Armazéns de Dados

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1

Data Warehouse Architectures

2

Bibliography

- Mastering Data Warehouse Design: Relational and Dimensional Techniques
  Claudia Imhoff, Nicholas Galemmo, Jonathan G. Geger
  Wiley, 2003

  Chapters 1, 13

- The Data Warehouse Lifecycle Toolkit: Experts Methods for Designing, Developing, and Deploying Data Warehouses
  Ralph Kimball, Laura Reeves, Margy Ross, Warren Thornthwaite
  Willey, 1998

  Chapters 8, 9, 10

- Modern Database Management
  J.Hoffer, M.Prescott, H. Topi
  Prentice Hall, 2008

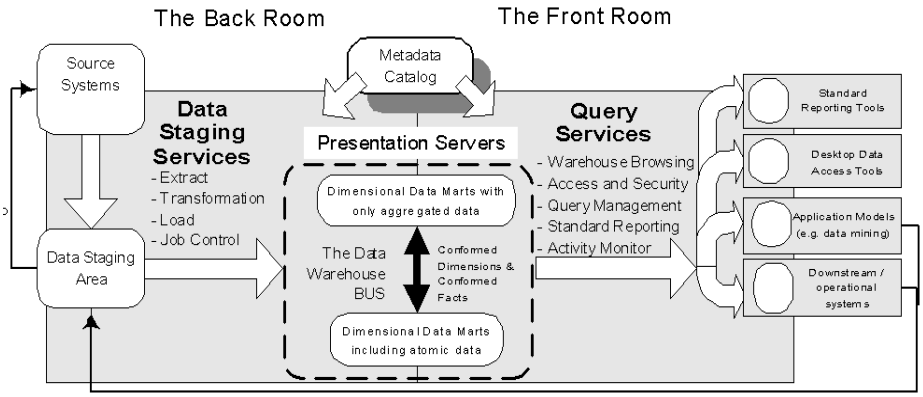
  Chapter 11

3

Data Warehouse Bus Architecture (Ralph Kimball)

4

DW BUS Architecture



- DW is built on a series of incremental data marts
  - "**Bottom-up**" or **incremental methodology**
- Has two major types of components: **services** and **data stores**

5

5

DW BUS Architecture

- Is divided into two groups of components and processes
  - **Back-room (data acquisition)**
    - Part responsible for gathering and preparing the data
    - Where data acquisition and data staging processes take place
  - **Front-room (data access)**
    - Part responsible for delivering data to business users
- Flow of data from source systems to user desktop is supported by the **metadata catalog**
- Includes two types of data marts in the data presentation area
  - **Atomic data marts**
  - **Aggregated data marts**

6

6

Back-Room

- Where the **data staging process** takes place
- **Engine room** of the DW
- Primary concern:
  - Getting the right data, with the appropriate transformations, at the right time, and load it into the DW

7

7

Source Systems

- Are the **obvious sources** of interesting business data
- Other high-value sources may be **external to the business**
  - Demographic customer information, target customer lists, and competitive sales data
- Data storage types are dictated by the source system
  - Many older legacy systems are standard mainframe data storage facilities: IMS, IDMS, VSAM, and DB2 are common
- **Flat file** is one often standard source for the DW
- Understanding their nature **is critical** for creating the back-room architecture

8

8

Data Staging Area

- Is both a **storage area** and **set of processes** commonly referred as **Extraction, Transformation and Loading** (ETL), not seen by end-users
- **Everything between** the source system and the DW presentation server
- Where much of the **data transformation** takes place and much of the **added value** of the DW is created
  - **Cleaning the data**
    - Correcting misspellings, resolving domain conflicts, dealing with missing values, or parsing into standard formats
  - **Integrating data** from multiple sources
  - **De-duplicating data**
  - **Assigning surrogate DW keys**
  - **…**

Back-Room Services

- **Tools and techniques** employed in the data staging process
  - Also known as ***data staging services***
- **Service** is an elementary function or task, that can be as simple as:
  - Creating a table in a database
  - Copying data from one table to another

