DATA WAREHOUSE

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OUTLINE

Users Problems and necessity for Data Warehouse

BI Definition and Components

Data Warehousing Concepts

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INTRODUCTION

There are 2 types of users: **Operational users** and **Decision-Maker users**

Operational users use **local data** while decision-makers use **historical data**

Database design is changed if data is used for take decision.

Data Warehousing is used for take decisions

Data Warehouses captures data different operational sources

Data Warehouses contain historical data

Operational Data :

Operational user

local data
gets frequent updates and queries
specific queries are needed

Historical Data:

Decision maker

"tells" about something
Very infrequent updates
Integrated data
Analytical queries that require huge amounts of aggregation
Query Performance is crucial

Example OLTP queries:

What is the salary of Mr .Johnson ? (point query)

What is address and phone number of Mr. Johnson ? (point query)

How many employees have received an 'excellent' credential in the last appraisal?

Example OLAP queries:

Is there a correlation between the geographical location of a company and profit of the company?

How is the age of the employee effect their performance ?

Is gender of a staff effect the performance ?

Data Problems and necessity for Data Warehouse

Without DW :

Data is everywhere and hard to manage

Same data is exist at different places

Data inconsistency

It is hard to deploy new data

Data is so complex and detailed

Data can not be analysed

There isn’t time series

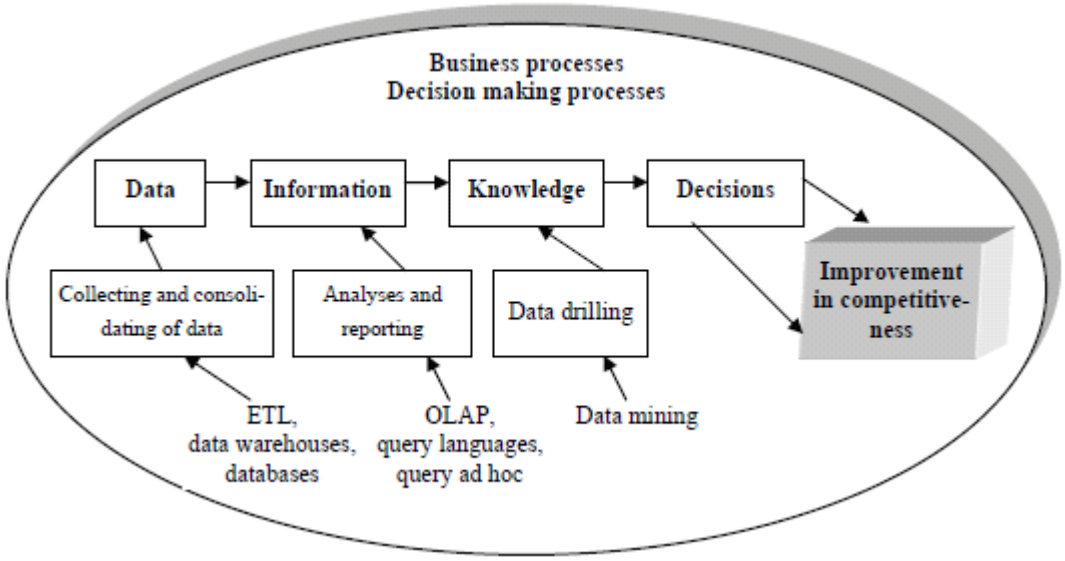
DECISION SUPPORT SYSTEM and The Origin of BUSINESS INTELLIGENCE

DECISION SUPPORT SYSTEM is a general name of any system to support decision-makers in the decision process.

DSS is the origin of the Business Intelligence system
Business intelligence is designed to support the process of decision-making

BI Definition

Business intelligence system –
A set of integrated tools, technologies and programmed products
used to collect, integrate, analyze, and make data (Koronios & Yeoh, 2010).



The Role of BI in decision making (Olszak & Ziemba, 2007, Figure 2, p.137)

Business Intelligence Systems:

Includes all technologies for gathering and analysing data

Provide the input to strategic and tactical decions at senior managerial levels

Managerial level don’t need daily information, they need historical, strategical data.

