CSC12107 – Information Systems for Business Intelligence

Chapter 1

Overview of Business Intelligence

KHOA CÔNG NGHỆ THÔNG TIN
TRƯỜNG ĐẠI HỌC KHOA HỌC TỰ NHIÊN

Learning Objectives

- Understand the Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely
- Understand the need for computerized support of managerial decision making
- Describe the business intelligence (BI) concepts and relate them to Decision support system (DSS)
- Understand the various types of analytics
- Summarize main applications and business value for BI

Contents

1. **CASE STUDY -** Magpie Sensing
2. The business demand for data, information, and analytics
3. BI definition – purpose – history
4. A framework for BI

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- Magpie Sensing, a start-up project under Ebers Smith and Douglas Associated LLC., provides a suite of ***cold chain*** monitoring and analysis technologies for the healthcare industry
- **Cold chain in healthcare**
- Cold Chain (a temperature-controlled supply chain)
- It consists of three major components
  - transport and storage equipment
  - trained personnel
  - efficient management procedures

Ramesh sharda dursun delen efraim turban - Sensing Cold Chain Analytics and Monitoring
https://www.cdc.gov/vaccines/pubs/pinkbook/vac-storage.html#storage

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- Vaccines must be stored properly from manufacture until they are available for use
- Maintained at a temperature of 35–46 degrees Fahrenheit (2–8 degrees Centigrade)
- Any extreme temperatures of heat or cold will reduce the vaccine potency
- if administered, might not yield effective results or could cause adverse effects
- Maintaining the temperatures of the storage units throughout the healthcare supply chain in real time

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- Problems:
- The Centers for Disease Control and Prevention (CDC) looked at the handling of cold chain vaccines by 45 healthcare providers around United States. The CDC reported that:
- Three-quarters of the providers experienced serious cold chain violations
- ➔ How to improve the efficiency of cold chain processes and predict cold storage problems before they occur

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

A Way Toward a Possible Solution:

- Monitored and analysis technologies in real time:
- the set point of the storage system's thermostat
- wireless temperature and humidity monitor
- location-aware tracking of the cold chain products during the shipment
- ➔All temperature information is displayed on a dashboard that shows a graph of the temperature inside a specific storage unit.
- ➔Can determine the set point of the storage unit's thermostat and alert the system's users if the system is incorrectly configured

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- **A Way Toward a Possible Solution (cont)**:

➔Sends alerts about possible temperature violations based on the storage unit's average temperature and subsequent compressor cycle runs, which may drop the temperature below the freezing point

- Report possible human errors, such as failing to shut the storage unit doors or having an incomplete seal
- Detected compressor or a power failure

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

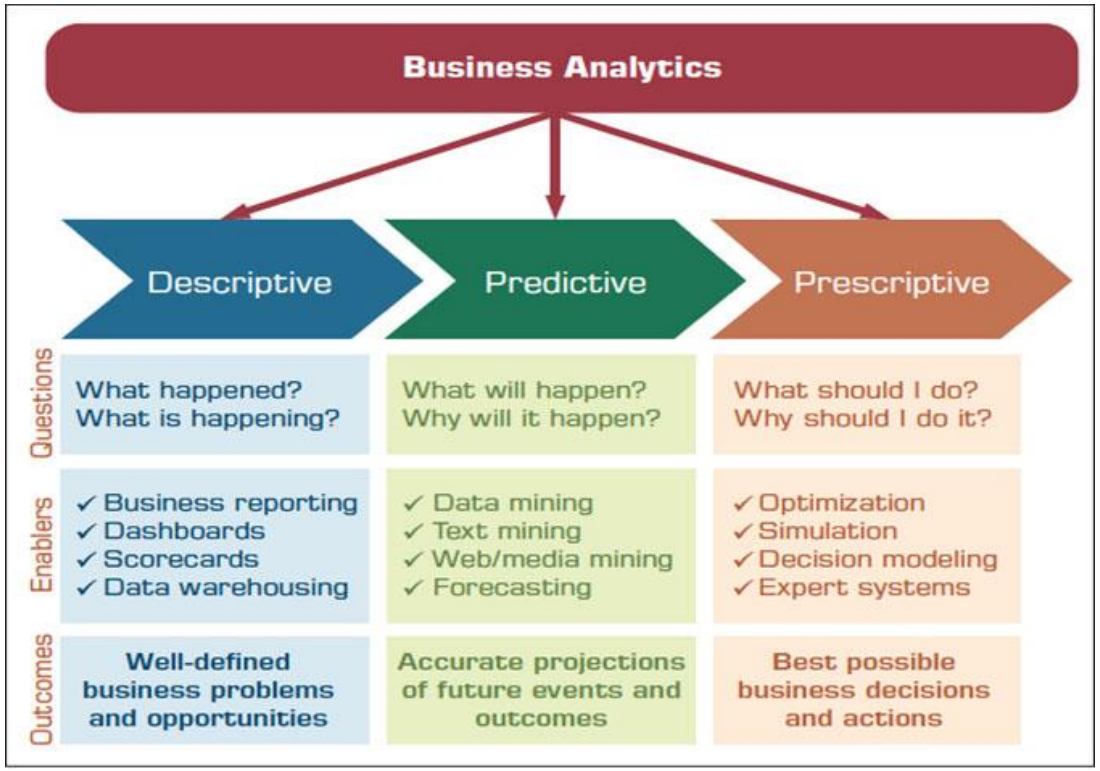
- **A Way Toward a Possible Solution (cont)**:

- Determined the estimate time before the storage unit reaches an unsafe temperature
  - help users dial in the optimal temperature setting
  - help formulate additional design training plans and institutional policies to ensure that the system is properly maintained and not overused
- Additional manufacturing time and expenditure can be eliminated by ensuring product safety throughout the supply chain, and effective products can be administered to the patients.
- Compliance with state and federal safety regulations can be better achieved

CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

- **Solutions:**
- Applies all three types of analytical techniques
- Gathered data from the monitoring devices

➔ Turn the raw data returned from the monitoring devices into actionable recommendations and warnings:



CASE STUDY: Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

What We Can Learn from This case study

- illustrates how data from a business process can be used to generate insights at various levels
- graphical analysis of the data (termed reporting analytics) allows users to get a good feel for the situation
- using data mining techniques to estimate what future behavior would be like
- create specific recommendations for operators
- innovative applications of analytics can create new business ventures

Retention in the mobile phone industry

The marketing manager of a mobile phone company realizes that a large number of customers are discontinuing their service, leaving her company in favor of some competing provider. As can be imagined, low customer loyalty, also known as customerattritionorchurn, is a critical factor for many companies operating in service industries.

Suppose that the marketing manager can rely on a budget adequate to pursue a customer retention campaign aimed at 2000 individuals out of a total customer base of 2 million people. Hence, the question naturally arises of how she should go about choosing those customers to be contacted so as to optimize the effectiveness of the campaign.

In other words, how can the probability that each single customer will discontinue the service be estimated so as to target the best group of customers and thus reduce churning and maximize customer retention?

The Business Environment

- Companies are moving aggressively to computerized support of their operations:
- **Business Environment**
  - create Pressures on Organizations
  - is becoming more and more complex
  - This complexity ***creates opportunities*** on the one hand ***and problems*** on the other
- **Organizational Responses:**
  - Be Reactive,
  - Anticipative,
  - Adaptive,
  - Proactive

The Business Environment

- Managers may take actions, such as:
  - Employ strategic planning.
    - Use new and innovative business models.
    - Restructure business processes
  - Improve partnership relationships
  - Improve customer service and relationships
  - Use new IT to improve communication, data access
  - Respond quickly to competitors' actions (e.g., in pricing, promotions, new products and services).
  - .....

