

# *“Πληροφοριακά Συστήματα Διοίκησης”*

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*Τεχνολογική Υποδομή*

*Βάσεις Δεδομένων*

*Δρ. Κώστας Κούτσικος*





## Η ατζέντα της ημέρας

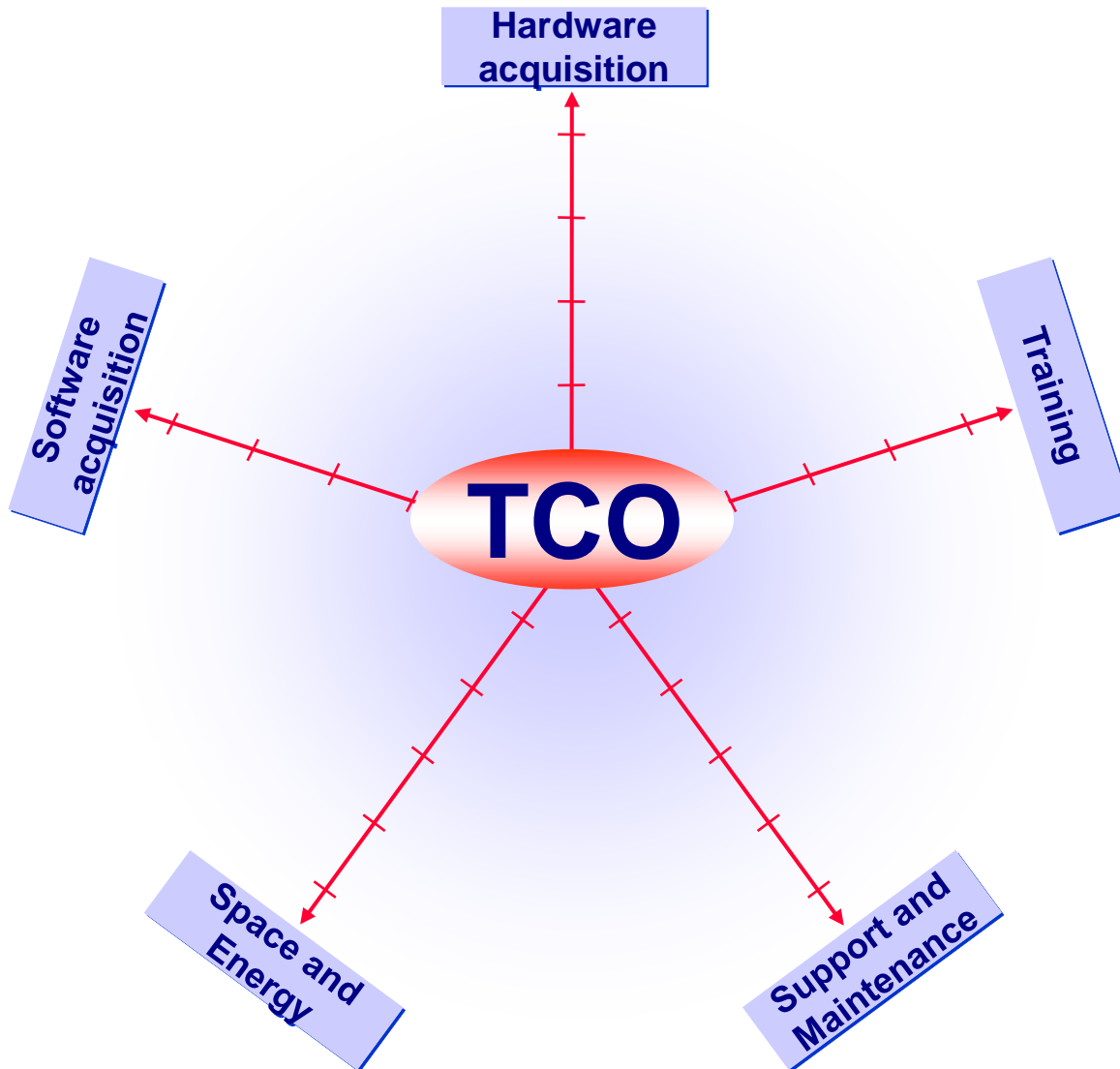




**In previous episodes ...**



## The total cost of ownership depends on several parameters



### Issues

- Includes both direct and indirect costs
- Hardware and software acquisitions often account for only 20% of the total cost of ownership
- Total cost of ownership for a PC may run to 3 times the original purchase price
- Hidden costs always creep in !