Companies invest large amount of money to BI technologies

Query driven Approach and Data Warehouse based

Disadvantages of Query driven Approach:

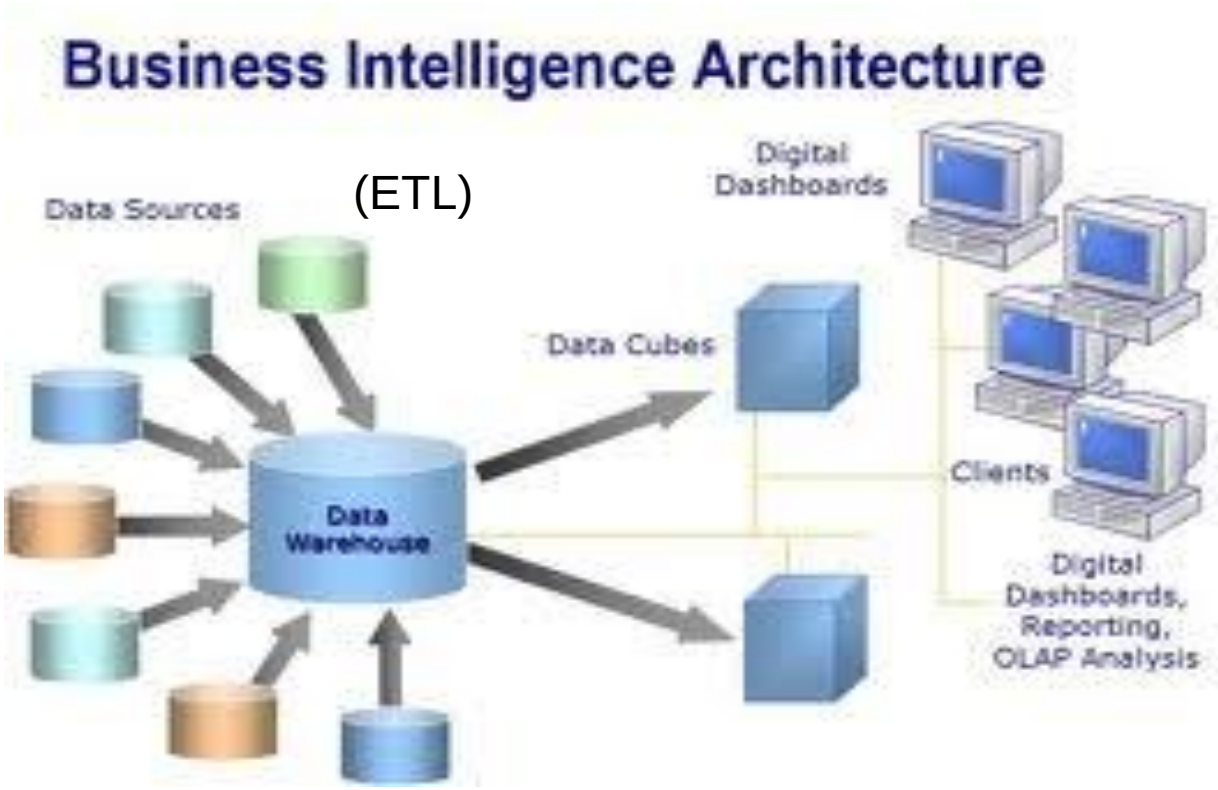
- Data is up to date, slowly queries because of transactions
- Historical data doesn't exist
- The Query Driven Approach needs complex integration and filtering processes, aggregation. So it is slow.
- This approach is very inefficient
- This approach is very expensive for frequent queries
- Competes with local processing at sources

Data Warehousing Approach

- This is the approach commonly used in BI systems.
- In this approach; the information from multiple heterogeneous sources is integrated in advance and stored in a warehouse.
- There is another database other than running database.
- The data in the database is stored in a data warehouse in periodically.
- Users don't access database directly, they access Data Warehouse for querying.
- This approach provides high performance.
- Data Warehouse also contains historical data

BI Components

- Data Warehouse (also called as OLAP systems)
- OLAP Cubes
- Dashboards
- ETL (Extract, Transform, Load)
- Data Mining



- Data Mining
- Take decision

Decision-makers use dashboard that contains report, analysis, chart, maps, etc.

Some Definitions of Data Warehousing

Data warehouse –
A subject oriented, collection of data used to support decision making in organizations (Anderson et al., 2008).

Data warehousing - A systematic approach to collecting relevant business in order to organize
and validate the data so that it can be analyzed to support
business decision making
(Cody et al., 2002).

A Data Warehouse is a subject-oriented, integrated, time-varying, non-volatile collection of data that is used primarily in organizational decision making."

-- W.H. Inmon, Building the Data Warehouse, 1992

A Data Warehouse is...