The Business Environment

- The decision support concepts in case study:
  - implemented incrementally,
  - under different names,
  - by many vendors that have created tools and methodologies for decision support

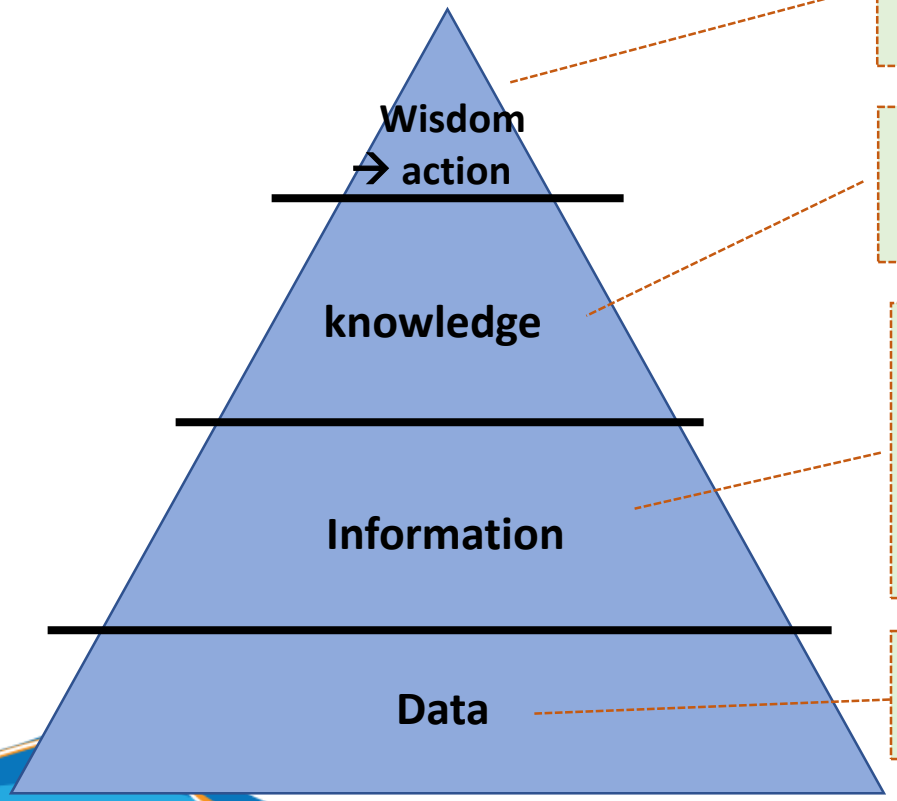
➔ **In this kind of environment, managers must respond quickly, innovate, and be agile**

➔ ***These actions require some computerized support ➔ DSS***

4.0 THE BUSINESS DEMAND FOR DATA, INFORMATION, AND ANALYTICS

- Data → information → knowledge → wisdom & action
- Knowledge that helps Organizations make informed decisions → to understand their operations, customers, competitors, suppliers, partners, employees, and stockholders...:
  - Insight into the past: what is happening in the business?
  - Understand the future: What might happen?
  - Advice on possible outcomes: what action to take?

THE BUSINESS DEMAND FOR DATA, INFORMATION, AND ANALYTICS



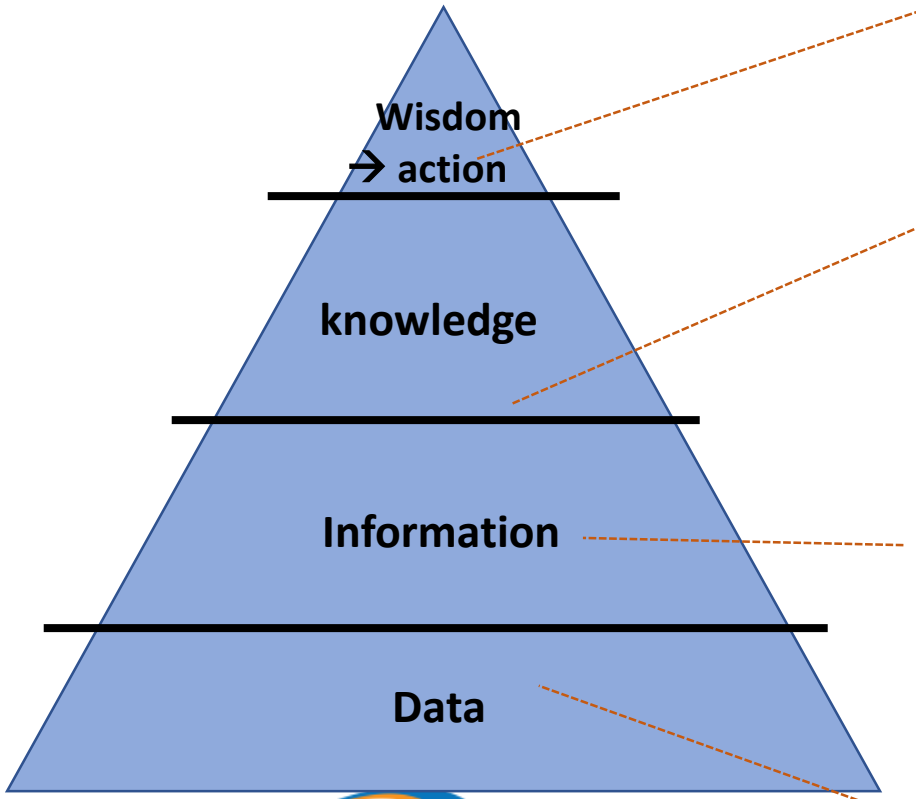
I shall book a train before other passengers realise the implications.

my experience says this will cause severe flight delays.

**Heathrow weather station;
visibility 15 km, sky completely cloudy;
wind direction north west, speed 85 kts;
temperature 15.7 degrees C**

03772 41565 83385 10157

THE BUSINESS DEMAND FOR DATA, INFORMATION, AND ANALYTICS



introducing a new free home delivery service for the customers residing in that specific area

sales analysis may detect that a group of customers, living in an area where a competitor has recently opened a new point of sale, have reduced their usual amount of business

The proportion of sales receipts in the amount of over $100 per week?
the number of customers holding a loyalty card who have reduced by more than 50% the monthly amount spent in the last three months
→ meaningful pieces of information that can be extracted from raw stored data

customers, points of sale and items, sales receipts → commercial transaction

4.0 THE BUSINESS DEMAND FOR DATA, INFORMATION, AND ANALYTICS

- Organizations tend to grow and prosper as they gain a better understanding of their environment
  - Evaluate through tracking daily transactions and analyzing company data
- Organizations are always looking for a competitive advantage
  - Product development, market positioning, sales promotions, and customer service
- Companies and software vendors addressed these multilevel decision support needs by creating autonomous applications for particular groups of users
  - This more comprehensive and integrated decision support framework within organizations became known as business intelligence

4.0 THE BUSINESS DEMAND FOR DATA, INFORMATION, AND ANALYTICS

- While enterprises still need leaders and decision-makers with intuition, they depend on data to validate their intuitions
- Data becomes a strategic guide that helps executives see patterns they might not otherwise notice.
- → **TOO MUCH DATA, TOO LITTLE INFORMATION**
- → the importance of analytics

Business **Intelligence** - DEFINITION

- Business intelligence (BI) is a broad category of **applications**, **technologies**, and **processes** for gathering, storing, accessing, and analyzing data to help business users make better decisions

Watson, Hugh J. (2009) " T utorial: Business Intelligence – Past, Present, and Future," Communications of the Association for Information Systems: V ol. 25, Article 39.

- Business intelligence (BI) is a data-driven DSS that combines ***data gathering***, ***data storage***, and ***knowledge management*** with analysis to provide input to the decision process

Negash S., Gray P. (2008) Business Intelligence. In: Handbook on Decision Support Systems 2. International Handbooks Information System. Springer, Berlin, Heidelberg

Business Intelligence - DEFINITION

- Business intelligence may be defined as a set of mathematical models and analysis methodologies that exploit the available data to generate information and knowledge useful for complex decision-making processes.

(Business Intelligence: Data Mining and Optimization for Decision Making - Carlo Vercellis)

- Other definitions

Business Intelligence - purpose

- The main purpose of business intelligence systems is to provide knowledge workers with tools and methodologies that allow them to make ***effective*** and ***timely*** decisions.