## Key learning points

### Issues

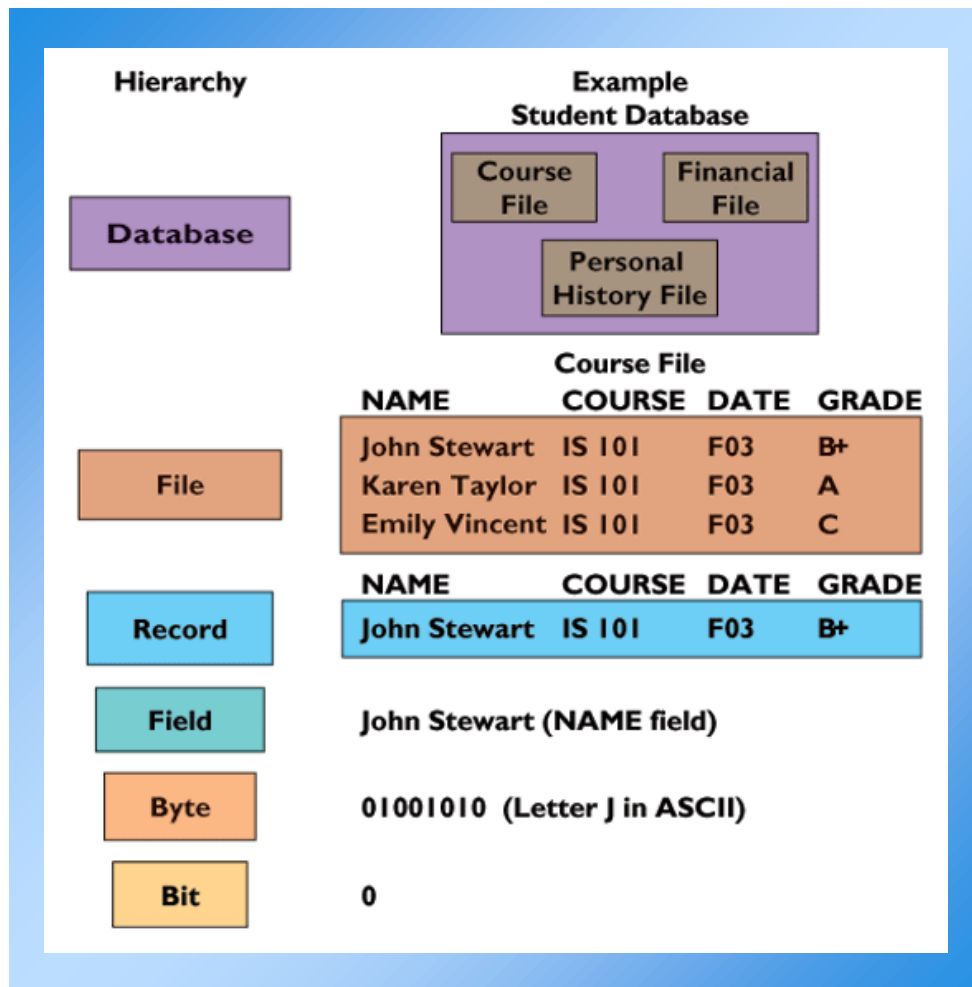
- **Organizations can choose among many different hardware options: from standalone PCs to networked servers to mainframes**
- **Such options incur different cost profiles and thus selection is an important business management issue**
- **In addition, the right selection of software tools can make the difference between chaos and smooth running of a business**
- **Unfortunately, such selections seem to be the easy management task. The real costs of owning hardware and software are the hidden ones (e.g. training)**



# Managing Data Resources



## In general, a database is ...



### Characteristics

- Είναι ένα σύνολο αρχείων
  - Κάθε αρχείο περιέχει σχετικά μεταξύ τους δεδομένα.
  - Τα δεδομένα συσχετίζονται με λογικές σχέσεις μεταξύ τους
- Είναι ειδικού σκοπού
  - Παρέχει συγκεκριμένες λύσεις σε έναν μικρόκοσμο (miniworld)
  - Περιγράφει κάθε φορά την κατάσταση του μικρόκοσμου
- Διαθέτει σύνολο προγραμμάτων για τη διαχείριση των αρχείων (αποθήκευση, πρόσβαση, κλπ).



