data
- Drill thru from InfoCube to atomic DWH-ODS-Object is possible

Issues:
- Responsibility?
- DWH-ODS-Object must be reporting enabled
- Remember the guidelines for the BW DWH Layer
**Operational Reporting and Classic DWH – Issues III**

Solution B:

- Dedicated InfoCubes/ODS-Objects with atomic data support operational reporting
  - directly loaded from PSA
  - life cycle of data normally not more than 6 month
  - they build an ‘ODS’
- An InfoCube with aggregated data supports tactical reporting
  - Drill thru from InfoCube to detailed data
  - Loading DWH layer several times per day and tactical InfoCube once per day

Mixing operational and tactical reporting using the same InfoCubes may corrupt BW load and retrieval performance!

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**Transaction Data Processing and Operational Reporting**

<table>
<thead>
<tr>
<th>Sourcesystem</th>
<th>Data Marts</th>
<th>Operational Data Store:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>ODS</td>
<td>after 11 am load</td>
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<td></td>
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<td>after 5 pm load</td>
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<tr>
<td></td>
<td>DWH</td>
<td>4 times a day</td>
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**Transaction Data Processing in the BW DWH Layer**

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**Sourcesystem**

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</table>

**BW and Operational/ Real Time Reporting**

Key-Questions:
- Data Latency ?
- Data Integration ?
- Workload on OLTP Systems ?

UI

BW Near real time data warehousing
BW remote InfoCube
BW virtual InfoCube
BW 'classic' data warehousing

BW Data Integration
BW Data Acquisition

OLTP

Adaptors

JDBC D2DBC XMLA SAP Query

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### Operational / Real Time Reporting

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Data Latency</th>
<th>Data Integration</th>
<th>Workload on OLTP Systems</th>
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<tbody>
<tr>
<td>Classic BW</td>
<td>1- several loads per day</td>
<td>Y</td>
<td>1 time extraction workload</td>
</tr>
<tr>
<td>BW Remote InfoCube</td>
<td>0</td>
<td>Y</td>
<td>query workload</td>
</tr>
<tr>
<td>BW Virtual InfoCube</td>
<td>0</td>
<td>Y</td>
<td>query workload</td>
</tr>
<tr>
<td>BW near real time data warehousing</td>
<td>~ 0</td>
<td>Y</td>
<td>1 time extraction workload</td>
</tr>
<tr>
<td>BI direct access</td>
<td>0</td>
<td>N</td>
<td>query workload</td>
</tr>
</tbody>
</table>

### Data Warehousing and Historical Information

- **BW Architectured Data Marts**
  - **volatile**
  - **summarized**
- **BW Operational Data Store**
  - **volatile**
  - **granular**
- **BW Data Warehouse**
  - **non-volatile**
  - **granular**

The BW Data Warehouse is the only place to store historical information:
- complete
- unfiltered
- in various fashions

Various fashions of history \(\rightarrow\) temporal data
SAP BW Layer Architecture - Overview

SAP Business Information Warehouse

- Data Acquisition
  - Staging Area
  - Cleansing Area
  - Transform

- Primary Data Management
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    - Master Reference Data
    - Transaction Data
  - ODS

- Data Delivery
  - Architectured Data Marts
    - Extended Star Schemas
  - Open Distribution

Meta-Data

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Operational Data Models and the Data Warehouse Data Model

Inconsistent data warehouse data models ⇒ stovepipe solutions
Consistent data warehouse data model ⇒ long term success

Not aligned operational data models
Consistent enterprise data model

SAP Applications and the BW Data Warehouse Data Model

BW Consistent data warehouse data model for SAP Applications and others ⇒ long term success

Not aligned operational data models
SAP enterprise data model
Enterprise Data Model and BW Expandable Data Model (Business Content) I

Operative entities and attributes ⇒ BW InfoObjects

BW Data Model

Entities, Attributes → BW InfoObjects

Enterprise Data Model:
- e.g. mySAP Component Object Models

Material Type
Material Group
Sales Orgs
Sales Person

Sales Transaction

BW Data Mart Data Model

BW Extended Star Schemas

Shared/Conformed Dimensions

InfoCubes with Local Dimensions

BW Data Mart Layer
Data Model defined by Business Content

BCT InfoSources = Subject Areas

BCT Extractors/DataSource

Material Type
Material Group
Sales Orgs
Sales Person

Customer
Material
Sales Transaction

Enterprise Data Model:
- e.g. mySAP Component Object Models
**BW Data Warehouse Layer Data Model**

- **Enterprise Data Model:**
  - e.g. mySAP Component
  - Object Models

- **Data Model defined by Business Content**

- **Customer**
- **Material**
- **Sales Person**

**BCT InfoSources** as Subject Areas

**BCT Extractors/DataSource**

**Master Data**

**Transaction Data**

**EDW InfoObject/ODS-Object**

- If Overwrite: Unique Identifier
- Source

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The Ideal Corporate BW Landscape?