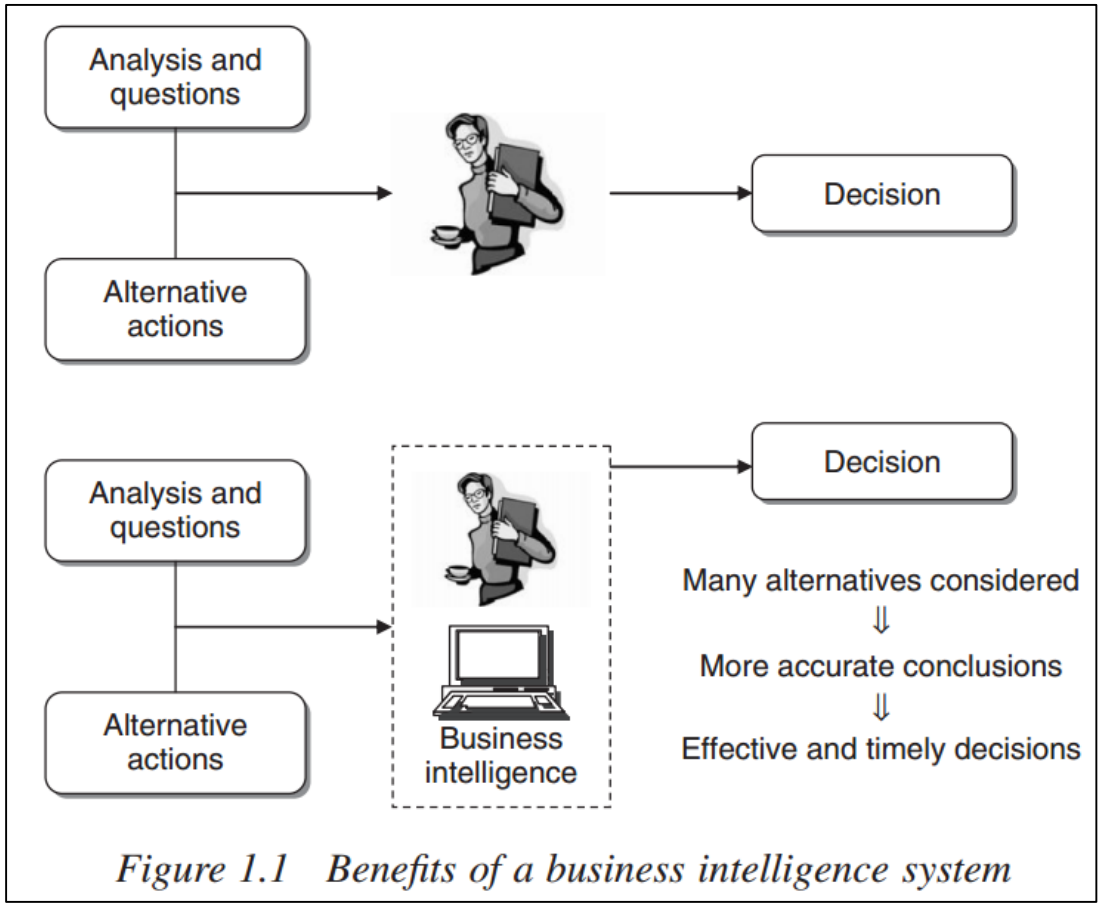
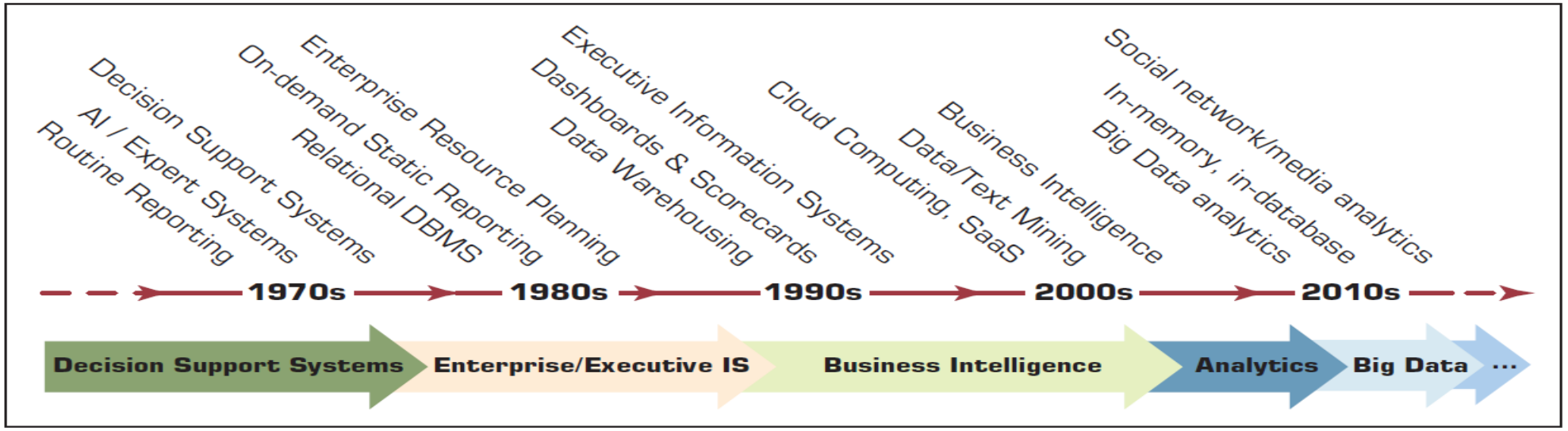


Figure 1.1 Benefits of a business intelligence system

(Source: Carlo Vercellis – Data mining and optimization for decision making)

Business Inteligent - HISTORY

(Evolution of Computerized Decision Support to Analytics/Data Science)



- The term business intelligence was first used in 1989 by Howard Dressner. Then a research fellow at Gartner Group
- BI Today is said to have evolved from the decision support systems (DSS) that began in the 1960s and developed throughout the mid-1980s.
- The number of BI vendors grew in the 1980s, as business people discovered the value of Business Intelligence