Subject-oriented, Organized by subject, not by application

Used for analysis, data mining

Optimized differently from transaction-oriented database

Single repository of information

Data Warehousing involves data cleaning, data integration and data consolidation

Supports analytical reporting, ad-hoc queries and decision making

User interface aimed at executive

Data Marts

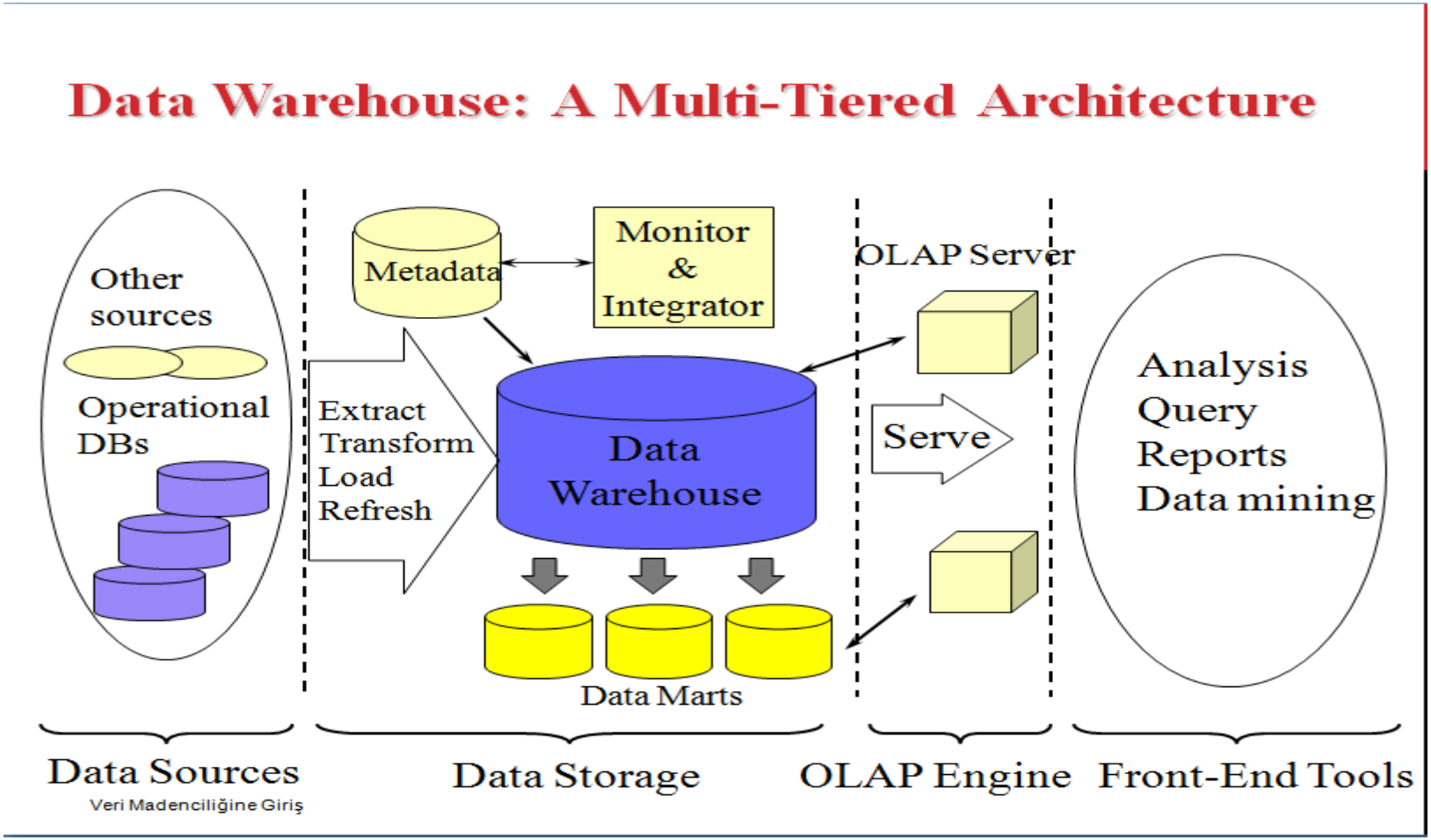
A data mart is a subset of the data warehouse. This data is specific to a particular group . Data warehouses are collection of "data marts".

Data marts are also seen as small warehouses for OLAP activities

It deals with specific information. For example, although a data warehouse includes the all data of an organization, a data mart includes the data of a department. The data mart is organized for regarding people. So these people don’t need to understand all the data, it is sufficient to understand the regarding data mart.