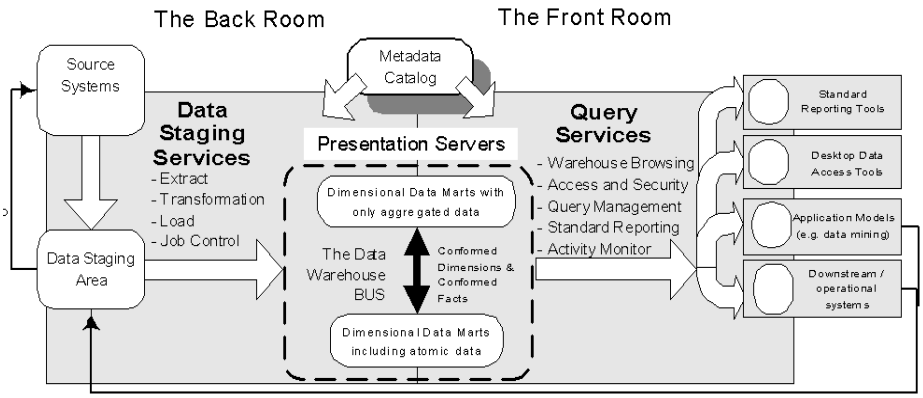
Back-Room Services

- Extract services
  - **Pulling the data from the source system(s)**
  - Largest effort in the DW project, especially if the source systems are decades-old or mainframe-based
- Data transformation services
  - Acts performed on the data to **convert it into something presentable to users and valuable to the business**
- Data loading services
  - Set of services responsible by **loading the data into the DW**
- Job control services
  - Captures metadata regarding the **progress and statistics of job execution**

11

11

DW BUS Architecture



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  - **"Bottom-up"** or **incremental methodology**
- Has two major types of components: **services** and **data stores**

12

12

Presentation Server

- Where the **data is stored** for direct querying by end-users, OLAP tools, reporting systems and other applications
- Is a **series of integrated data marts**
  - Data mart presents the data from a single business process
- Data in the queryable presentation server of the DW must be:
  - **Dimensional**
  - **Atomic** (to unpredictable ad-hoc user queries)
- All data marts must be built using ***common/ shared dimensions***

13

13

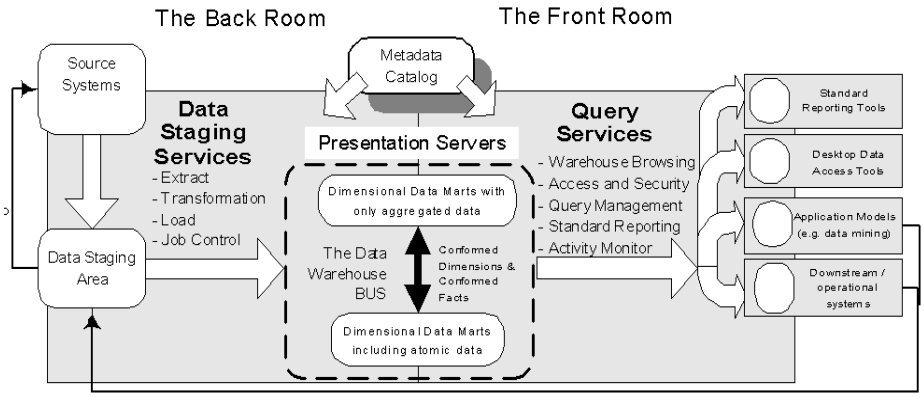
Data Marts in Presentation Server

- **Atomic data marts**
  - Hold multidimensional data at the **lowest detail level**
- **Aggregated data marts**
  - Hold multidimensional data that have been **summarized**
  - Improve **query performance**
  - Loaded from the **data staging area** or from the **atomic data marts**
- All star schema-based data marts **may or not reside within the same database instance**
- Collection of star schemas which share dimensions and facts is the basis of the **DW Bus Architecture**

14

14

DW BUS Architecture



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15

15

Front-Room

- **Public face of the DW**
  - It's what the business users see and work with day-to-day
- **Data access services are between the users and the data**, hiding some of the complexities and helping them to find what they are looking for

16

16

Front-Room Services

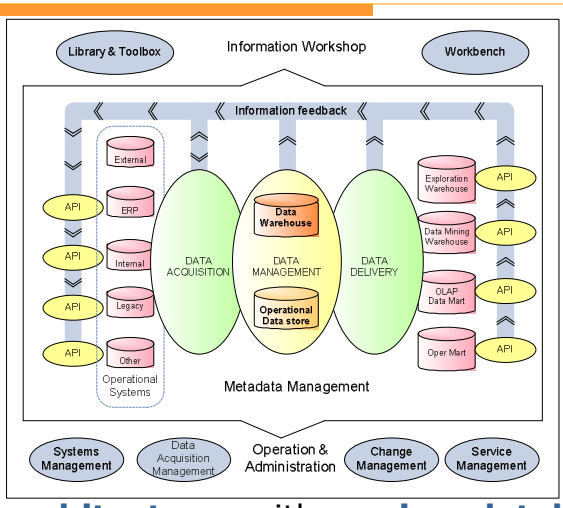
- Warehouse browsing
  - Takes advantage of the metadata catalog to support the users in their efforts to **find and access the data they need**
- Access and security services
  - Facilitate a **user's connection to the DW**
- Activity monitoring services
  - Capture information about the **use of the DW**
- Query management services
  - Set of capabilities that manage the exchange between the **query formulation**, the **execution of the query** on the database, and the **return of the result set** to the desktop
- Standard reporting services
  - **Ability to create fixed-format reports** that have limited user interaction and regular execution schedules