Business Inteligent - HISTORY

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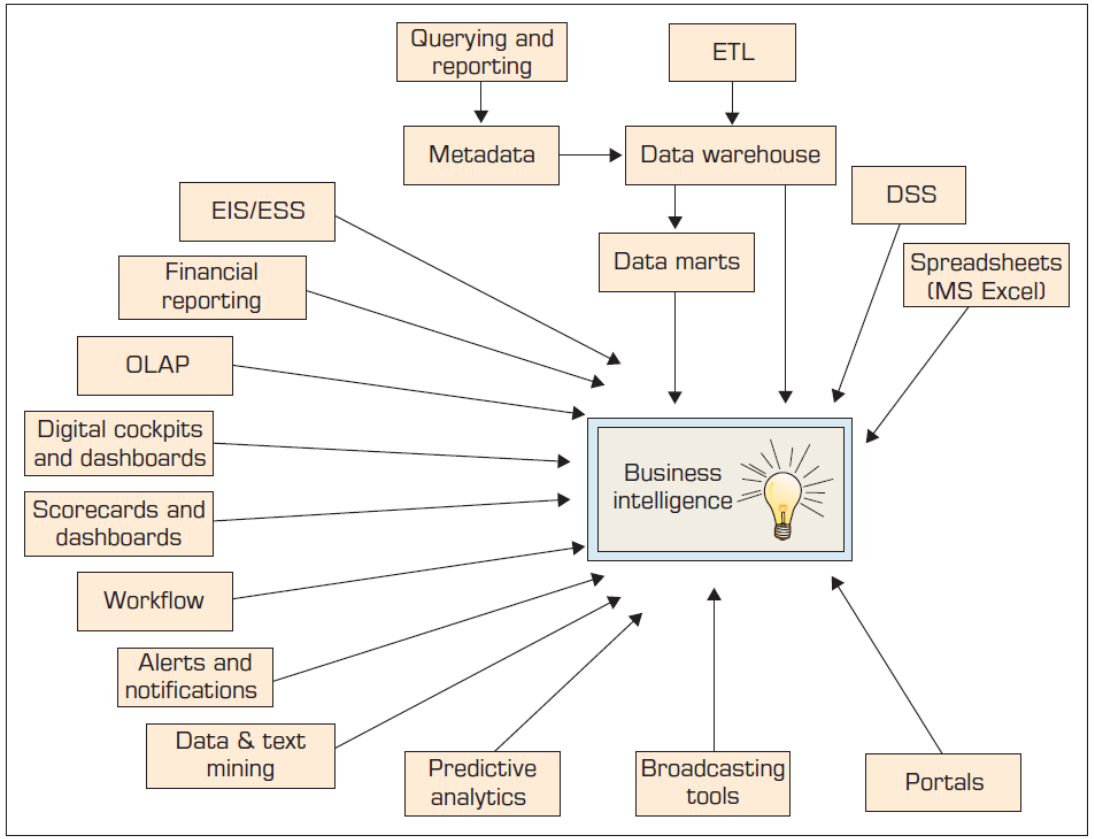
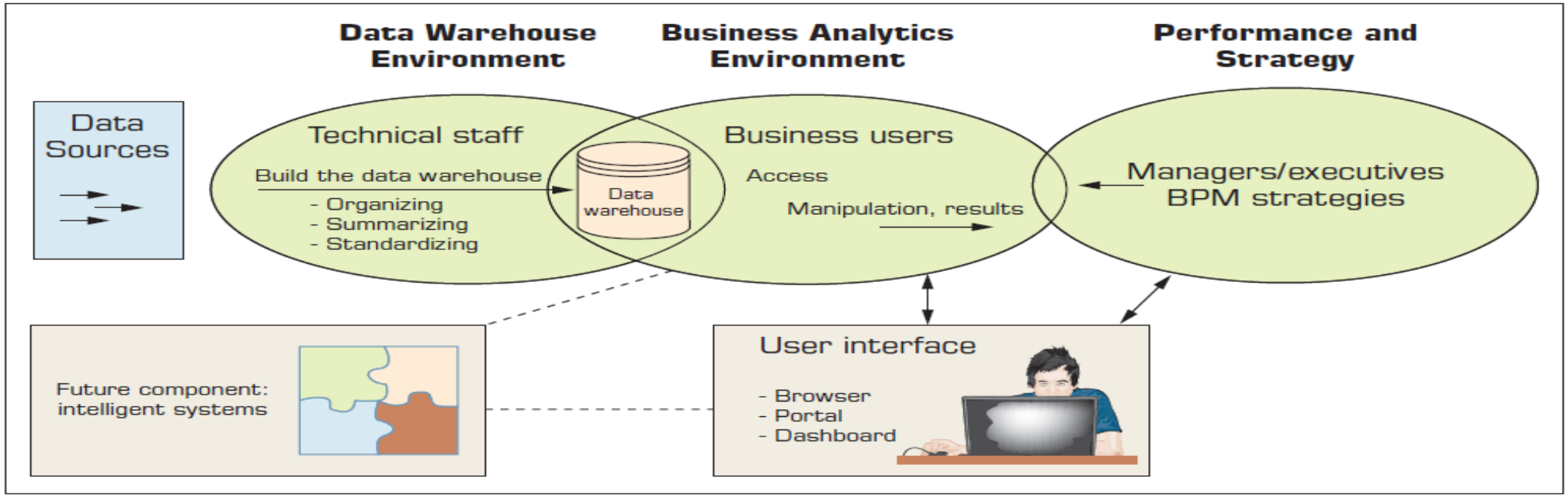


Evolution of Business Intelligence (BI)

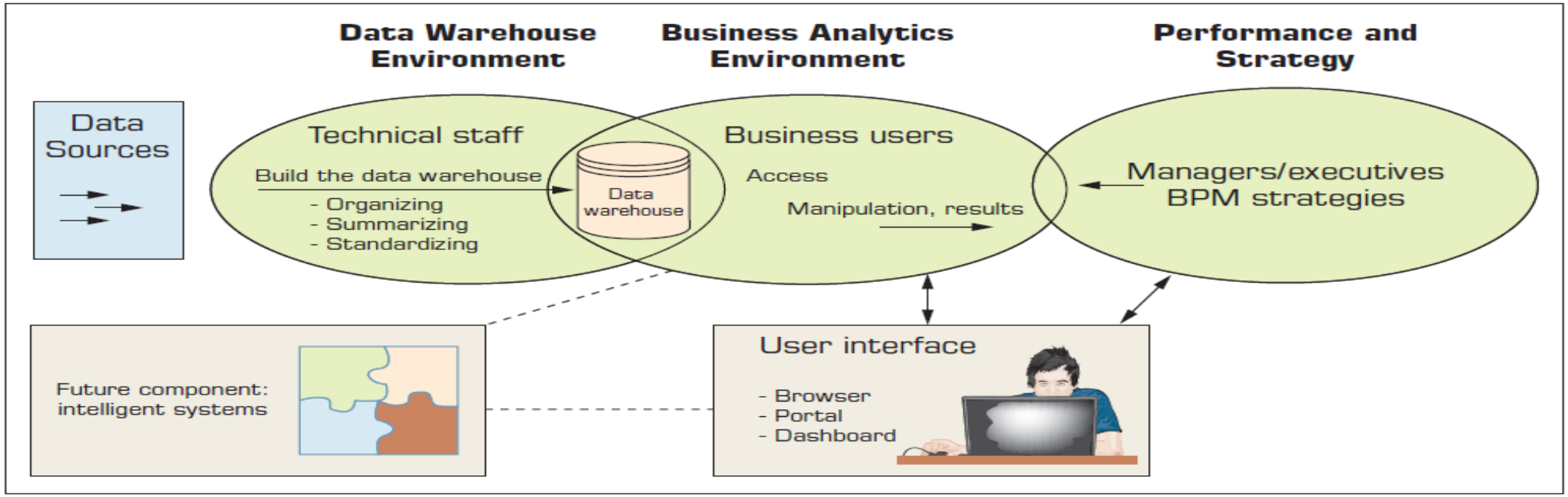
A Framework for Business Intelligence



- A High-Level Architecture of BI has four major components:
  - **A data warehouse (DW)**
  - Business analytics
  - Business performance management
  - User interface