Management and autherization would be easierr when using data marts.

Generic Warehouse Architecture



Differences Between Operational Systems and Data Warehousing Systems

An **operational database** stores information about the activities of an organization

The purpose of an operatioanal system is
providing online querying and processing, daily routines
Operational systems are also called as **OLTP** (Online Transactional Processing)

Data Warehouses help users to data analyze and make decisions

Warehouse is a Specialized DB
Data Warehousing Systems are also called as **OLAP** (Online Analytical Processing)

OLAP vs OLTP

	OLTP	OLAP
users	clerk, IT professional	knowledge worker
function	day to day operations	decision support
DB design	application-oriented (ER)	subject-oriented (star schema)
data	current, up-to-date detailed, flat relational isolated	historical, summarized, multidimensional integrated, consolidated
usage	repetitive	ad-hoc
access	read/write index/hash on prim. key	lots of scans
unit of work	short, simple transaction	complex query
# records accessed	tens	millions
#users	thousands	hundreds
DB size	100MB-GB	100GB-TB
metric	transaction throughput	query throughput, response

Types of OLAP Servers

•Multidimensional OLAP (MOLAP) : array-based multi dimensional storage

•Relational OLAP(ROLAP) : Uses Relational Database. Includes aggregation, additional tools and services.

•Hybrid OLAP (HOLAP) : Both MOLAP and ROLAP

•Specialized SQL Servers

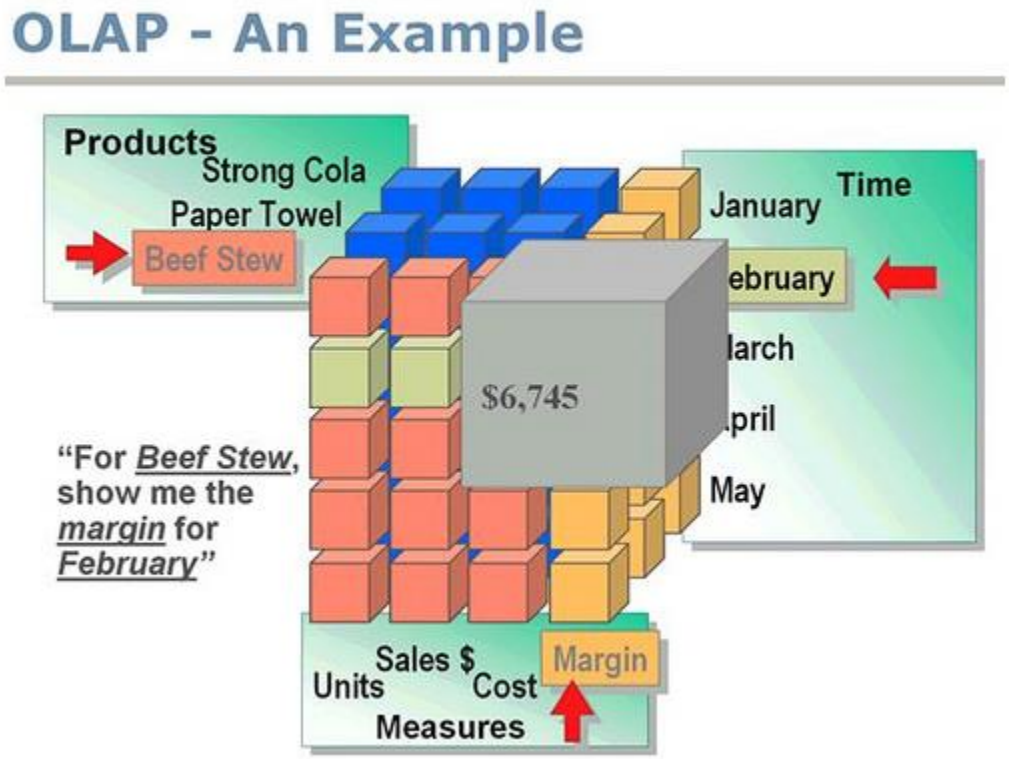
OLAP CUBES

Data cube help us to represent data in multiple dimensions.
The data cube is defined by dimensions and facts. The dimensions are the entities with respect to which an enterprise keeps the records.

OLAP cube is the main object of the OLAP. This cube is a multi-dimensional cube. The components of a cube are:
fact table, dimension tables and measures.