## Pros

- **Ταυτόχρονη προσπέλαση**
  - Πολλοί χρήστες / ταυτόχρονη πρόσβαση στις εγγραφές (κοινή χρήση, sharing)
  - Δυνατότητα ελέγχου σε περίπτωση ταυτόχρονης πρόσβασης σε μία συγκεκριμένη εγγραφή
- **Μικρός χρόνος επεξεργασίας και απόκρισης**
  - Σαφής και βέλτιστη οργάνωση των δεδομένων
  - Δυνατότητα εύκολης μεταφοράς των δεδομένων στην κεντρική μνήμη του Η/Υ
  - Γρήγορη επεξεργασία των δεδομένων
  - Γρήγορη απόκριση στις ερωτήσεις του χρήστη
- **Ευελιξία**
  - Εύκολη προσαρμογή σε νέες προδιαγραφές
  - Δυνατότητα αλλαγών στα υπάρχοντα πεδία των εγγραφών
  - Εισαγωγή νέων πεδίων στις ήδη ορισμένες εγγραφές





## The key business questions that surround the use of databases are ...

### Issues

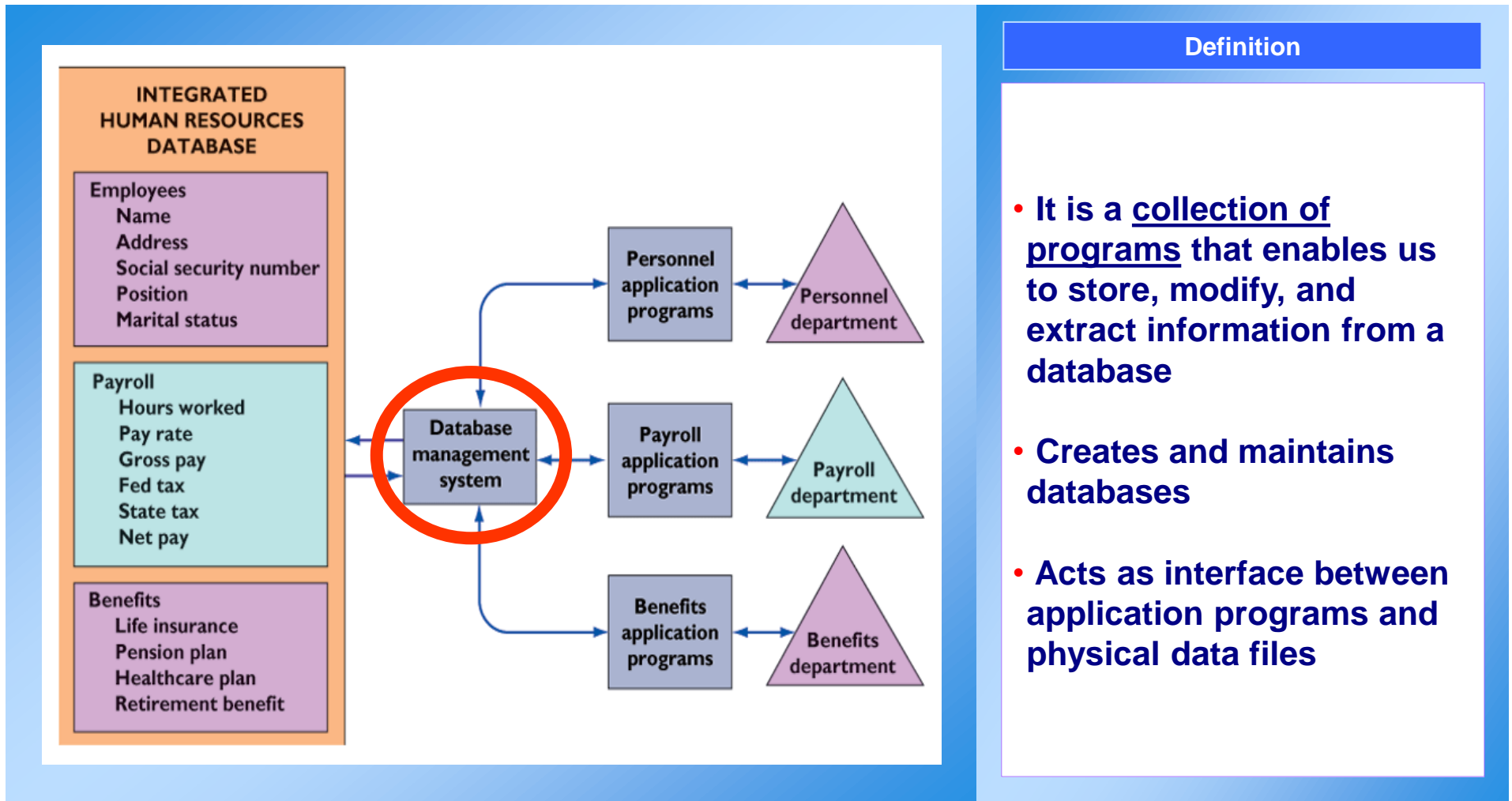
- **Why do businesses have trouble finding the information they need in their information systems ?**
- **How does a database management system help businesses improve the organization of their information ?**
- **What are the managerial and organizational requirements of a database environment ?**