- data sources
- Operational data stores
- Data marts
- Meta data

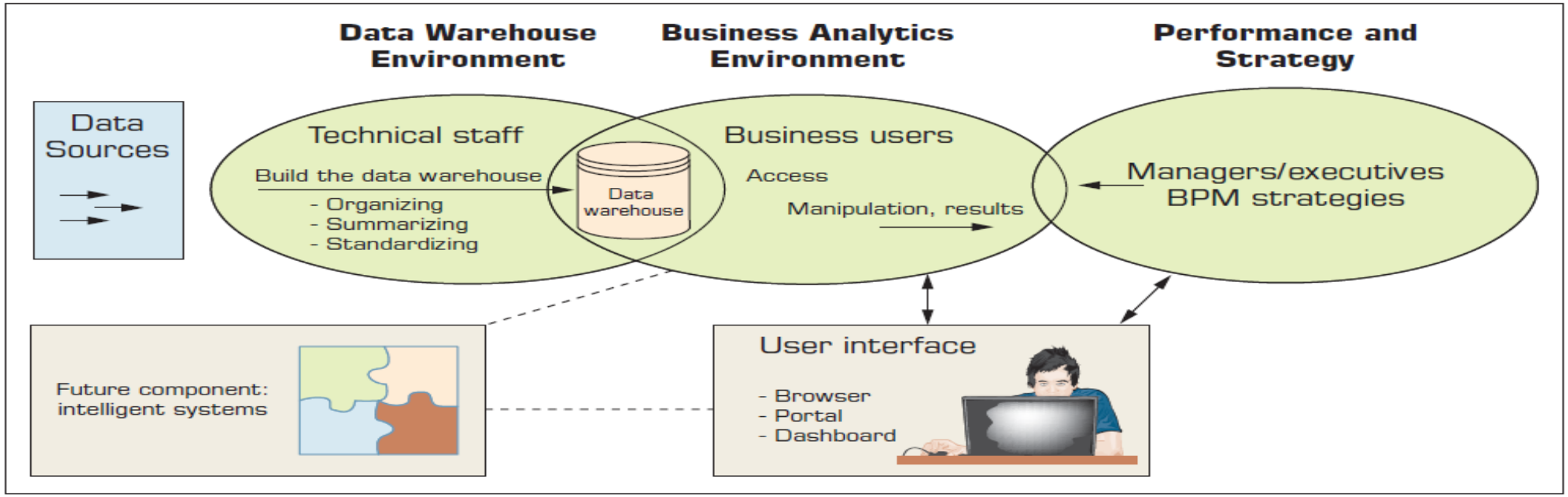
A Framework for Business Intelligence



- A High-Level Architecture of BI has four major components:
  - A data warehouse
  - **Business analytics**
  - Business performance management
  - User interface

- Tools for manipulating, mining, analyzing data in DW

A Framework for Business Intelligence



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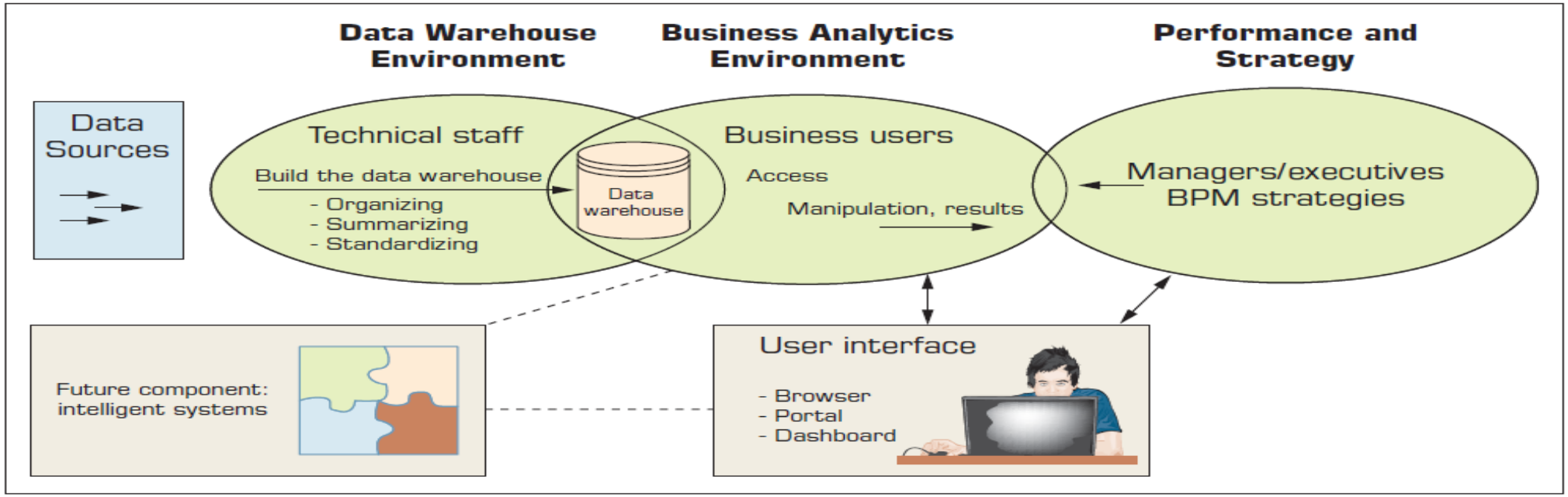
For monitoring and analyzing performance

A Framework for Business Intelligence



- A High-Level Architecture of BI has four major components:
  - A data warehouse (DW)
  - Business analytics
  - Business performance management
  - **User interface**

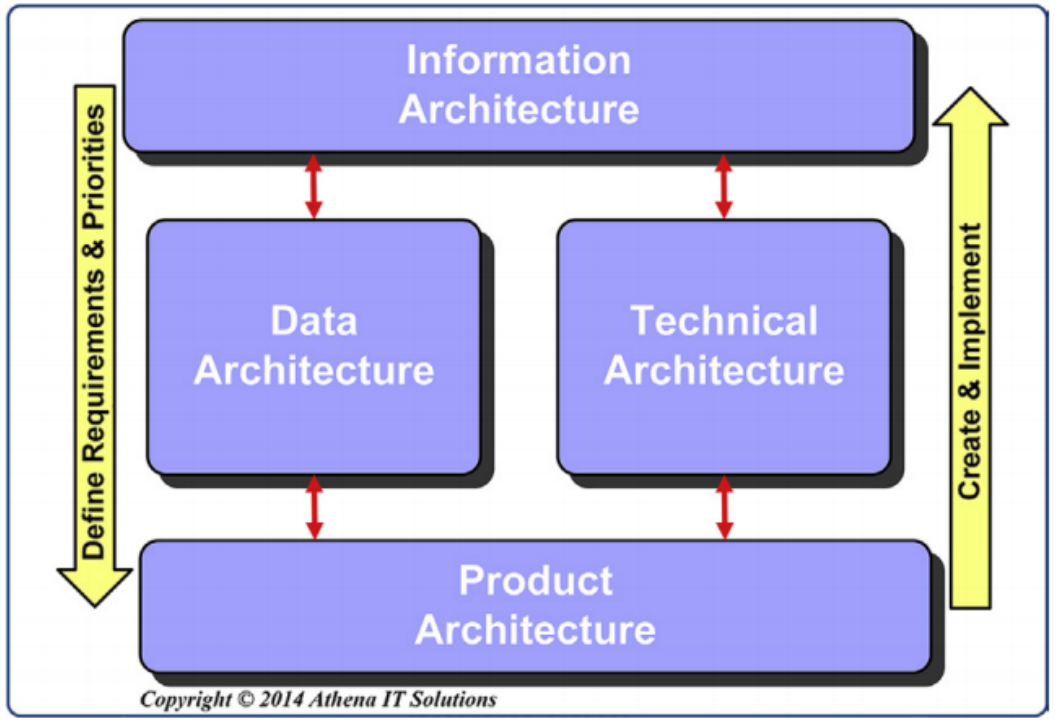
- Eg: dashboard

A Framework for Business Intelligence

- What happens if you skip the architect and go straight to a builder?
- Many enterprises today have a BI environment that **did not have** the benefit of an architecture:
  - Several different BI tools
  - Many application-specific reporting environments in addition to an enterprise BI environment.
  - Various databases created for BI outside the application environments that were created at different times, by different teams for different purposes
  - Data silos, hand code
  - Vertical fragmentation of informational systems
  - ….

