



Lisbon School  
of Economics  
& Management  
Universidade de Lisboa



Carlos J. Costa


# BUSINESS INTELLIGENCE

# Business Intelligence

- What is Business Intelligence?
- Business Analytics
- BI Products and vendors
- Datawarehouse
- Predictive analytics
- Big Data Analytics
- Internet of Things (IoT)
- Location Analytics and Geographic Information Systems
- Decision Support for Senior Management
- Decisions Support Techniques
- Multidimensional Structure

# What Is Business Intelligence?

# What Is Business Intelligence?

- Business intelligence
    - Infrastructure for
      - collecting,
      - storing
      - analyzing
    - Databases, data warehouses, data marts
- data produced by business
- 

# Business Intelligence

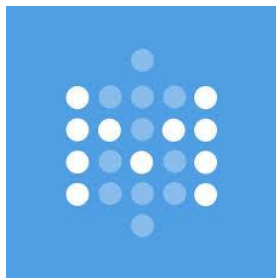
- Goal is to deliver accurate real-time information to decision makers
- Main analytic functionalities of BI systems
  - Production reports
  - Parameterized reports
  - Dashboards/scorecards
  - Ad hoc query/search/report creation
  - Drill down
  - Forecasts, scenarios, models

# Business analytics

- Tools and techniques for analysing data
- OLAP, statistics, models, data mining

# Business intelligence vendors

- Business intelligence and analytics software
- E.g. Pentaho, Jasper, Qlikview, Tableau, PowerBI, Metabase ...

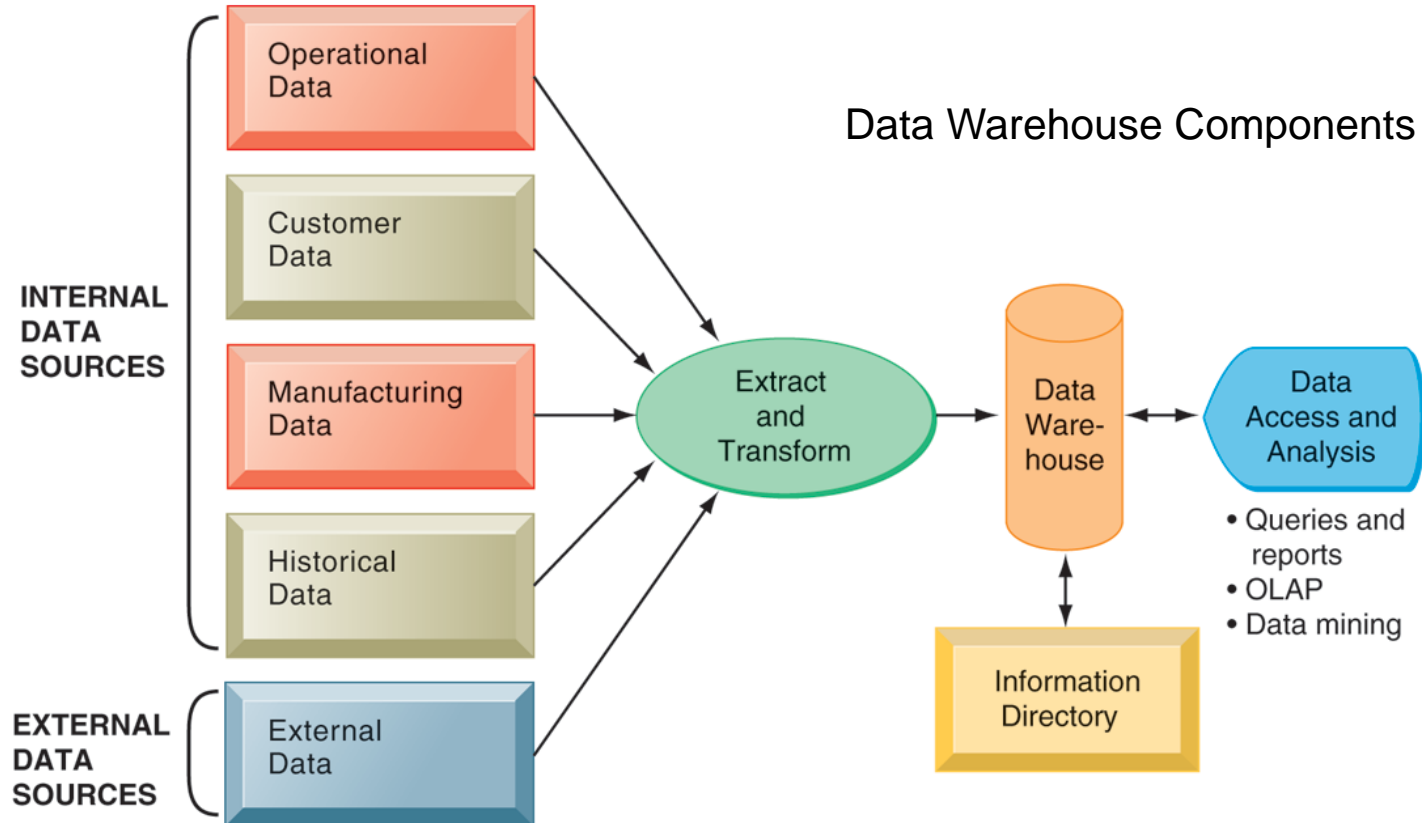


# Data Warehouse

- Central repositories
- Integrate data from one or more disparate sources.
- Store current and historical data in one single place
- Are used for creating analytical reports for workers throughout the enterprise.