The cube concept is used to understand multi-dimensional model better. Data cubes are used for people that don't have advanced database knowledge. The cubes are capable of analyzing data from multiple dimensions.
Relational databases are not suitable for very large data. So, OLAP cube is created from these data for an easy analyze.
If there are more than 3 dimensions in a cube, it is called hypercube.

OLAP CUBE Example



(Modelling Types) Schema Types in Data Warehousing

Some modelling types:

Star Schema

Flat schema

Terraced Schema

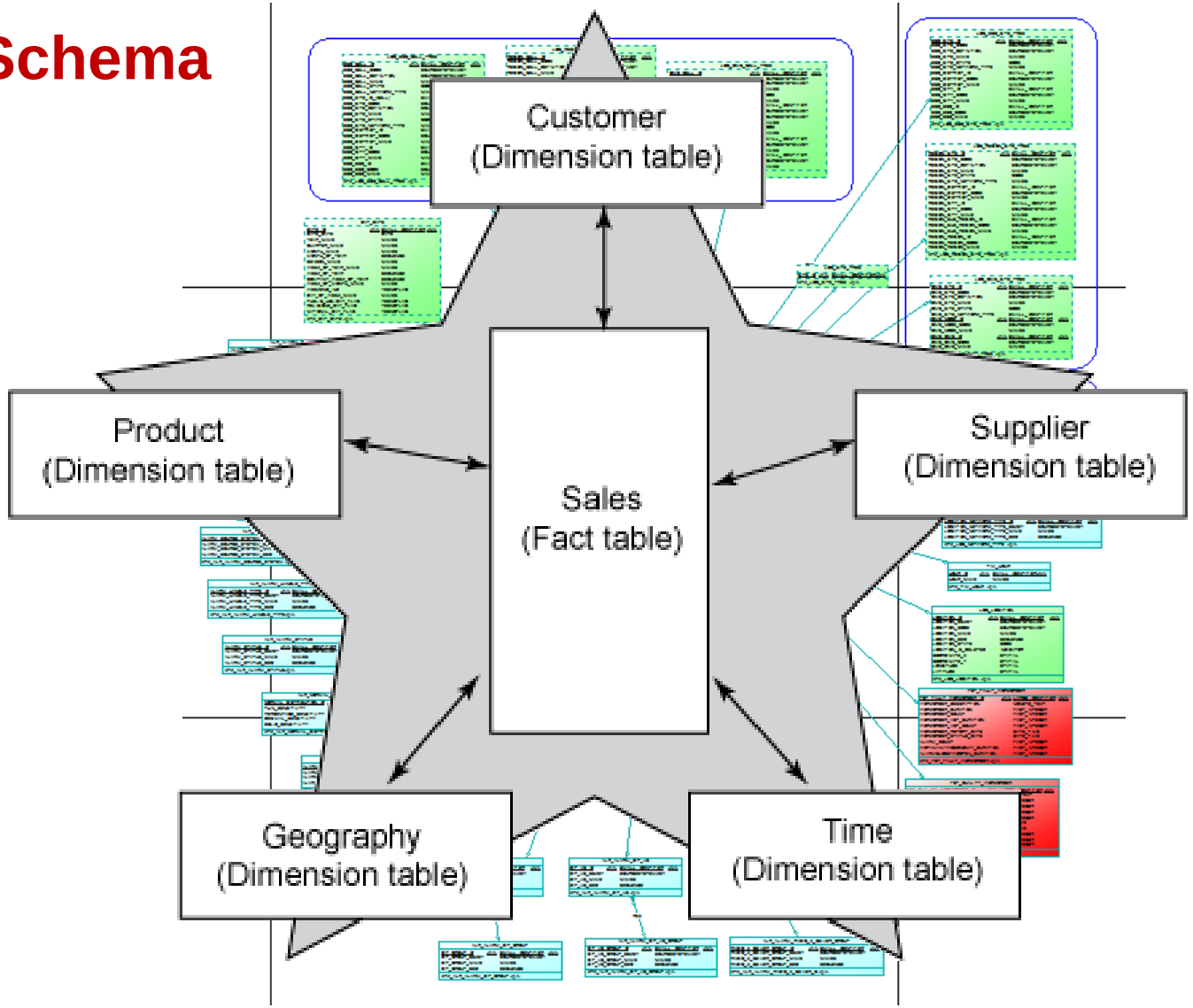
Snowflake Schema

Star Cluster Schema

Fact Constellation Schema , ..

