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# ICT-TEX course on Digital skills

## Topic 11: ICT in Enterprise Management

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Cooperation for innovation and the exchange of good practices [Knowledge Alliance](#)

**ICT IN TEXTILE AND CLOTHING HIGHER EDUCATION AND BUSINESS**

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## 11.2. Business Intelligence Systems

These slides are part of the topic on  
*“Topic 11: ICT in Enterprise Management”* of the course on  
Digital skills in Textile and clothing industry.

Check also the other themes in this topic:

- 11.1. Enterprise Resource Planning
- 11.3. Digital Marketing



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# Introduction to Business Intelligence

- The term Business Intelligence (BI) is a modern term gaining more and more popularity
- There are many interpretations of what exactly the term BI means and what it encompasses.
- Often the term BI is closely related to Business Analytics and Analytics definitions, but there are many differences between all of them.



# Introduction to Business Intelligence

- Business Intelligence includes various software applications, services, and technologies that process and transform business data into meaningful business information, helping it make better business decisions.
- BI supports the management of business decision-making processes.
- BI systems process, analyze, and visualize business data to the stakeholders of an organization



# Business Intelligence Definition

- Definition of BI

*BI “is an umbrella term that combines architectures, tools, databases, analytical tools, applications, and methodologies... The process of BI is based on the transformation of data to information, then to decisions, and finally to actions”.*

- Sharda, R., Delen, D., Turban, E.: Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4<sup>th</sup> Edition, Global Edition. Pearson Education, UK 2018, pp.42, ISBN: 978-1-292-22054-3 (2018)



# Business Intelligence Definition

- The main points in defining BI systems are:
  - BI often refers to a large set of software tools, services, technologies, etc.
  - BI is focused on the current state of the organization.
  - BI is focused on historical and current business data, and data report, storage, and maintenance of that data.
  - BI transforms business data into meaningful information for the business
  - BI uses effectively use this knowledge to drive informative business decisions





# Business Intelligence vs Business Analytics

- Often the term BI is closely related to Business Analytics definitions, but there are many differences between all of them.
- Both BI and Business analytics process business related-data
- Both BI and Business Analytics extract knowledge from the data
- Both BI and Business analytics use data visualizations to present data to the users



# Business Intelligence vs Business Analytics

## Data Storage

- Business Intelligence is focused on historical business data and the data report, storage, and maintenance of that data.
- Business Analytics is not focused on data storage and often uses external databases.



# Business Intelligence vs Business Analytics

- Business Intelligence uses mainly the analytics capabilities of descriptive analytics to analyze the organization data from the past.
- Business Intelligence tries to answer the questions:
  - What has happened?
  - What is happening?
  - What to do (take action) based on the historical data?



# Business Intelligence vs Business Analytics

Business Analytics can combine different types of analytics.

- Business Analytics tools can present models for analyzing past business data to predict the future (Predictive analytics capabilities) and provide some explanation for the occurrence of an event in a business.
  - Can answer the business questions:
    - What is happening? What has happened?
    - What can happen? Why will it happen?



# Business Intelligence vs Business Analytics

- Business Analytics can determine what to do next as a result of a business event and provide evidence of the most optimal level of key variables to achieve a particular desired and expected business outcome (Prescriptive analytics capabilities), resulting in increased business value and performance.
  - Can answer the business questions:
    - What should happen? What must be done?
    - Why should I do it?



# Business Intelligence vs Business Analytics

- Often Business Intelligence cannot use the combination of different types of analytics and their functionalities, such as the capabilities of predictive analytics and prescriptive analytics.
- Business Analytics can use unstructured and structured business data. Business Intelligence is focused on using only structured business data.