# Database Management Systems



## In a modern database environment, database management systems (DBMS) are the data 'controllers'

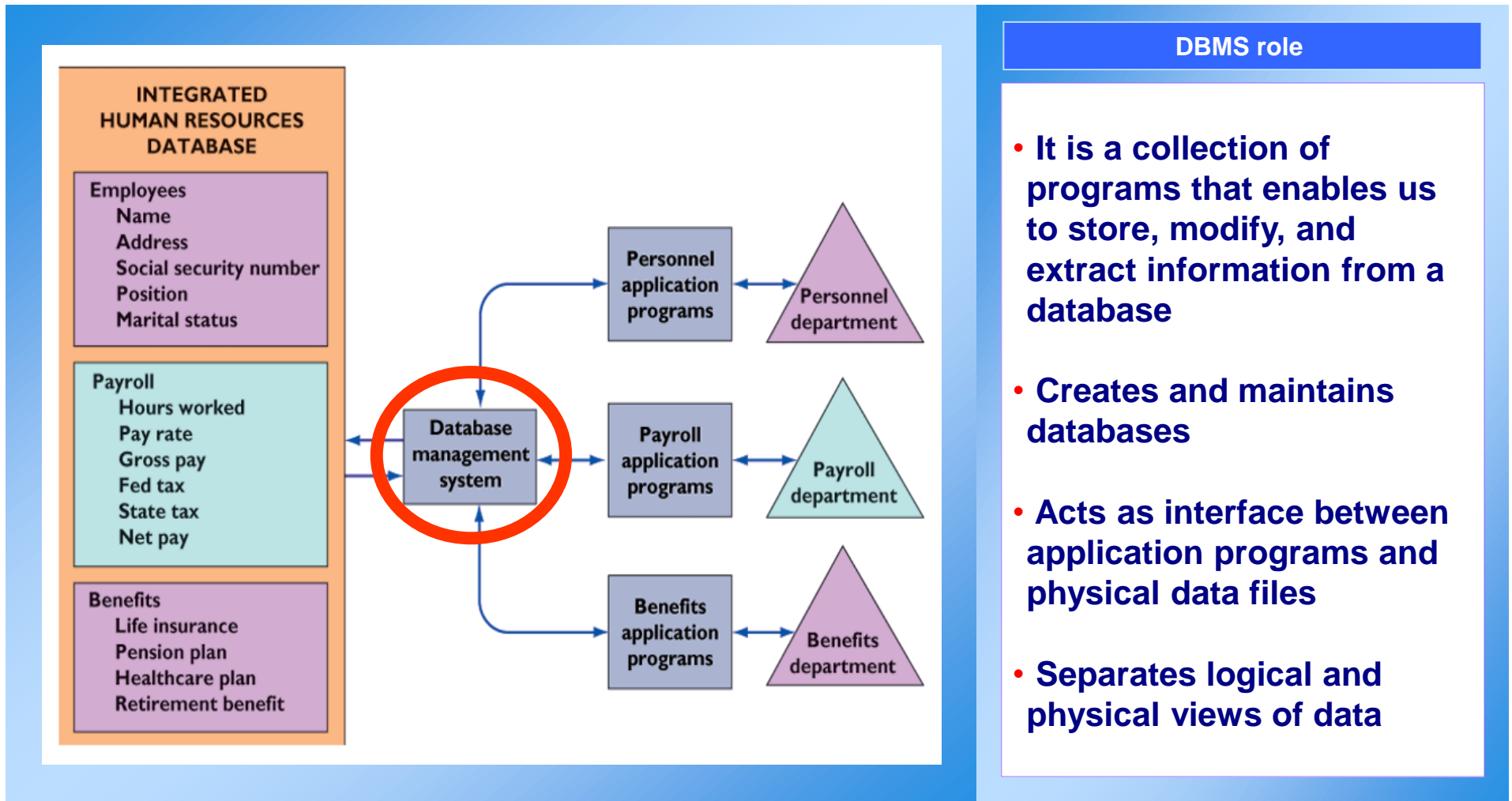


### Definition

- It is a collection of programs that enables us to store, modify, and extract information from a database
- Creates and maintains databases
- Acts as interface between application programs and physical data files