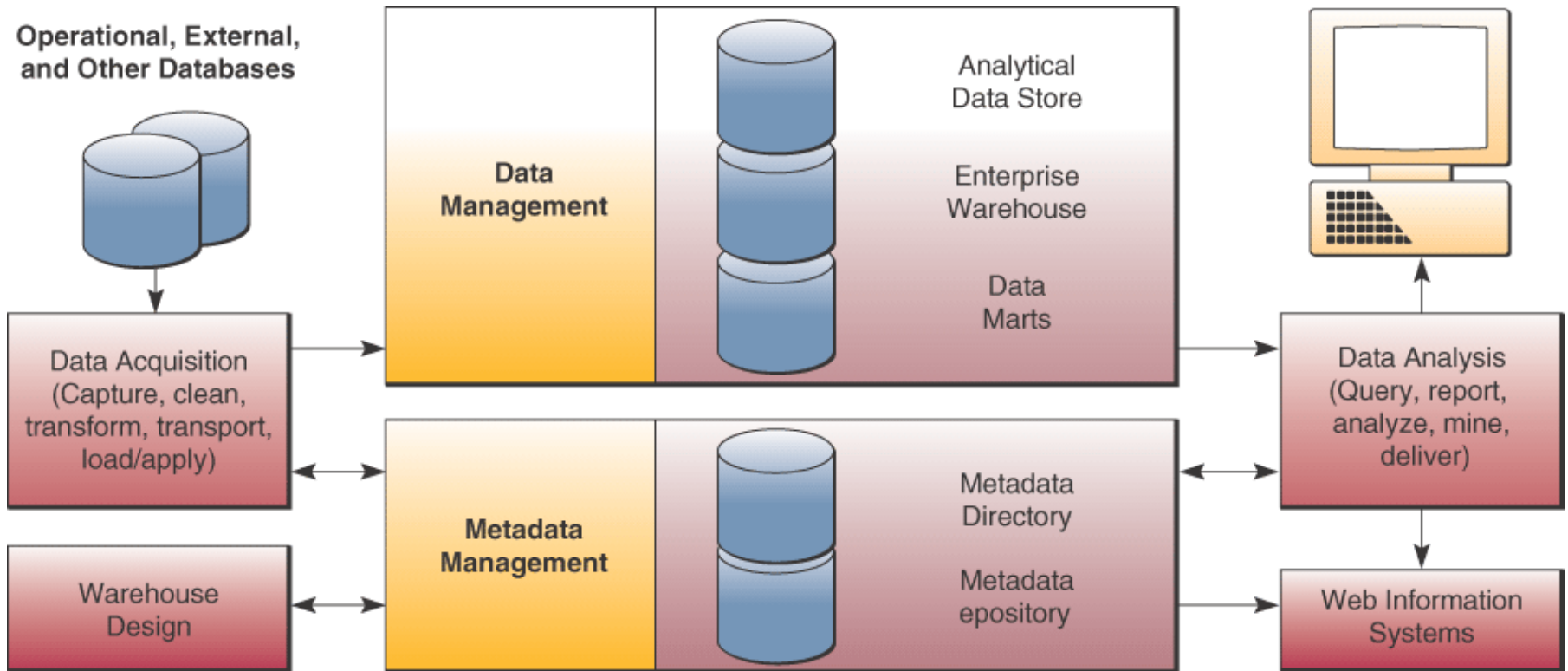
# Data Warehouse



Laudon & Laudon (2012)