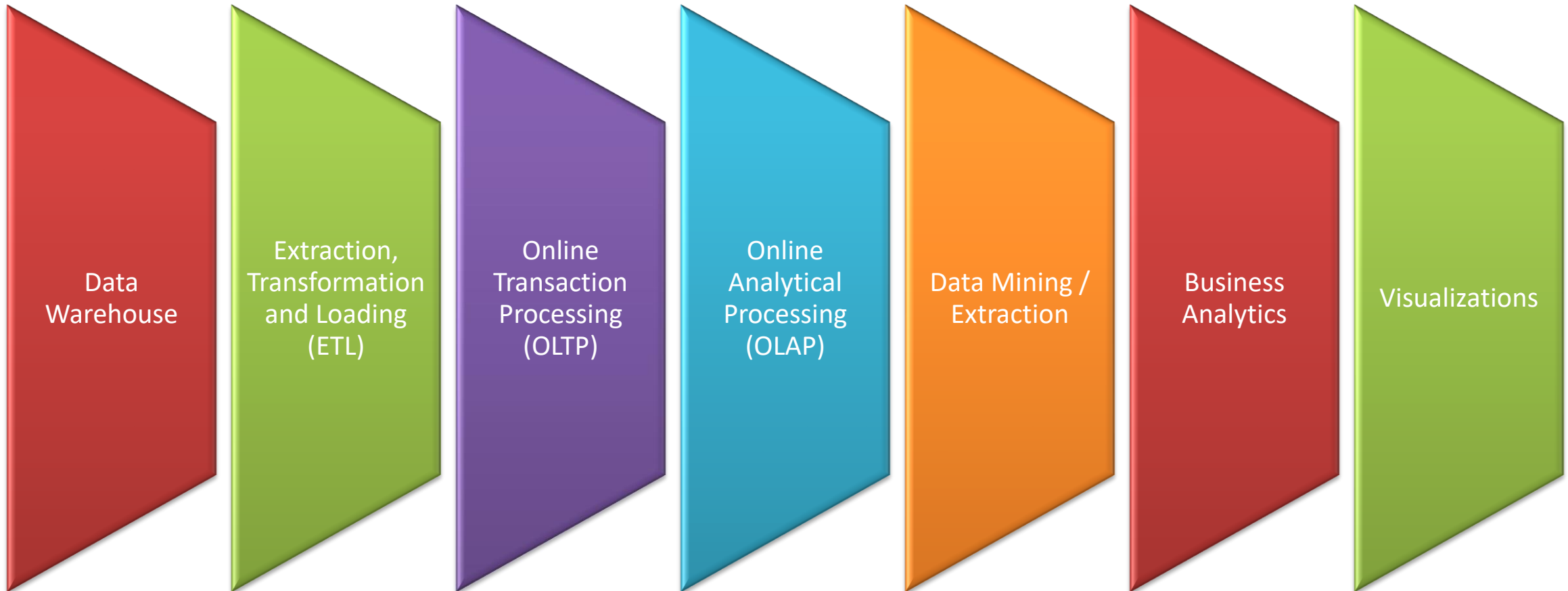
# Business Intelligence System Architecture

The general architecture of the business intelligence system refers to a four-tier architecture consisting of four levels:

- Data Warehouse and data sources
- Business Analytics (tools for data manipulating, data mining, data analyzing all the data in the Data Warehouse)
- Performance and strategy (Business Process Management strategies)
- User Interface



# Components of a Business Intelligence System







# Data Warehouse - Definition

- Data Warehouse (DW) represents a BI system or a central repository, that stores the historical and current business data
- DW transforms business data and stores it in a structured way
- DW supports the decision-making process
- A DW is *“a subject-oriented, integrated, time-variant, nonvolatile collection of data in support of management’s decision-making process.”*

- Sharda, R., Delen, D., Turban, E.: Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4<sup>th</sup> Edition, Global Edition. Pearson Education, UK 2018, pp.42, ISBN: 978-1-292-22054-3 (2018)



# Data Warehouse - Characteristics

- The main characteristics of DW are:
  - **Subject oriented** – DW delivers information for a theme (sales, marketing, and so on)
  - **Integrated** – Integrating data from different data sources into a reliable format, naming conventions, codes, and so on.
  - **Time variant** – data is maintained in defined intervals of time
  - **Nonvolatile** – data stored in DW is read-only (cannot be modified or updated). Operations in DW: Data loading and Data Access