A Framework for Business Intelligence

- Successful enterprise BI solutions with enduring business value are not completed in a “one and done” project, but rather evolve over time
- BI framework is composed of four architectural layers:



A framework for Business intelligence

- The **information architecture** defines the “what, who, where, and why” for BI or analytical applications
- Defines the **business context** necessary for successful BI solutions to be built on a sustaining basis

Question	Description
WHAT	• What business processes or functions are going to be supported • What types of analytics will be needed • What types of decisions are affected
WHO	• Who will have access—employees, customers, prospects, suppliers, or other stakeholders
WHERE	• Where is the data now • Where will it be integrated • Where will it be consumed in analytical application
WHY	• Why will the BI solution(s) be built, i.e. what are the business and technical requirements

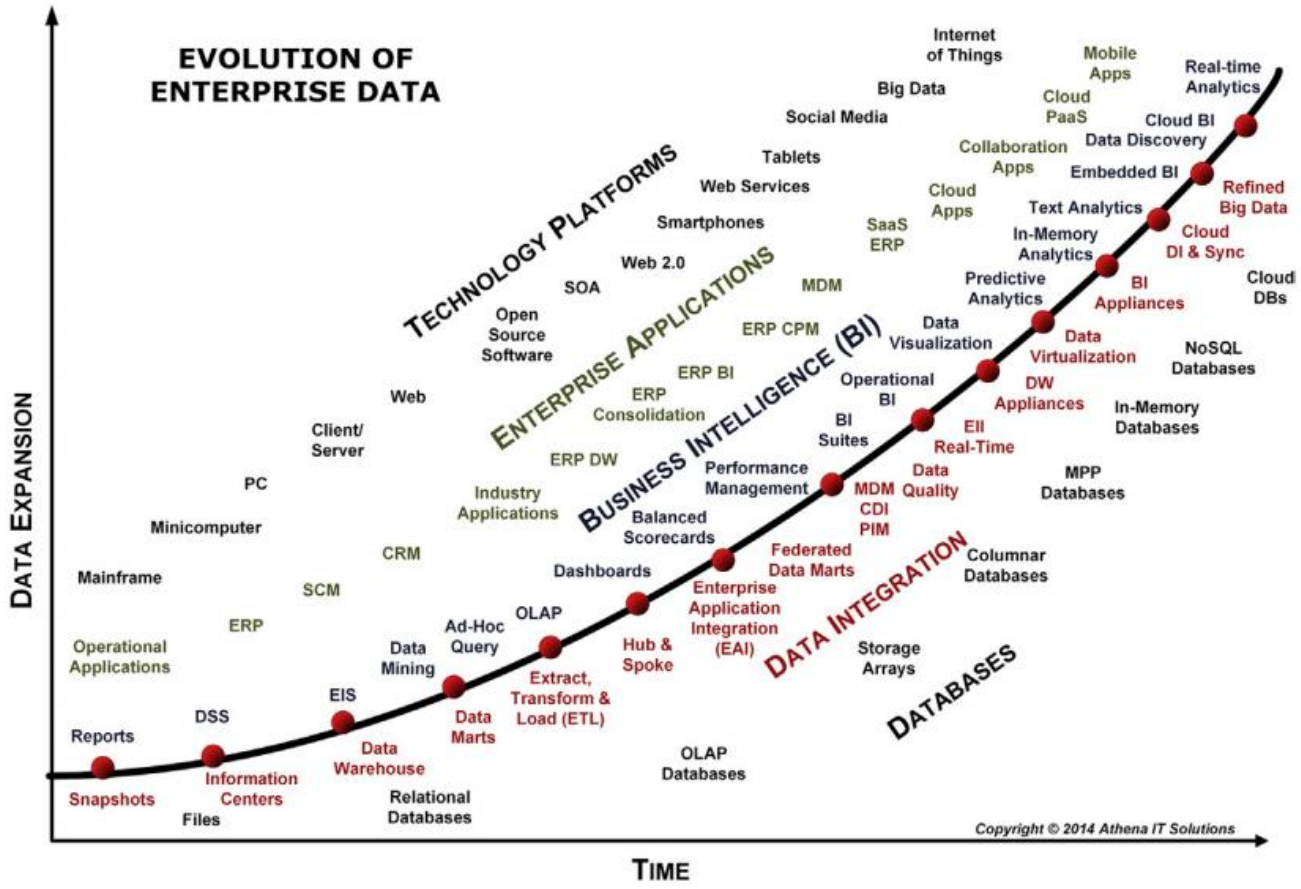
A framework for Business intelligence

Data architecture

- Helps you gain a better understanding of the data
- Provides guidelines for managing data from initial capture in source systems to information consumption by business people.
  - Guides how the data is collected, integrated, enhanced, stored, and delivered to business people who use it to do their jobs
- Provides a structure upon which to develop and implement data governance