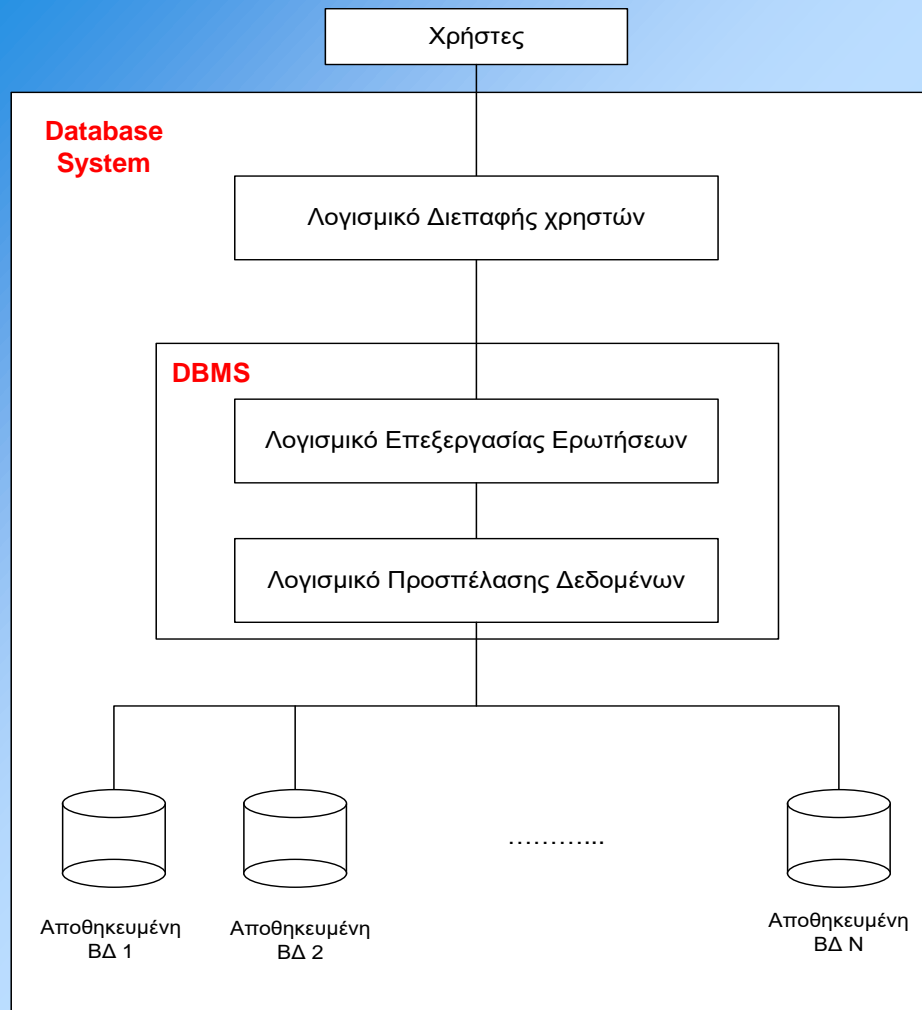


## In a modern database environment, database management systems (DBMS) are the data 'controllers'





# Database Systems (DBS) vs. Database Management Systems (DBMS)



## DBS vs. DBMS

- Η βάση δεδομένων (Database System) αποτελεί τον αποθηκευτικό χώρο των αρχείων δεδομένων
- DBMS είναι λογισμικό το οποίο διευκολύνει τον ορισμό, την υλοποίηση, και τη διαχείριση μιας βάσης δεδομένων· η βάση δεδομένων, όμως, δημιουργείται από το DBMS
- Το DBMS αναλαμβάνει να ρυθμίσει την επικοινωνία των χρηστών με τη βάση δεδομένων. Επικοινωνεί με τους χρήστες και παίρνει με εύκολο και φιλικό τρόπο τις εντολές τους προς τη βάση δεδομένων

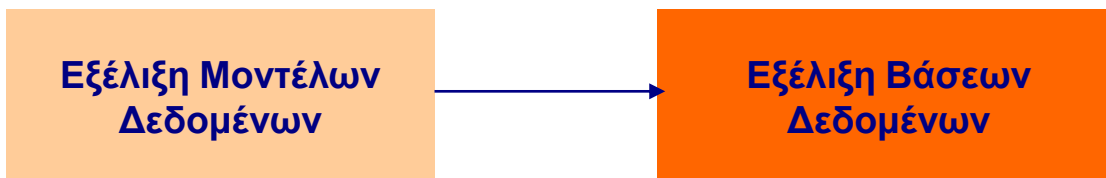


# Μοντέλα δεδομένων Βάσεων Δεδομένων



## Definitions

- **Σύνολο εννοιών και κανόνων για τον ορισμό μιας ΒΔ :**
  - οργάνωσης των δεδομένων
  - βασικών πράξεων σ' αυτά.
- **Κατέχει ένα υψηλό επίπεδο αφάιρεσης**
  - κατανοητό από τους χρήστες για περιγραφή της δομής της βάσης
  - Ορισμός των:
    - τύπων των δεδομένων,
    - συσχετίσεων μεταξύ τους, και
    - σχετικών περιορισμών