Strategic Corporate Implementation Options:

- **Inside-Out**
  - BW Enterprise Data Warehouse
  - Spoke BW
  - Enterprise BW

- **Outside-IN**
  - Local BW
  - Global BW
  - Outside-IN BW Landscape

Corporate BW Landscape Influencers:

- **Organization**
  - Centralized, headquarter oriented companies versus
  - Companies where local units have a large degree of independency
    - Including all intermediate stages

- **Political issues – ownership of data**

- **Business**
  - Companies with a unique business line
  - Companies with divisions totally diverse in business

- **Master data integration status and strategy**

- **Awareness of important role of Consistent Information**

- **Investment**

- **Sponsorship**
  - C-Level or other

- **IT strategy - Operative System Landscape**

- **Competitive pressure**

There is no 'one size fits all' BW landscape!
BW as Central Enterprise Data Warehouse (EDW)

BW Enterprise Data Warehouse: BW Data Warehouse layer as ‘single point of truth’ for the entire corporation

EDW Patterns

- Organization is centralized
  - Headquarter or division headquarter or even regional division headquarter oriented companies
- Often a single line of business
- Master data integration exist or at least a strategy to achieve it
- Awareness of the important role of Consistent Information is high
  - i.e. bad experience led to the conclusion that a data warehouse is more than a sexy front-end
- Sponsorship is high
- High competitive market
Inside-Out:
Central BW Instance Covers All

Inside-Out:
- Central EDW Instance Covers All

Enterprise BW

PSA

BW EDW
integrated consistent granular

BW ODS operational/near real time reporting granular

BW Architected Data Marts

- tactical/operational like reporting
  - less granular
- strategic reporting
  - aggregated

External Data Marts

Inside-Out:
Central EDW BW Instance and BW Spoke Instances

Inside-Out:
- Central EDW BW Instance as Information HUB
- Architected Data Marts Spoke Instances

Enterprise BW

PSA

BW EDW
integrated consistent granular

BW ODS operational/near real time reporting granular

BW Architected Data Marts

- tactical/operational like reporting
  - less granular

External Data Marts

Corporate BW Data Mart

- strategic reporting
  - aggregated
The Ideal Corporate BW Landscape?

Strategic Corporate Implementation Options:

- **Inside-Out** BW Enterprise Data Warehouse
- **Outside-IN** BW Landscape

'Simply building a central single data warehouse does not address the size and complexity of the problem posed by the need for integrated, historical easily accessible data across a complex global enterprise.'

W.H. Inmon ‘Managing Multiple Data Warehouse Development’

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Corporate Data Warehouse Landscape based on BW Local and Global Data Warehouses

- **Global**
  - 'global' BWs
  - BW Headquarter

- **Divisional**
  - 'local' BWs

- **Regional**
  - BW Region Europe Division A
  - BW Region Asia Division A
  - BW Region Americas Division A
  - BW Region Asia Division B

- **Local Sites**
  - ERP/Legacy
  - ERP/Legacy
  - ERP/Legacy
  - ERP/Legacy
The Role of a Global BW without a Central EDW

Focus on Headquarter Reporting

Focus on Integration and Headquarter Reporting → Global BW as the Corporate Integrator

Architected Multiple BW Landscape

Global BW Headquarter

Global BW Division A

Global BW Division B

Global BW Division C

Virtual BW Enterprise Data Warehouse
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**Architected Multiple BW Landscape:**

**BW Template Roll-Out**

- Global BW
  - Global BW Headquarters
  - Division A

**Regional**

- BW Europe
  - R/3-ERP Europe I
  - Data Warehouse
  - Staging
  - ODS
- BW Americas
  - R/3-ERP Americas I
  - Data Warehouse
  - Staging
  - ODS
- BW Asia
  - R/3-ERP Asia
  - Data Warehouse
  - Staging
  - ODS