A framework for business intelligence

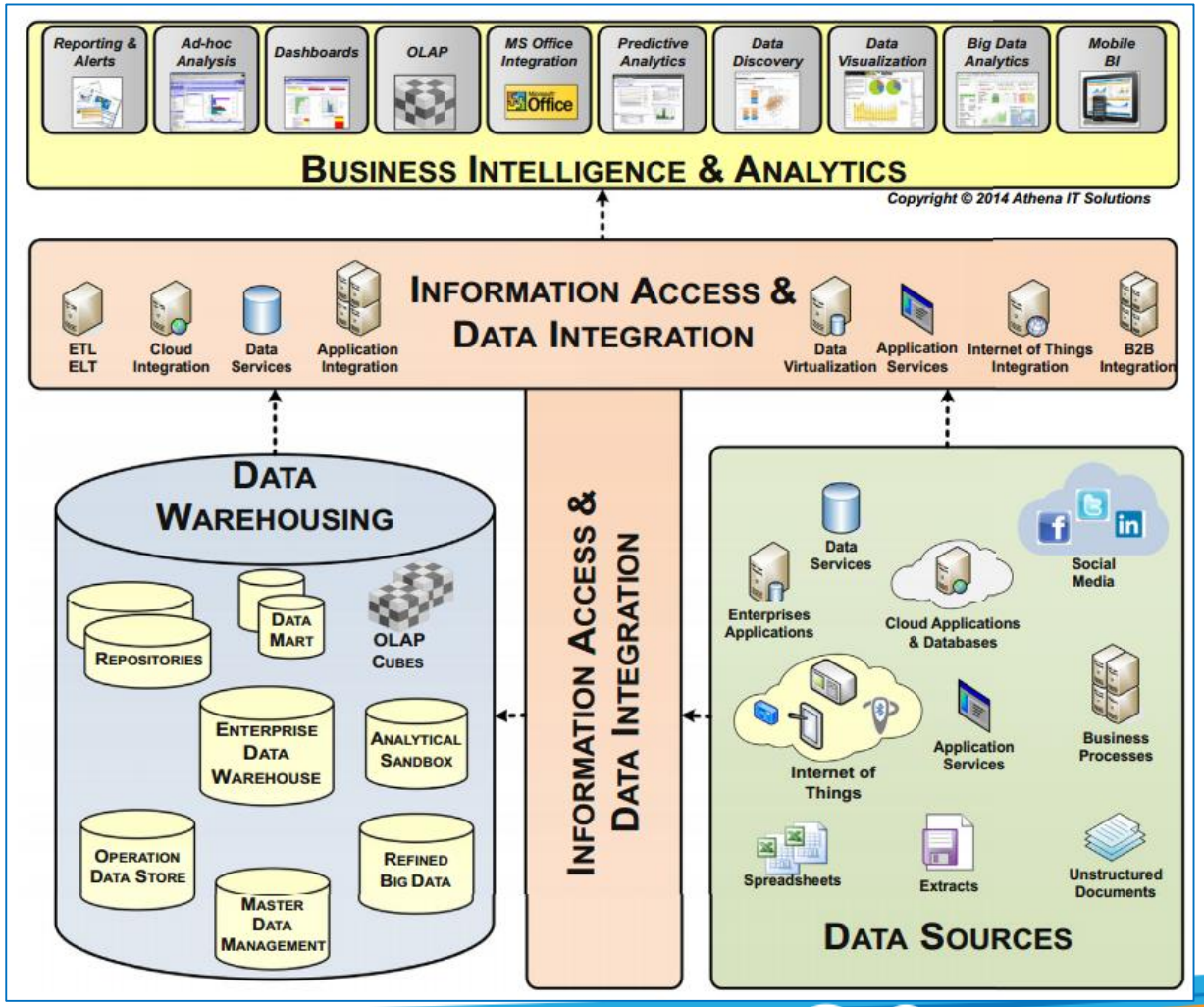
- TECHNOLOGY & PRODUCT ARCHITECTURE



A framework for business intelligence

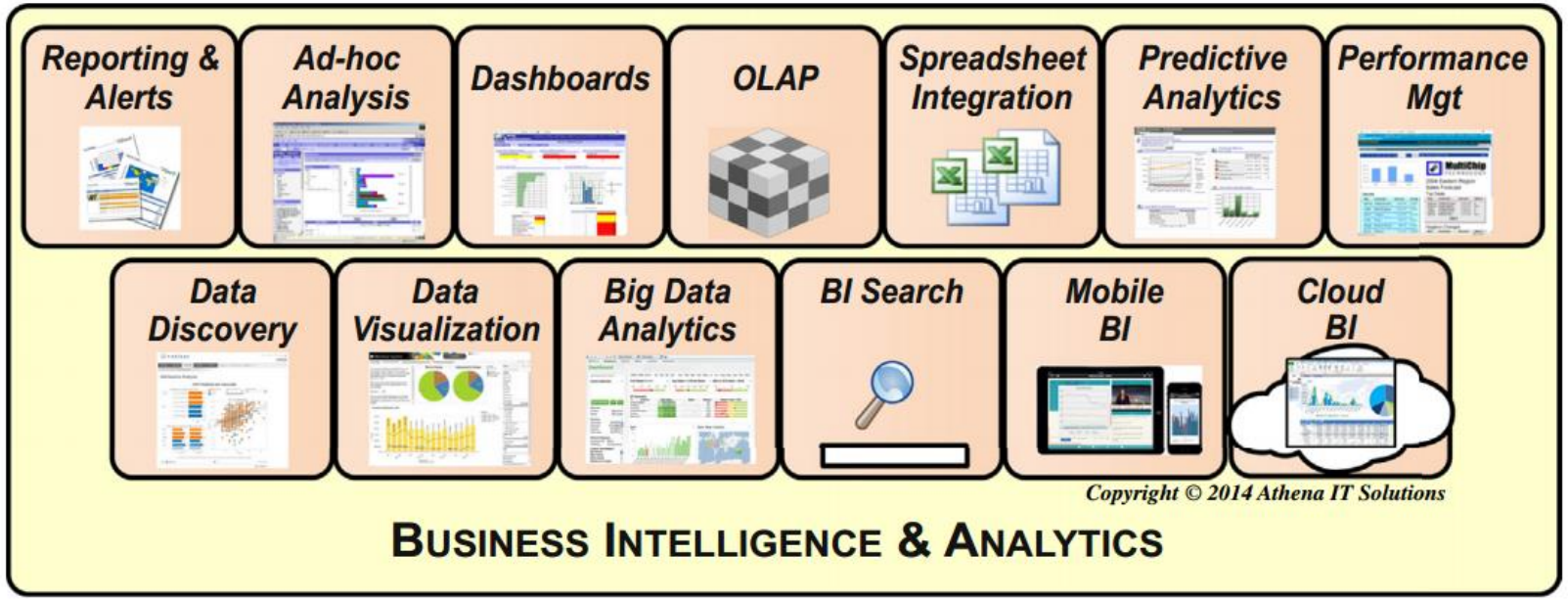
Technology & product architecture

- **There are four technology layers:**
  - Business intelligence and analytics
  - Information access and data integration
  - Data warehousing
  - Data sources



A framework for business intelligence

- BUSINESS INTELLIGENCE AND ANALYTICS



A Framework for Business Intelligence

1. **Source Systems**
   - **Many possible sources** – (ERP, CRM, legacy system, unstructured data, etc.)
   - **Many platforms** – IBM, Oracle, Microsoft, Sybase, SAS
   - **Many formats** – Relational, Hierarchical, Columnar, Multi-dimensional, Big data MapReduce Databases, Unstructured text data

A Framework for Business Intelligence

2. ***Integration Services*** (ETL, Operational Data Feeds, Enterprise Application Integration, Enterprise Information Integration)
3. ***Data Management Services*** (data warehouse, data marts, federated data marts, OLAP cubes, etc.)
4. ***Reporting and Analytical Services*** (Analytical Reporting, ad-hoc query and batch reporting, dashboards/scorecards, predictive and prescriptive modeling, data & text mining/forecasting)
5. ***Information Delivery and Consumption Services*** (Web portals, subscription, direct user access, internal portals

Types of BI users

- IT developers
- Analysts
- Information workers
- Managers and executives
- Front line workers
- Suppliers, customers, and regulators

Development of a BI system

- the specific path followed by each organization might differ from that outlined in the figure
- The development of a business intelligence system can be assimilated to a project, with a specific final objective, expected development times and costs, and the usage and coordination of the resources needed to perform planned activities.

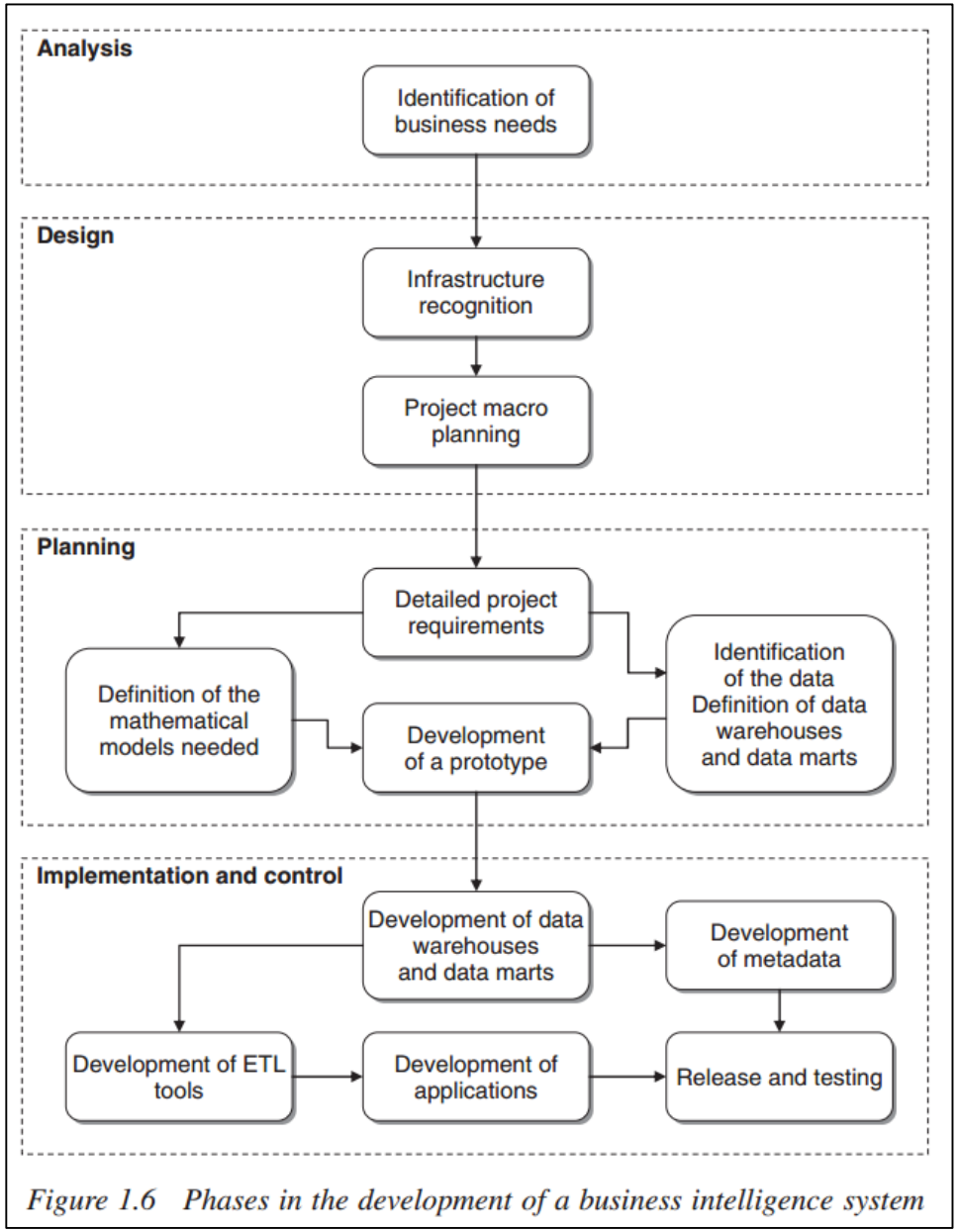


Figure 1.6 Phases in the development of a business intelligence system

(Source: Carlo Vercellis – Data mining and optimization for decision making)