•Data normalization in DW is not as important as OLTP systems

Star Schema


Customer
(Dimension table)
Product
(Dimension table)
Sales
(Fact table)
Supplier
(Dimension table)
Geography
(Dimension table)
Time
(Dimension table)

Charecteristics of Fact and Dimension Tables

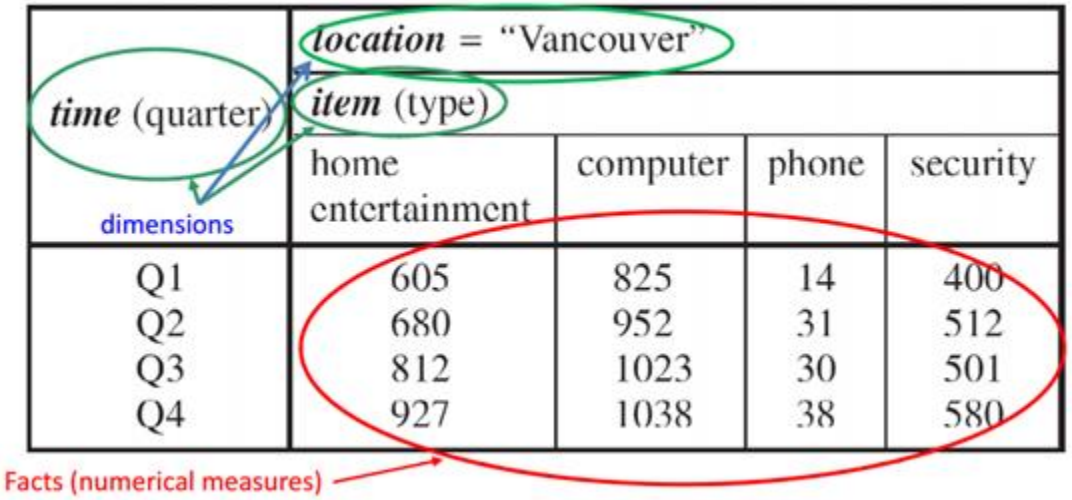
Fact table:

- Contains numeric values that called measurements
- Contains **huge** size of data
- Expand fast and quickly
- Includes stable, derived, summarized, aggregated data
- Have foreign key relation with dimension tables

Dimension tables:

- Are Reference tables
- Generally includes text type data that users want to see
- Generally includes static data
- Data size is low

Example:



time (quarter)	location = "Vancouver"			
	item (type)			
	home entertainment	computer	phone	security
Q1	605	825	14	400
Q2	680	952	31	512
Q3	812	1023	30	501
Q4	927	1038	38	580

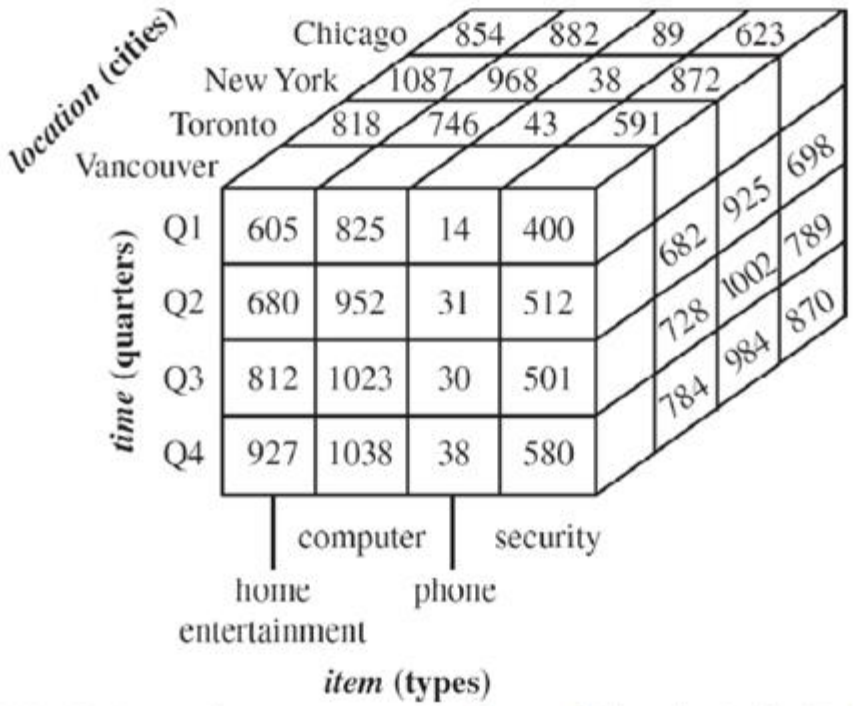
Table 1: 2-D view of sales data according to the dimensions time and item, where location is 'Vancouver'.
The mesure displayed is dollar in thousand