# Data Warehouse

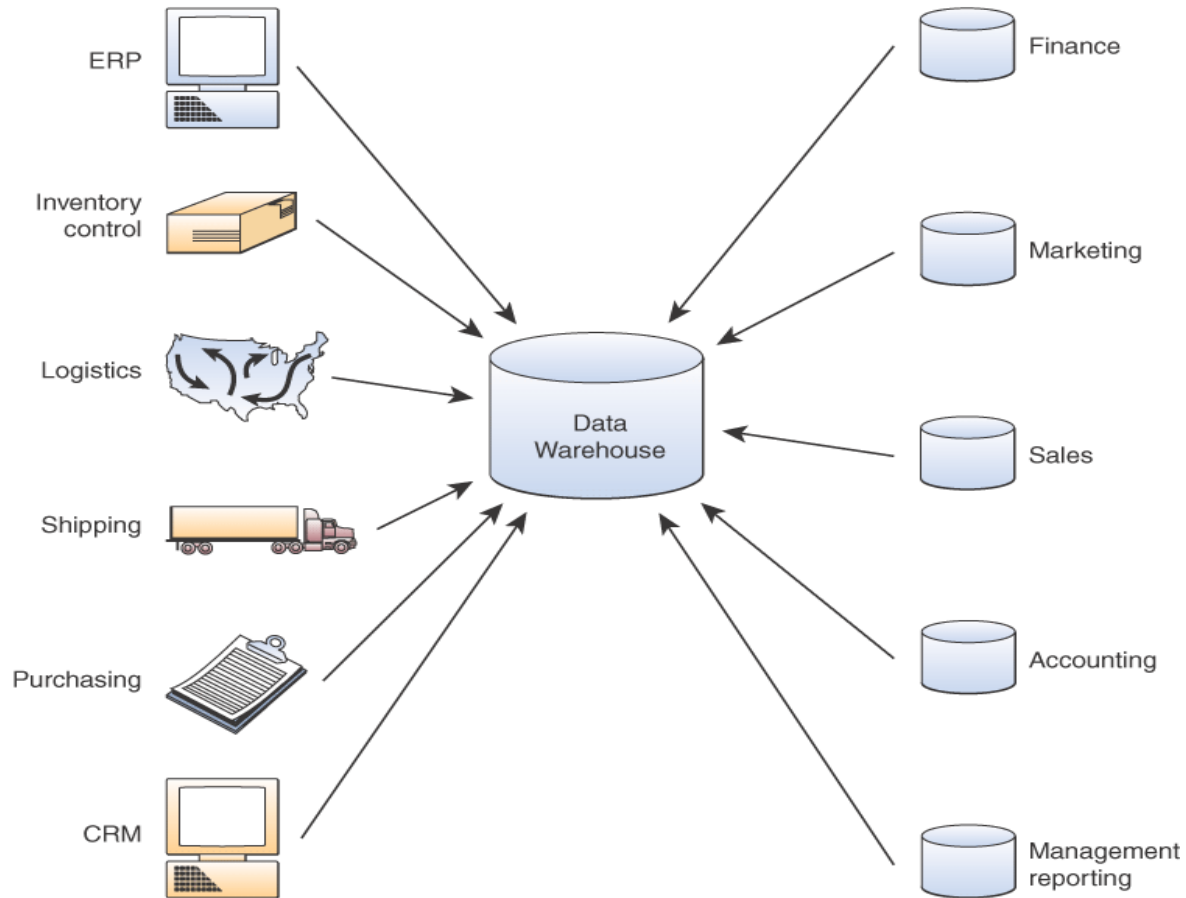
## Data Warehouse Components



Laudon & Laudon (2012)

# Data Warehouse

Applications



Data  
Marts

O'Brien & Marakas, 2011

# Predefined Production Reports

BUSINESS FUNCTIONAL AREA	PRODUCTION REPORTS
Sales	Forecast sales; sales team performance; cross-selling; sales cycle times
Service/call center	Customer satisfaction; service cost; resolution rates; churn rates
Marketing	Campaign effectiveness; loyalty and attrition; market basket analysis
Procurement and support	Direct and indirect spending; off-contract purchases; supplier performance
Supply chain	Backlog; fulfillment status; order cycle time; bill of materials analysis
Financials	General ledger; accounts receivable and payable; cash flow; profitability
Human resources	Employee productivity; compensation; workforce demographics; retention