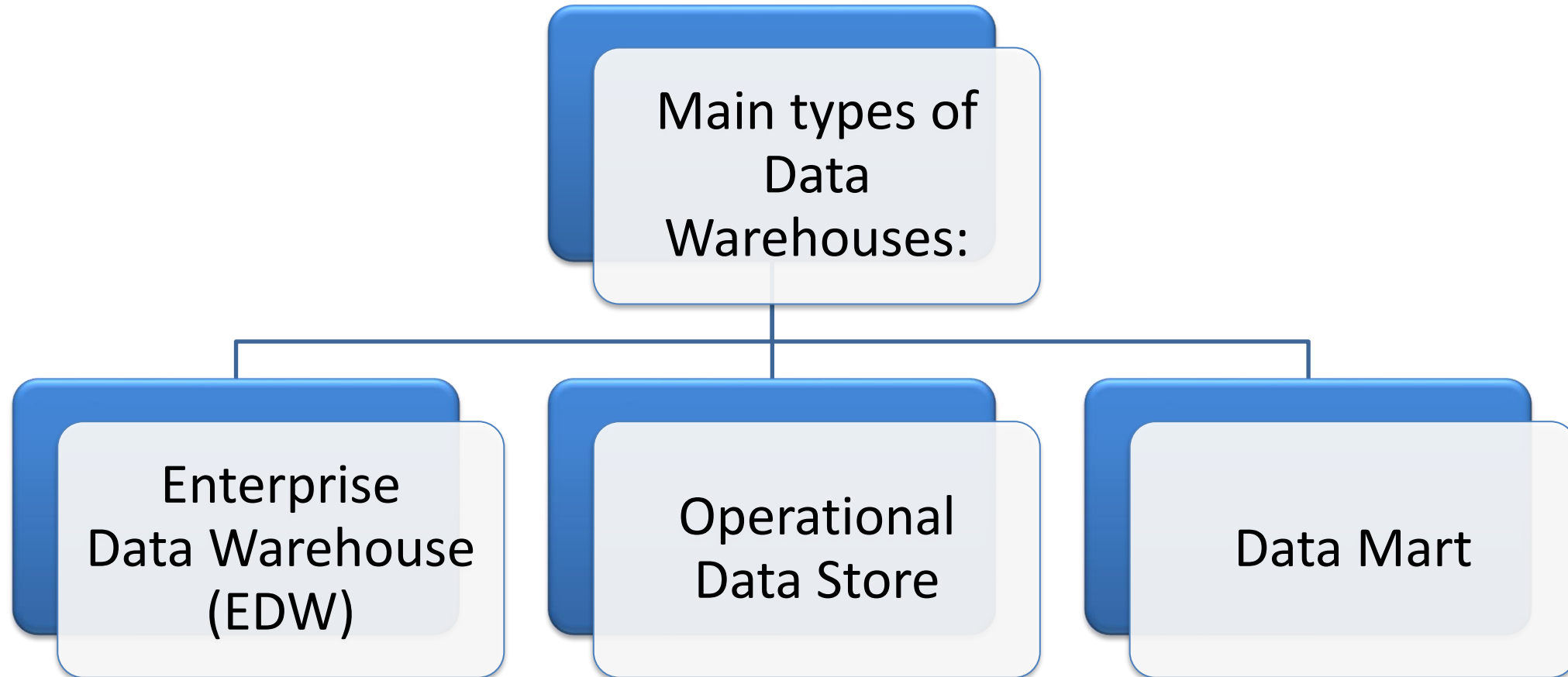


# Data Warehouse – Data types

- Data flows come from different data sources and has different data types
- Data flows have different data types:
  - **Structured data**
  - **Semi-structured data**
  - **Unstructured data**
- DW merges data into one central comprehensive database



# Data Warehouse Types





# Enterprise Data Warehouse

- Enterprise DW represents a data warehouse for large storage of data for large enterprises
- Enable storage of heterogeneous data from different data sources into a unified format
- Enables support for:
  - Customer relationship management (CRM)
  - Supply chain management (SCM)
  - Business performance management (BPM) and many more



# Operational Data Stores

- Operational Data Stores (ODS) are databases refreshed in real-time, supporting DW and Online Transaction Processing (OLTP)
- ODS is used for daily business routines, requiring fast and quick data updates
- ODS is used for quick short-term business decisions
- ODS stores only very recent information (DW stores permanent information)