17

Corporate Information Factory (Bill Inmon)

18

CIF Architecture

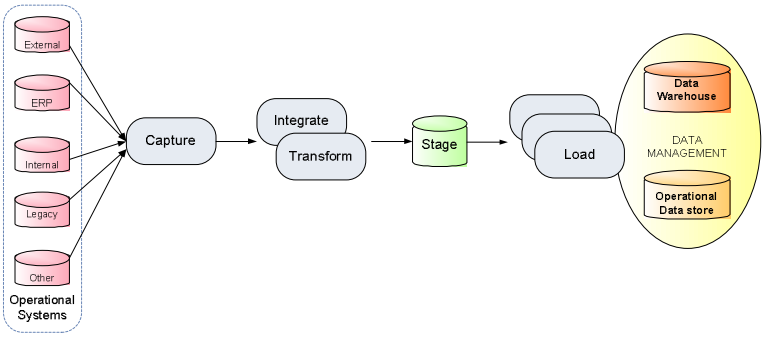


Logical architecture with **major databases** and **processes** to effectively and efficiently move data from source systems to business users

19

19

Data Acquisition

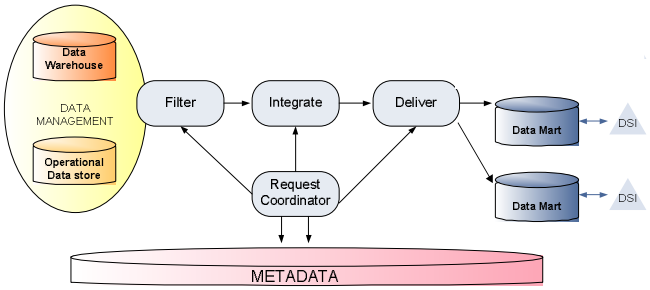


- Set of processes and programs that extract data from the operational systems to the **DW** and to the **Operational Data Store (ODS)**
- Perform the **cleaning**, **integration** and **transformation** of the data into an enterprise format

20

20

Data Delivery



- Process that moves data from the DW or ODS into **data marts** and **oper marts**
- Like in the acquisition layer, data is manipulated as it is moved
- Origin is the **DW** or **ODS**, which already contains high quality integrated data that **conforms to the enterprise business rules**

DW vs. ODS

- **DW** – A **subject-oriented**, **integrated**, **time variant** and **non-volatile** collection of data used in strategic decision making [Inmon and Hackathorn, 1994]
- **ODS**
  - Data is **fully integrated** like in a DW
  - **Data is current**
  - **Data is volatile or updatable** (no history is retained)
  - Data is **usually entirely detailed**
  - Source of **near real-time** and **accurate data** – accessible from anywhere in the corporation

Data Marts vs. Oper Marts

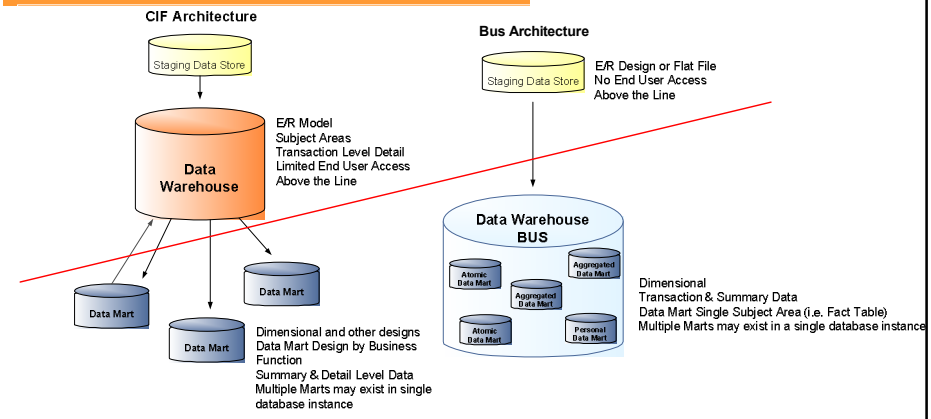
- **Data marts** are customized and/or aggregated subsets of data derived from the DW
  - Where the analytical activities take place
- Data in each data mart is usually **tailored for specific analytical requirements** of a business unit or function
  - Product profitability analysis, sales analyses, …
- **Oper marts** are derived from the **ODS** and used to provide the business community with **dimensional access to current operational data**