# Predictive Analytics

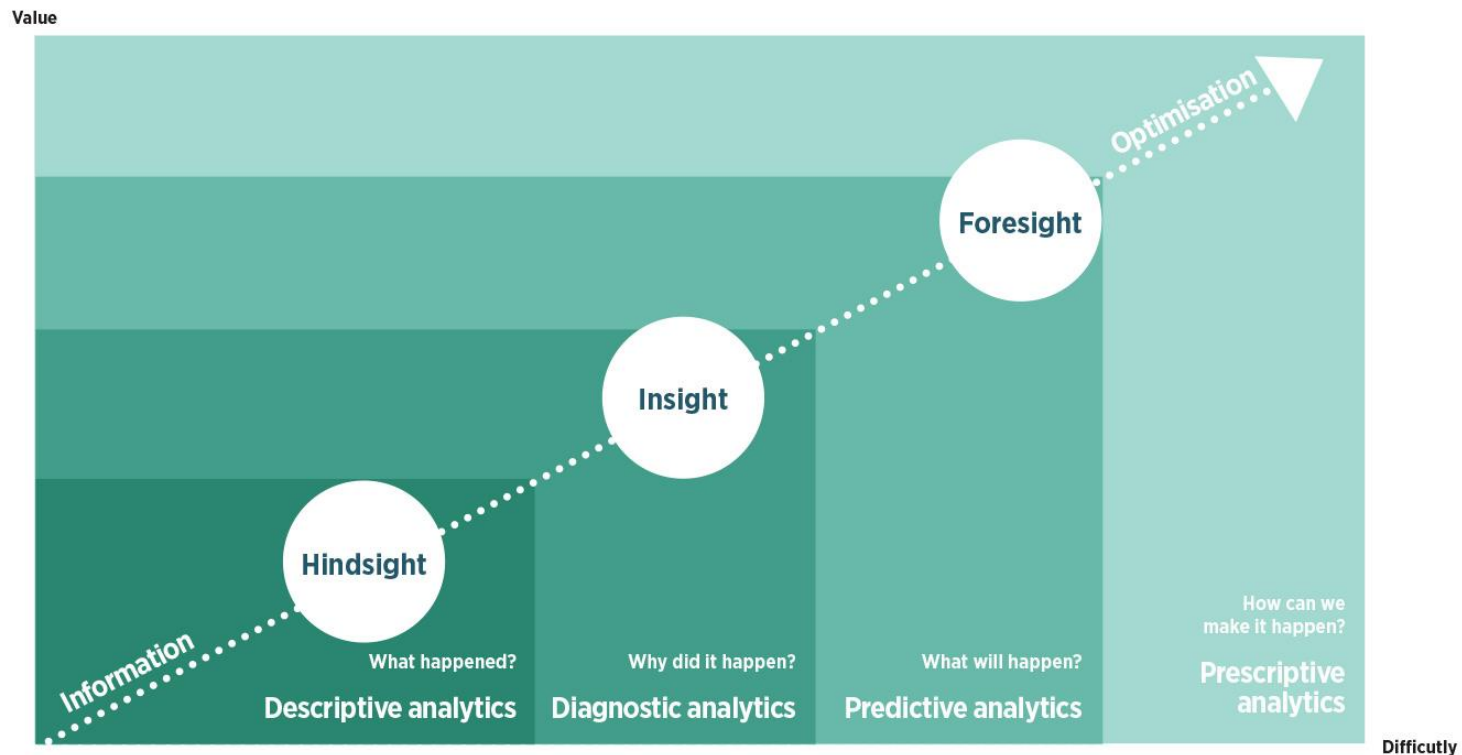
- Uses variety of data, techniques to predict future trends and behavior patterns
  - Statistical analysis
  - Data mining
  - Historical data
  - Assumptions
- Incorporated into numerous BI applications for sales, marketing, finance, fraud detection, health care
  - Credit scoring
  - Predicting responses to direct marketing campaigns

# Predictive Analytics

- <https://trends.google.com/>
- [https://trends.google.pt/trends/explore?date=all&q=%2Fg%2F11\\_p4w4lm,%2Fg%2F125n18f5v,%2Fm%2F03c6\\_\\_1,%2Fg%2F1z3t20rmg](https://trends.google.pt/trends/explore?date=all&q=%2Fg%2F11_p4w4lm,%2Fg%2F125n18f5v,%2Fm%2F03c6__1,%2Fg%2F1z3t20rmg)