# Data Marts

- Data Marts represent a single theme smaller database, representing a subset of DW
- Data Marts are focused only on one theme (subject area) such as marketing, finance, and so on
- Data Marts can be two types:
  - Dependent Data Mart
  - Independent Data Mart

# Metadata

- Metadata is all data that is about the available data in the DW
- Metadata is used for DW build, maintenance and management
- According to the use of Metadata:
  - Technical Metadata
  - Business Metadata
- According to the pattern view
  - Syntactic Metadata
  - Structural
  - Semantic





# Data Types and File Formats

Data can be also categorized as:

- Primary – generated data or collected data
- Secondary – data created from others
- Qualitative – data related to text, images, sound, and video recordings, and so on
- Quantitative – data related to numerical data



# Data Types and File Formats

Common classification of data types refers to the following:

- Observational
- Experimental
- Derived or compiled
- Simulation
- Reference or canonical



# Data Types and File Formats

- The data is available in various formats such as text, multimedia, numeric, code, software, models, specific data for a discipline or instruments, and so on
- The file formats provide sharing, access of data for a long period of time, and preservation of data.
- Choosing the appropriate data file formats for the purposes is crucial



# Extensible Markup Language (XML) File Format

- The XML file format is an extensible markup language file for representing structured information
- XML files are used for the storage and transport of structured data
- XML files contain tags (providing the structure of the data) and text (positioned between these tags)
- XML files provide: readability, compatibility, customizations, and many others

# JavaScript Object Notation (JSON) File Format

- JSON is a data-interchange file format (a subset of JavaScript syntax) for data store and data exchange
- JSON represents text written with JavaScript object notation
- Easy for humans to read and write
- Easy for machines to parse and generate
- Supported from modern languages for programming



# Comma-separated values (CSV) File Format

- CSV represents a simple format for structuring data in a plain text format
- CSV files stores data as database rows and columns
- Most spreadsheets programs support importing data from CSV file formats
- Supported from many applications for data management, data processing, and data extracting



# Data Warehouse Architecture

- Data Warehouse Architecture represents a BI information system storing current and historical data.
- The DW architecture can be:
  - **Single-tier architecture**
  - **Two-tier architecture**
  - **Three-Tier architecture**



# Data Warehouse Architecture – Three-Tier

The three-tier DW architecture is one of the most commonly used today.

## TOP-TIER

Client (front-end) software (Data Client workstation)

## MIDDLE TIER

Data acquisition (back-end) software, that communicates between top-tier and bottom tier (Application server)