**Local**

- R/3 template roll-out
- virtual BW Enterprise Data Warehouse

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30
Local BW Data Structures

- Source for corporate reporting
- Distilled corporate
- Local defined local reporting

Content Delivery at the Customer Site

- Customer Content System (Headquarter)
- InfoCube /ABC/IC1
- InfoObject 0MATERIAL
- InfoObject /ABC/IO01

- Export (D Version)
- Import

- Subsidiary
- InfoCube /ABC/IC1
- InfoObject 0MATERIAL
- InfoObject /ABC/IO01
Master Data and Integration

A major deliverable of data warehousing is integrated data regardless whether we talk about Architected Data Marts, ODS or the Data Warehouse layer itself.

The ideal world that anticipates the source systems either offer already integrated master data or that the master data can be mapped to common coded values during staging.
Master Data Integration Issues

Entity values from source systems are not integrated and cannot be mapped at load time to common coded values

- The most common reason is the lack of a corporate master data strategy
- Only a delayed integration is possible
  - i.e. at load time integrated values are not available until after a certain time span
- Due to mergers and acquisitions new, not harmonized (common coded) sources may appear

Best Practice: Discuss the Status and Strategy of Corporate Common Coding Efforts

The strategy and the status of corporate master data common coding should be discussed at an early stage because of the huge influence to the BW information model and thus all scope implementations.

Checking InfoObject Integration Status

<table>
<thead>
<tr>
<th>InfoObject</th>
<th>Common Coded at Source Sites?</th>
<th>Integration in BW possible at load time?</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL</td>
<td>PARTLY</td>
<td>NO</td>
</tr>
<tr>
<td>CUSTOMER</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>MATTYPE</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>COSTCENTER</td>
<td>YES</td>
<td>NO ACTION</td>
</tr>
</tbody>
</table>

InfoObject Concatenation

Key-value Concatenation

- BW-Key
- Concatenated-Key
- Separators
- Attributes

Source-System 1: Source-Value U04711 AUDI
Source-System 2: Source-Value U04711 BMW
InfoObject Automatic Compounding

Automatic Compounding
> Source System-ID (0SOURSYSTEM) is Separator

BW-Key

<table>
<thead>
<tr>
<th>Source-Value</th>
<th>Source-Key</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>004711</td>
<td>AUDI</td>
<td></td>
</tr>
<tr>
<td>004711</td>
<td>BMW</td>
<td></td>
</tr>
</tbody>
</table>

Build Key automatically

Source-System 1 Source-System 2

BW and MDM : E.G. Content Integration

Sources

R/3 Material

IS: Material

IS: MDM Product ATTR+TEXT

MDM

ID Mapping

Matching

Description of a master data object

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**Agenda**

- Evolution of BW
- Enterprise Data Warehousing Basics
  - Controlled Redundancy
- BW Architecture Aspects
  - Data Layer
  - Data Model
  - Landscape
- Further Aspects of a Corporate BW Strategy
  - Application Development
  - Data Integration

**Exercise**

**Discussion**

**Summary**

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**A Real Life BW Landscape Example**

**Global**

- HQ BW
- SubDiv BW

**BW Local**

- Sub-Division A
  - R/3 Global
- Sub-Division B
  - R/3 only Germany
- Sales Europe R/3

**Source Systems**

- R/3 Div S-Amerika
- R/3 Div N-Amerika
- R/3 Div Asia
- R/3 Div Europe
- R/3 Div S-America
- 12 systems worldwide

**MDMS**

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“Controlled Redundancy” is crucial for mid- and long-term success of all (BW) data warehousing activities.

BW offers features in all areas to control redundancy.

But, you need corporate BW proceedings and corporate BW guidelines that guarantee consistent usage of these features.
Further Information

- **Public Web:**
  - [www.sap.com](http://www.sap.com) ➔ bi

- **Consulting Contact**
  - Roy Wood, VP SAP Consulting (r.wood@sap.com)

- **Related Workshops/Lectures at SAP TechEd 2003**
  - BW 301, Data Aging with mySAP Business Intelligence, Lecture
  - Oct. 2, 2003, 10 am, Room L2

Questions?

Q&A
Please complete your session evaluation and drop it in the box on your way out.

Thank You!

The SAP TechEd '03 Basel Team