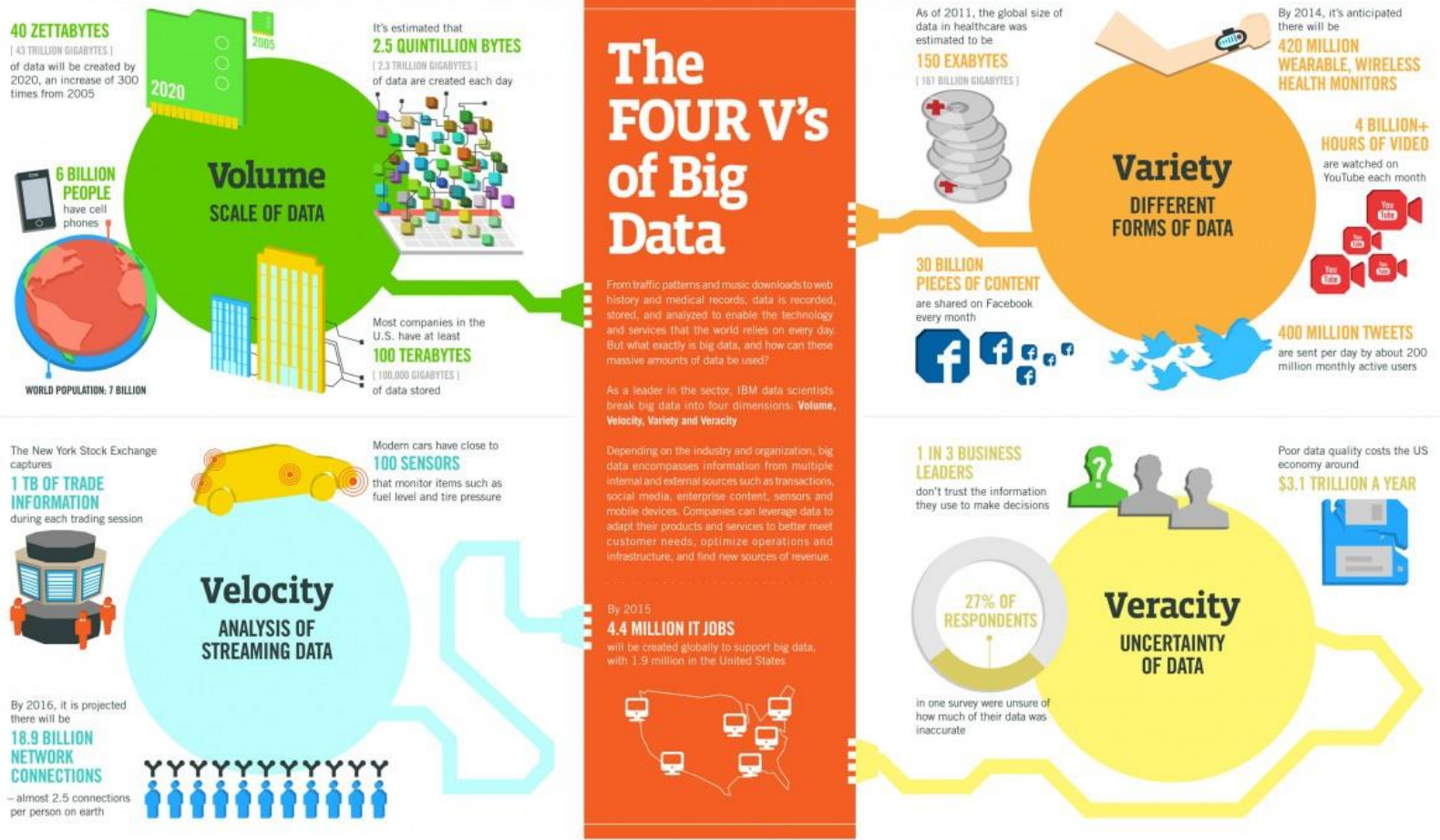
# Predictive Analytics

## MEASURING THE DIFFICULTY AND VALUE OF ANALYTICS



Source: Gartner

# Big Data Analytics



Sources: McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MEPTec, QAS



Source: <https://www.ibmbigdatahub.com/infographic/four-vs-big-data>



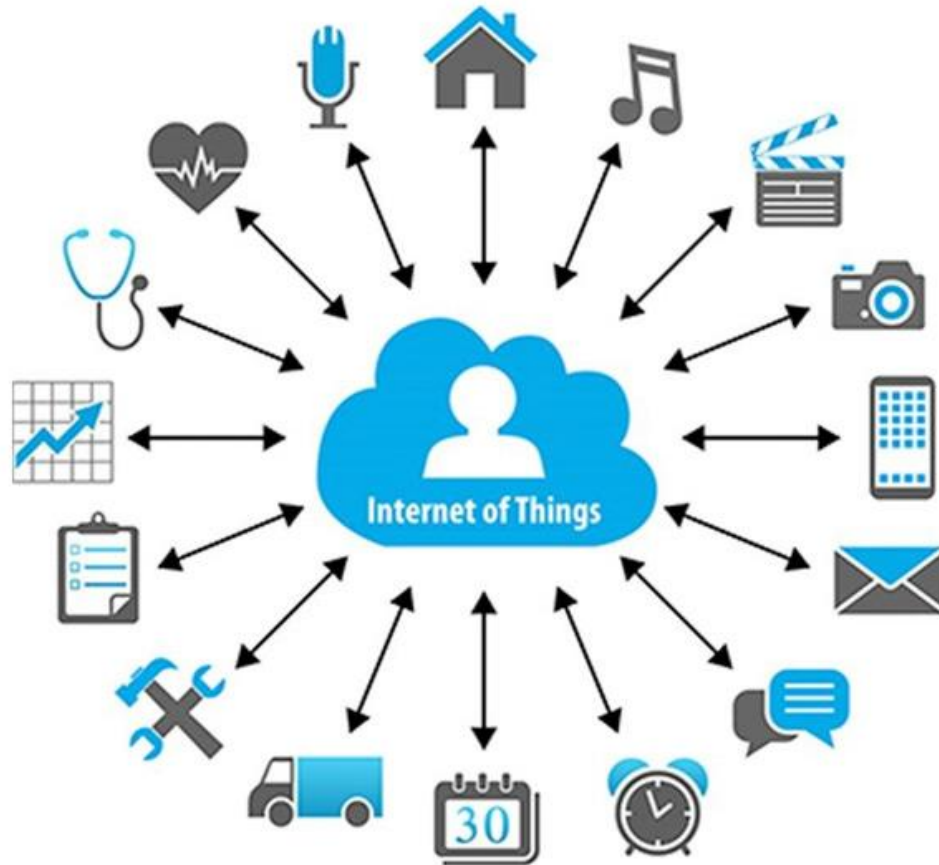
# Big Data Analytics

- <https://www.youtube.com/watch?v=6seM6mYUEzo>

# Big Data Analytics

- Big data: Massive datasets collected from social media, online and in-store customer data, and so on
- Help create real-time, personalized shopping experiences for major online retailers
- Smart cities
  - Public records
  - Sensors, location data from smartphones
  - Ability to evaluate effect of one service change on system

# Internet of Things (IoT)



# Internet of Things (IoT)

- Collection and use of data generated by sensors
- Creating huge streams of data from web activities, sensors, and other monitoring devices