23

Bus Architecture vs CIF Architecture

24

Comparing CIF and BUS Architectures



Access is usually not allowed above the red line

- Back room is completely off-limits to users in the BUS architecture
- Direct access to the CIF DW is discouraged

25

25

CIF vs. BUS: Differences

- **No physical repository equivalent** to the CIF DW in the BUS architecture
- BUS DW is the collection of **atomic and aggregate data marts**
- BUS architecture data marts **(star schemas)** are significantly different from the design of the CIF DW **(relational schema)**
- Various data marts schemas "conform" through **common dimensions** in the BUS architecture
- In the BUS architecture **all components are dimensional**, **except the data staging area**

26

26

CIF vs. BUS: Similarities

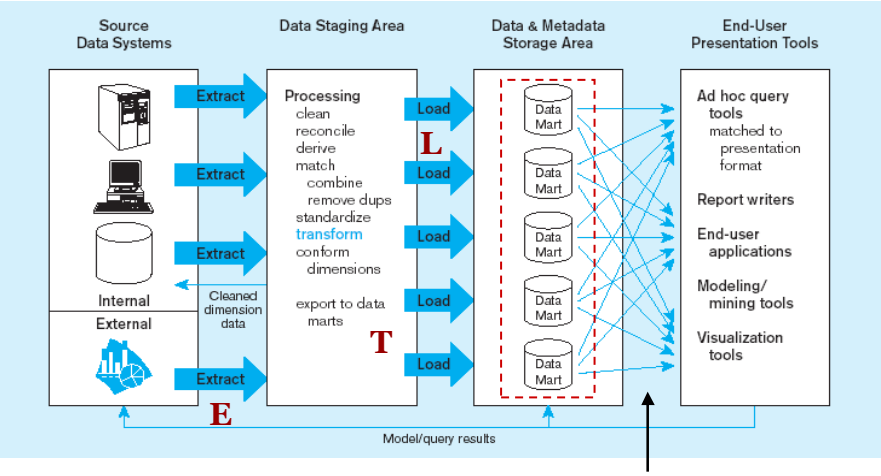
Both architectures:

- Have a **separate staging area**, **metadata management**, **data acquisition** and **data delivery** processes
- Power of information resides in the **atomic data**, which embed all available information dimensionality
- Existence of **dimensional data marts**
  - **Aggregate data mart** in BUS architecture is the **usually the same** as the **data mart** in the CIF architecture

27

27

Kimball DW Architecture



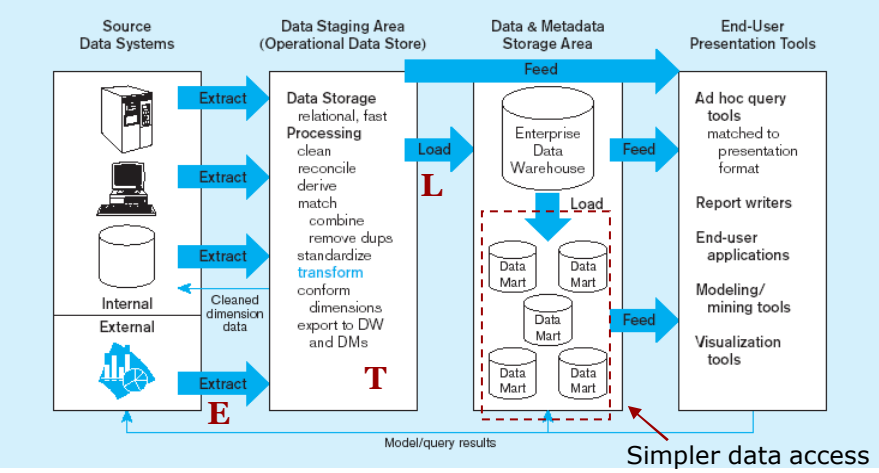
➔ Separate ETL for each **independent** data mart

➔ No single consolidated DW from the beginning

28

28

Inmon DW Architecture



➔ Single ETL for **Enterprise Data Warehouse**

➔ Data marts loaded from Enterprise DW

29

29

Kimball Approach

- **Most common approach**
- Begins with **a single data mart** and **others are added over time** for more subject areas
  - Will require an overall **integration plan**
- Relatively **inexpensive** and **easy** to start to implement
  - Can be used as a **proof of concept** for DW
- Separate ETL process is developed for each data mart, which yields **costly redundant data and processing efforts**
- Can perpetuate the **"silos of information" problem**
- Key is to a have an **overall plan for integrating the different data marts**

30

30

Inmon Approach

- **Comprehensive DW is built initially**
- Data marts are built using **aggregate subsets of the data in the DW**
- Like all complex projects, it is **expensive**, **time consuming**, and **prone to failure**
- When successful, it results in an **integrated and scalable DW**