Example:

	location = "Chicago"				*location* = "New York"				*location* = "Toronto"				*location* = "Vancouver"			
time	*item*				*item*				*item*				*item*			
	home ent.	comp.	phone	sec.	home ent.	comp.	phone	sec.	home ent.	comp.	phone	sec.	home ent.	comp.	phone	sec.
Q1	854	882	89	623	1087	968	38	872	818	746	43	591	605	825	14	400
Q2	943	890	64	698	1130	1024	41	925	894	769	52	682	680	952	31	512
Q3	1032	924	59	789	1034	1048	45	1002	940	795	58	728	812	1023	30	501
Q4	1129	992	63	870	1142	1091	54	984	978	864	59	784	927	1038	38	580

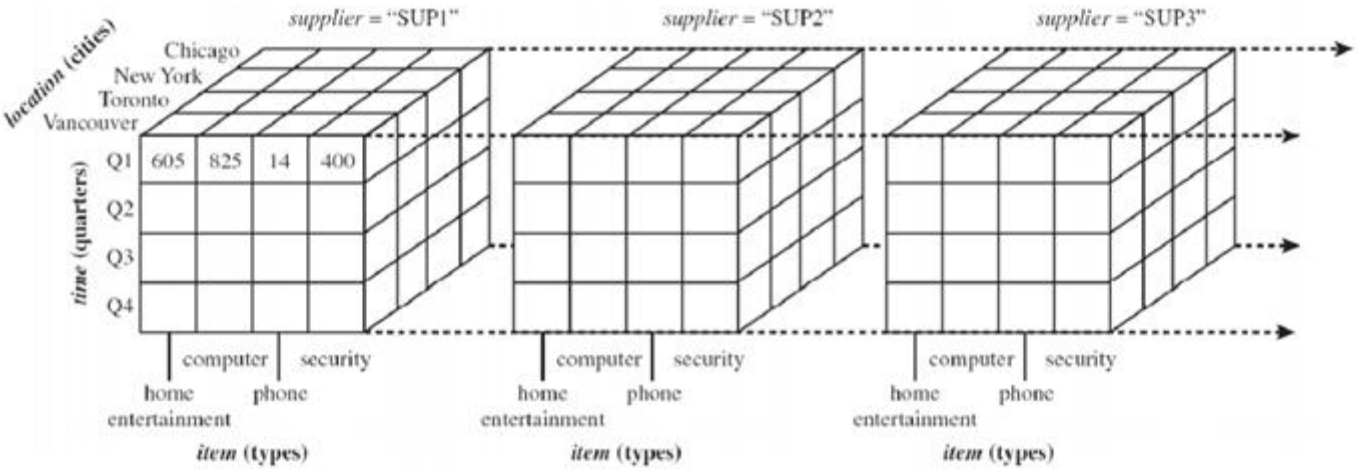
Table 2: 3-D view of sales data according to the dimensions time, item and location. The measure displayed in dollar-sold in thousand

Example:



3-D data cube representation of the data in table 2

Example:



4-D data cube representation, according to the dimensions time, item, location and supplier