# Location Analytics and Geographic Information Systems

- Location analytics
  - Ability to gain business insight from the location (geographic) component of data
    - Mobile phones
    - Sensors, scanning devices
    - Map data
- Geographic information systems (GIS)
  - Ties location-related data to maps
  - Example: For helping local governments calculate response times to disasters

# Location Analytics and Geographic Information Systems

- Google Maps

# Decision Support for Senior Management

**Power Users:  
Producers  
(20% of employees)**

## Capabilities

**Casual Users:  
Consumers  
(80% of employees)**

IT developers

Production Reports

Customers/Suppliers  
Operational employees

Super users

Parameterized Reports

Senior managers

Business analysts

Dashboards/Scorecards

Managers/Staff

Analytical modelers

Ad hoc queries; Drill down  
Search/OLAP

Business analysts

Forecasts; What if  
Analysis; statistical models

Laudon & Laudon (2012)

# Decision Support for Senior Management

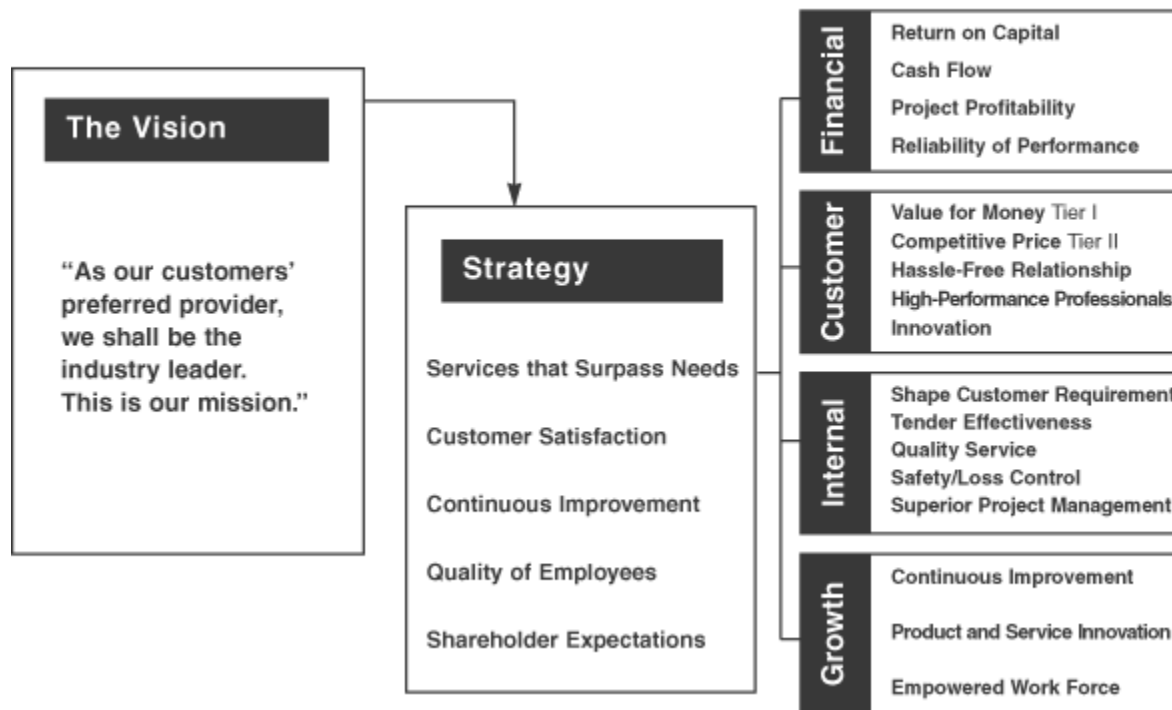
- ESS: decision support for senior management
  - Help executives focus on important performance information
- Balanced scorecard method
  - Measures outcomes on four dimensions
    - Financial
    - Business process
    - Customer
    - Learning and growth
  - Key performance indicators (KPIs) measure each dimension



# Decision Support for Senior Management

## The Balanced Scorecard Framework

### Rockwater's Strategic Objectives



Kaplan & Norton (1993)

# Decision Support for Senior Management

- Key Performance Indicator (KPI)
  - is a type of performance measurement.
  - the physical values which are used to measure, compare and manage the overall organizational performance
  - evaluate the success of an organization or of a specific activity (e.g. programs, projects, products and other initiatives).