Transaction Processing Versus Analytic Processing

- Online Transaction Processing (OLTP)
  - Operational databases (accounting system, sales / student management system…)
  - ERP, SCM, CRM, …
  - Goal: data capture, well-defined processes, almost no change in the process
    - data concurrency (supporting multiple users)
    - data integrity
    - read/write performance

Transaction Processing Versus Analytic Processing

- Online Analytical Processing (OLAP)
  - Data warehouses
  - Goal:
    - support mid-term and long term decisions (sale analysis by region, by determined period of time, by product or group of product…);

OLTP vs BI system

OLTP Systems	BI Systems
Application orientated. Tables and views are optimized to make the application run faster.	**Subject orientated**. Tables are modeled on business concepts and designed for usability.
Non integrated. Data for different business applications (like finance versus marketing) is often stored across multiple systems.	**Integrated**. All data relating to a specific subject (like Customers) is stored together.
Volatile. Data is updated each time a transaction occurs. Records are edited in place in the database.	**Non-volatile**. Records are rarely updated or deleted. They are almost always only added.
Little summary data. Data is normalized to optimize for performance. There is no storage of rolled-up values.	**Multiple granularity with summaries**. Data is summarized at various levels of granularity to provide appropriate response times for large volumes of transaction data.
Non-time variant. Holds data that represents the current state of the enterprise.	**Time variant**. Holds data for several time periods so that useful growth comparisons can be made.

Operational Data versus Decision Support Data

- Operational data and decision support data serve different purposes
  - Operational data is useful for capturing daily business transactions
  - Decision support data gives tactical and strategic business meaning to the operational data
- Decision support data differs from operational data in three main areas
  - Time span
  - Granularity (level of aggregation)
  - Dimensionality

Operational Data versus Decision Support Data

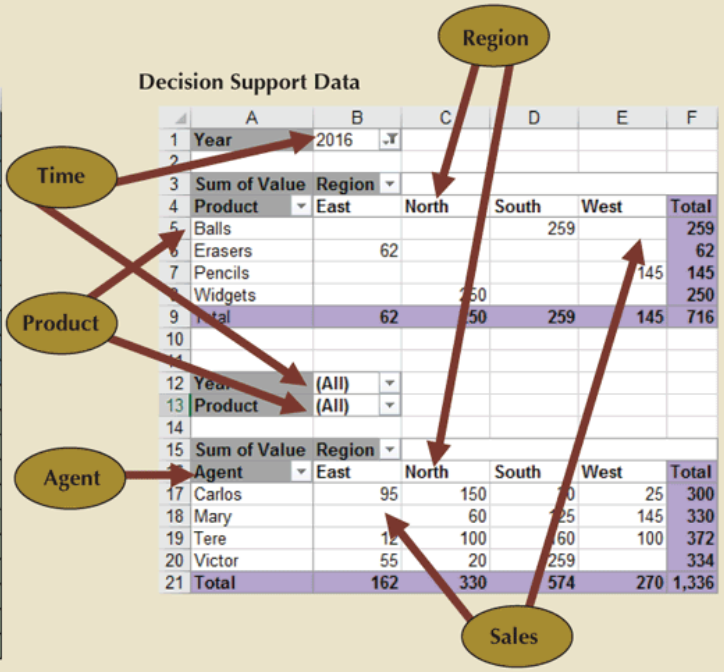
FIGURE 13.3 TRANSFORMING OPERATIONAL DATA INTO DECISION SUPPORT DATA

Operational Data

	A	B	C	D	E
1	Year	Region	Agent	Product	Value
2	2016	East	Carlos	Erasers	50
3	2016	East	Tere	Erasers	12
4	2016	North	Carlos	Widgets	120
5	2016	North	Tere	Widgets	100
6	2016	North	Carlos	Widgets	30
7	2016	South	Victor	Balls	145
8	2016	South	Victor	Balls	34
9	2016	South	Victor	Balls	80
10	2016	West	Mary	Pencils	89
11	2016	West	Mary	Pencils	56
12	2017	East	Carlos	Pencils	45
13	2017	East	Victor	Balls	55
14	2017	North	Mary	Pencils	60
15	2017	North	Victor	Erasers	20
16	2017	South	Carlos	Widgets	30
17	2017	South	Mary	Widgets	75
18	2017	South	Mary	Widgets	50
19	2017	South	Tere	Balls	70
20	2017	South	Tere	Erasers	90
21	2017	West	Carlos	Widgets	25
22	2017	West	Tere	Balls	100

Operational data has a narrow time span, low granularity, and single focus. Such data is usually represented in tabular format, in which each row represents a single transaction. This format often makes it difficult to derive useful information.

Decision Support Data



	A	B	C	D	E	F
1	Year	2016				
2						
3	Sum of Value	Region				
4	Product	East	North	South	West	Total
5	Balls			259		259
6	Erasers	62				62
7	Pencils				145	145
8	Widgets		250			250
9	Total	62	250	259	145	716
10						
11						
12	Year	(All)				
13	Product	(All)				
14						
15	Sum of Value	Region				
16	Agent	East	North	South	West	Total
17	Carlos	95	150	30	25	300
18	Mary		60	25	145	330
19	Tere	12	100	160	100	372
20	Victor	55	20	259		334
21	Total	162	330	574	270	1,336

Decision support system (DSS) data focuses on a broader time span, tends to have high levels of granularity, and can be examined in multiple dimensions. For example, note these possible aggregations:

- Sales by product, region, agent, and so on
- Sales for all years or only a few selected years
- Sales for all products or only a few selected products

Operational Data versus Decision Support Data

Table 13.5 Contrasting Operational and Decision Support Data Characteristics		
Characteristic	**Operational Data**	**Decision Support Data**
Data currency	Current operations Real-time data	Historic data Snapshot of company data Time component (week/month/year)
Granularity	Atomic-detailed data	Summarized data
Summarization level	Low; some aggregate yields	High; many aggregation levels
Data model	Highly normalized Mostly relational DBMSs	Non-normalized Complex structures Some relational, but mostly multidimensional DBMSs
Transaction type	Mostly updates	Mostly query
Transaction volumes	High-update volumes	Periodic loads and summary calculations
Transaction speed	Updates are critical	Retrievals are critical
Query activity	Low to medium	High
Query scope	Narrow range	Broad range
Query complexity	Simple to medium	Very complex
Data volumes	Hundreds of gigabytes	Terabytes to petabytes

Source: (database systems – design, implementation and management, 13th edition)

BI Benefit

- **Concepts, practices, tools and techniques to help business**
  - Understand core capabilities
  - Provide snapshots of the company situation
  - Identify key opportunities to create a competitive advantage
- **Provides a framework**
  - Collecting and storing operational data and aggregating it into decision support data
  - Analyzing decision support data and presenting generated information to end users to support business decisions
  - Making business decisions which generate more data
  - Monitoring results to evaluate outcomes and predicting future outcomes with a high degree of accuracy

BI Disadvantages

- **Cost**
  - Business intelligence software can be expensive
  - have to consider the costs of the hardware and IT staff needed to implement the software effectively
- **Complexity**
  - complexity in implementation of datawarehouse (Poor Data Quality, Difficulty Analyzing Different Data Sources
- **Time Consuming Implementation**

Business Value of BI Analytical Applications

- Customer segmentation
- Propensity to buy
- Customer profitability
- Fraud detection
- Customer attrition
- Channel optimization

Application Case 1.1

Sabre Helps Its Clients Through Dashboards and Analytics

Questions for Discussion

1. What is traditional reporting? How is it used in the organization?
2. How can analytics be used to transform the traditional reporting?
3. How can interactive reporting assist organizations in decision making?