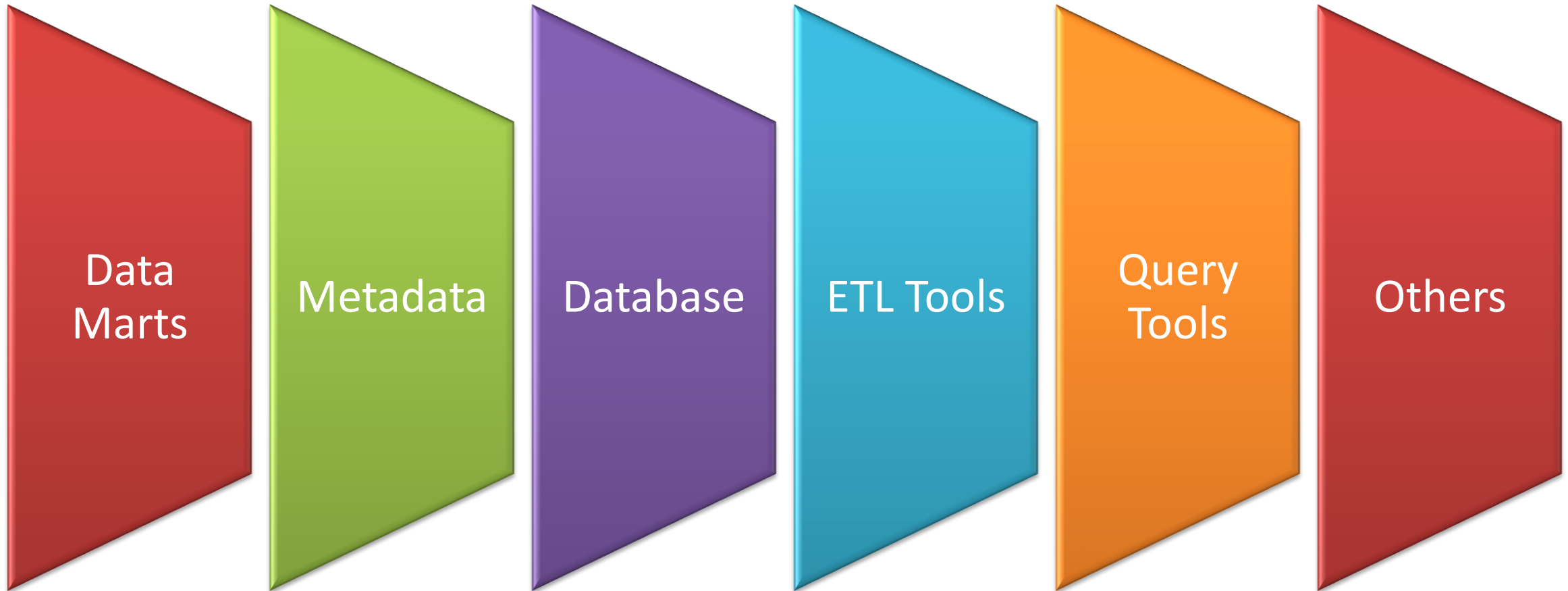
## BOTTOM TIER

Data warehouse containing data, software (Database server)





# Components of Data Warehouse Architecture





# Data Warehousing Process

The Data Warehousing process includes:

- Data Sources
- Data extraction and transformation
- Data loading
- Comprehensive database
- Metadata
- Middleware tools



# Extraction, Transformation and Loading (ETL)

- ETL tools read and extract data from data sources
- ETL tools transform heterogeneous data into a unified data format for Data warehousing
- ETL tools transport data from different sources of data to the Data Warehouse
- ETL process includes:
  - 1)**Extract**, 2)**Transform**, 3)**Load**



# Online Transaction Processing (OLTP)

- Online Transaction Processing systems often are responsible for capturing and storing data for current business activities
- OLTP represents an online transactional system
- OLTP provides tactical or operational decision support
- OLTP system stores operational data
- OLTP is efficient for transaction processing



# Online Analytical Processing (OLAP)

- Online Analytical Processing represents an online analysis and data retrieving process.
- OLAP represents an online database query management system
- OLAP uses the data from OLTP
- OLAP provides support for answering business and management queries



# Online Analytical Processing (OLAP)

## OLAP commonly used analytical operations

- Slice
- Dice
- Roll-up
- Drill-down
- Slice and dice
- Pivot



# OLTP vs OLAP

- OLTP transactions vs OLAP information
- OLTP is focused on business processes, strategy, transactions, and operations (operational day-to-day business data) – uses traditional Database Management Systems (DBMS).
- OLAP is focused on analysis and transformation of business data from Data Warehouse – uses the Data Warehouse
- OLTP (market-oriented) vs OLAP (customer-oriented)



# OLTP vs OLAP

- OLTP (simple queries) vs OLAP (complex queries)
- OLTP (numerous short online transactions) vs OLAP (massive amounts of data)
- OLTP (fast response time) vs OLAP (depending on the amount of data processed)
- OLTP (data source - transactions) vs OLAP (data source - aggregated data from transactions)





# Business Intelligence Benefits

- Facilitates and improves the efficient strategic decision-making process
- Improves business profitability and efficiency
- Operational reporting capabilities
- Real-time data delivery and data analysis
- Powerful BI Dashboards
- Business Analytics capabilities
- Data visualizations capabilities

# Popular BI Companies

- Examples of popular BI Companies:
  - Tableau Software
  - Sisense
  - Microsoft Business Intelligence
  - Geckoboard
  - Oracle BI
  - Power BI
  - Pentaho
  - Domo
  - GoodData
  - Targit
  - And many others



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