# Decision Support for Senior Management

- Key Performance Indicator (KPI)
- Strategy -> Objectives
- KPY= Objectives +Measurements
- Must be **SMART**
  - **S**pecific
  - **M**easurable
  - **A**chievable
  - **R**elevant (aligned with strategy).
  - **T**ime-bound (reached in specific time range)

# Decision Support for Senior Management

- Business performance management (BPM)
  - Translates firm's strategies (e.g., differentiation, low-cost producer, scope of operation) into operational targets
  - KPIs developed to measure progress toward targets
- Data for ESS
  - Internal data from enterprise applications
  - External data such as financial market databases
  - Drill-down capabilities

# Decisions Support Techniques

- Decision-support systems
  - Support for semistructured decisions
- Use mathematical or analytical models
- Allow varied types of analysis
  - “What-if” analysis
  - Sensitivity analysis
  - Backward sensitivity analysis
  - Multidimensional analysis / OLAP
    - For example: pivot tables

# Decisions Support Techniques

## Sensitivity Analysis

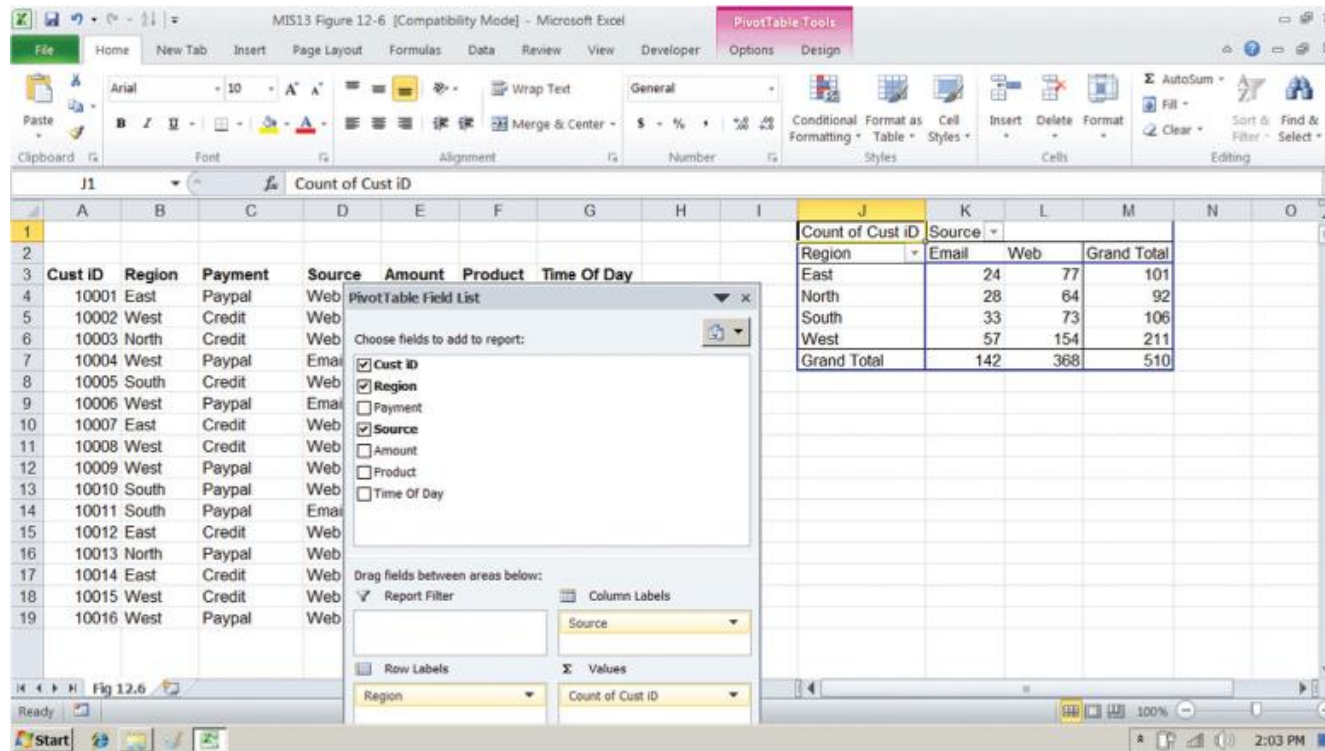
Total fixed costs	19000					
Variable cost per unit	3					
Average sales price	17					
Contribution margin	14					
Break-even point	1357					
			Variable Cost per Unit			
Sales	1357	2	3	4	5	6
Price	14	1583	1727	1900	2111	2375
	15	1462	1583	1727	1900	2111
	16	1357	1462	1583	1727	1900
	17	1267	1357	1462	1583	1727
	18	1188	1267	1357	1462	1583

Laudon & Laudon (2012)

# Decisions Support Techniques

## A Pivot Table

## Examining Customer Regional Distribution and Advertising



Laudon & Laudon (2012)

# Decisions Support Techniques

- Group Decision-Support Systems (GDSS)
  - Interactive system to facilitate solution of unstructured problems by group
  - Specialized tools
    - Virtual collaboration rooms
    - Software to collect, rank, edit participant ideas and responses
  - Promotes collaborative atmosphere, anonymity
  - Cisco's Collaboration Meeting Rooms Hybrid (CMR)
  - Skype for Business



# Multidimensional structure

- a variation of the relational model that uses multidimensional structures to organize data and express the relationships between data

O'Brien & Marakas (2009).

# Dimensional Schema

- Primary keys
- Foreign keys
- Fact tables
- Dimension Tables
- Star schemas
- Snowflake schemas

# Primary key

- A primary key is a column or a set of columns in a table whose values uniquely identify a row in the table.
- A relational database is designed to enforce the uniqueness of primary keys by allowing only one row with a given primary key value in a table.