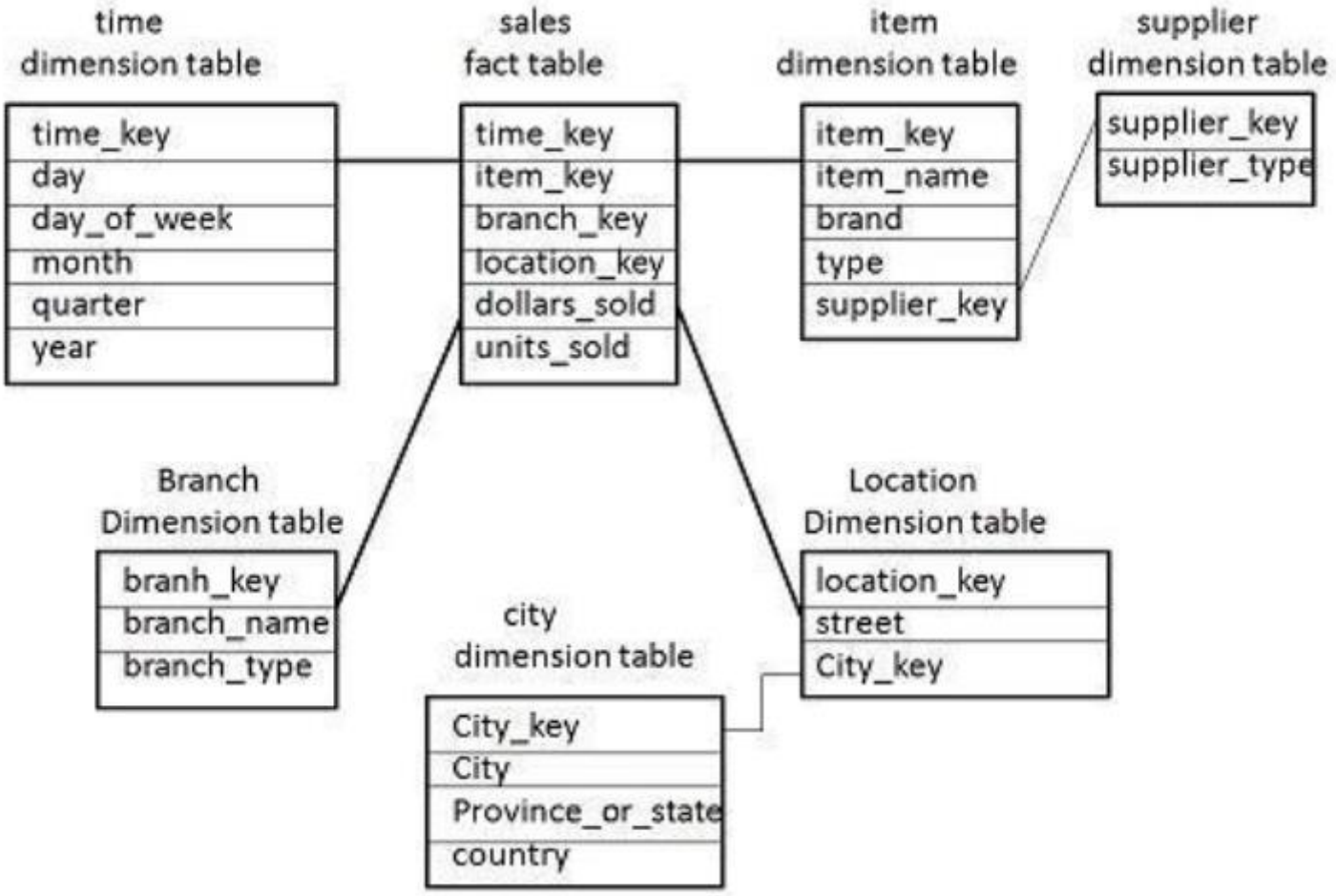
Snowflake Schema

- There is only one fact table
- Some dimension tables are normalized
- Due to normalization,

  redundancy is reduced

  therefore it becomes easy to maintain and save storage space

Snowflake Schema Example



Data Mining Query Language (DMQL)

DMQL is a SQL based language. First, it is developed for data mining process.

But, It can be also used for describing data warehouses elements.

SYNTAX FOR CUBE DEFINITION
define cube < cube_name > [< dimension-list > }: < measure_list >

SYNTAX FOR DIMENSION DEFINITION
define dimension < dimension_name > as (< attribute_or_dimension_list >)

DMQL (Data Mining Query Language) Examples

Star Schema of Sales Cube Definitons:

define cube sales star [time, item, branch, location]:

dollars sold = sum(sales in dollars),

define dimension time as (time key, day, month, year)

define dimension item as (item key, item name)

define dimension location as (location key, street, postal code, city)

The Conversion of a Relational Database into a Multidimensional Database

- *Find Subjects and Data Marts*
- *Find all dimensions that exist but are hidden* in a relational database schema
- *Knowledge (measurements)*

OLAP OPERATIONS

- Roll-up : Performs aggregation on a data cube
- Drill-down : reverse of the roll-up
- Slice : Performs selection on a dimension of a cube
- Dice : Performs selectşon on two or more dimensions
- Pivot (rotate) : It rotates data axes

SUMMARY

- OLAP vs OLTP
- BI components are DW, OLAP, Cubes, Dashboards, ETL and Data Mining
- DW is subject oriented data and used in Decision Support Systems
- DW is also called OLAP
- DW includes time dimension, historical data
- Querying and analysing data is easy on DW system
- Generally managers use DW to query
- Star-Schema structure is used in DW at most (fact, dimensions, measures)

Thank You & Any Question ?