# Foreign key

- is a column or a set of columns in a table whose values correspond to the values of the primary key in another table.
- In order to add a row with a given foreign key value, there must exist a row in the related table with the same primary key value.
- The primary key/foreign key relationships between tables in a star or snowflake schema, sometimes called many-to-one relationships, represent the paths along which related tables are joined together in the database.

# Dimension tables

- A *dimension table* is a table in a star or snowflake schema that stores attributes that describe aspects of a dimension.
- For example, a time table stores the various aspects of time such as year, quarter, month, and day.
- A foreign key of a fact table references the primary key in a dimension table in a many-to-one relationship.

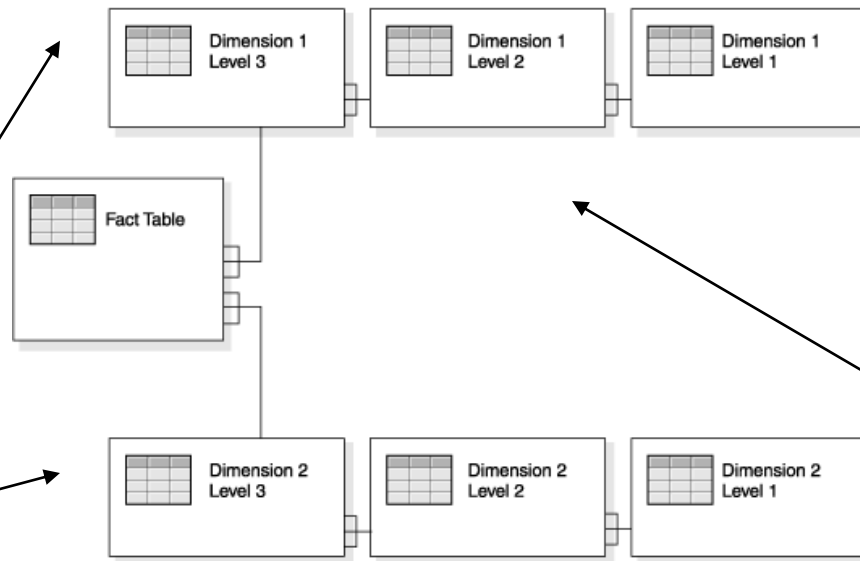
# Fact table

- A fact table is a table in a star or snowflake schema that stores facts that measure the business, such as sales, cost of goods, or profit.
- Fact tables also contain foreign keys to the dimension tables.
- These foreign keys relate each row of data in the fact table to its corresponding dimensions and levels.

# Snowflake schemas

- A snowflake schema can have any number of dimensions and each dimension can have any number of levels.

Snowflake Schema

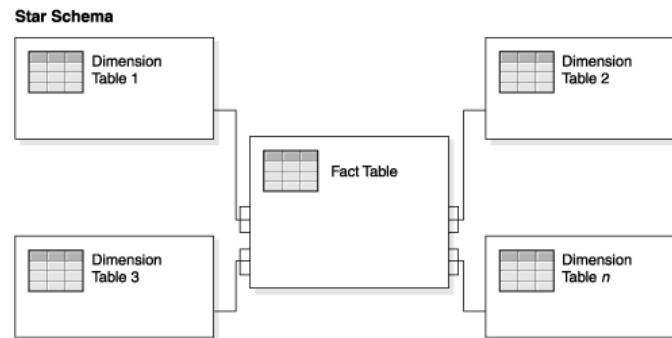


- snowflake schema with two dimensions,
  - each having three levels.

Source: IBM

# Star schemas

- A star schema can have any number of dimension tables.
- The multiple branches at the end of the links connecting the tables indicate a many-to-one relationship between the fact table and each dimension table.



- star schema with a single fact table and four dimension tables.

Source: IBM



# Snowflake vs. Star Schema

## Comparison chart

	Snowflake Schema	Star Schema
<b>Ease of maintenance / change</b>	No redundancy and hence more easy to maintain and change	Has redundant data and hence less easy to maintain/change
<b>Ease of Use</b>	More complex queries and hence less easy to understand	Less complex queries and easy to understand
<b>Query Performance</b>	More foreign keys-and hence more query execution time	Less no. of foreign keys and hence lesser query execution time
<b>Type of Datawarehouse</b>	Good to use for datawarehouse core to simplify complex relationships (many:many)	Good for datamarts with simple relationships (1:1 or 1:many)
<b>Joins</b>	Higher number of Joins	Fewer Joins
<b>Dimension table</b>	It may have more than one dimension table for each dimension	Contains only single dimension table for each dimension
<b>When to use</b>	When dimension table is relatively big in size, snowflaking is better as it reduces space.	When dimension table contains less number of rows, we can go for Star schema.
<b>Normalization/ De-Normalization</b>	Dimension Tables are in Normalized form but Fact Table is still in De-Normalized form	Both Dimension and Fact Tables are in De-Normalized form
<b>Data model</b>	Bottom up approach	Top down approach

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