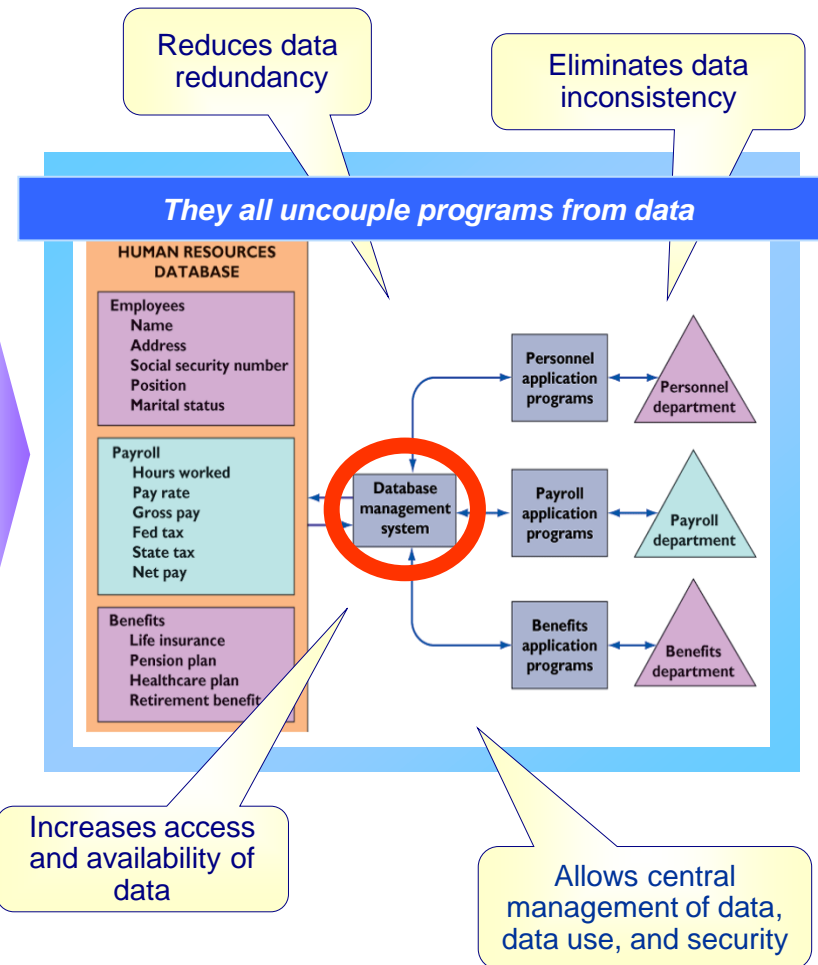
# There are different types of Database Management Systems

## Relational DBMS

- Represents data as two-dimensional tables called relations
- Relates data across tables based on common data element

### Three basic operations:

- **Select:** Creates subset of database that meet specific criteria
- **Join:** Combines relational tables to provide users with information
- **Project:** Enables users to create new tables containing only relevant information



## Hierarchical DBMS

- Older system presenting data in tree-like structure
- Models one-to-many parent-child relationship
- Found in large legacy systems for intensive high-volume transactions (banks; insurance companies)

## Network DBMS

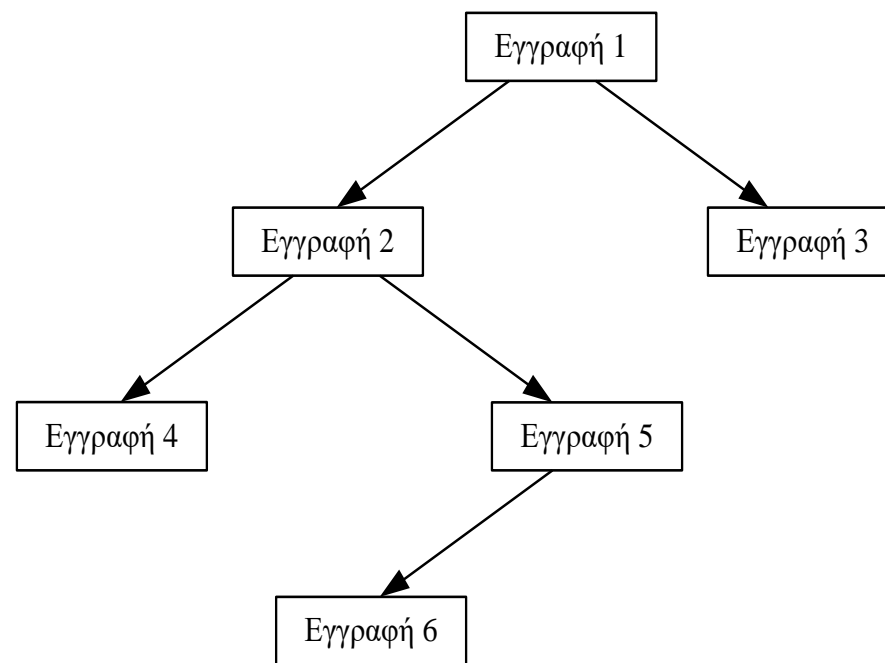
- Older logical database model
- Models many-to-many parent-child relationships





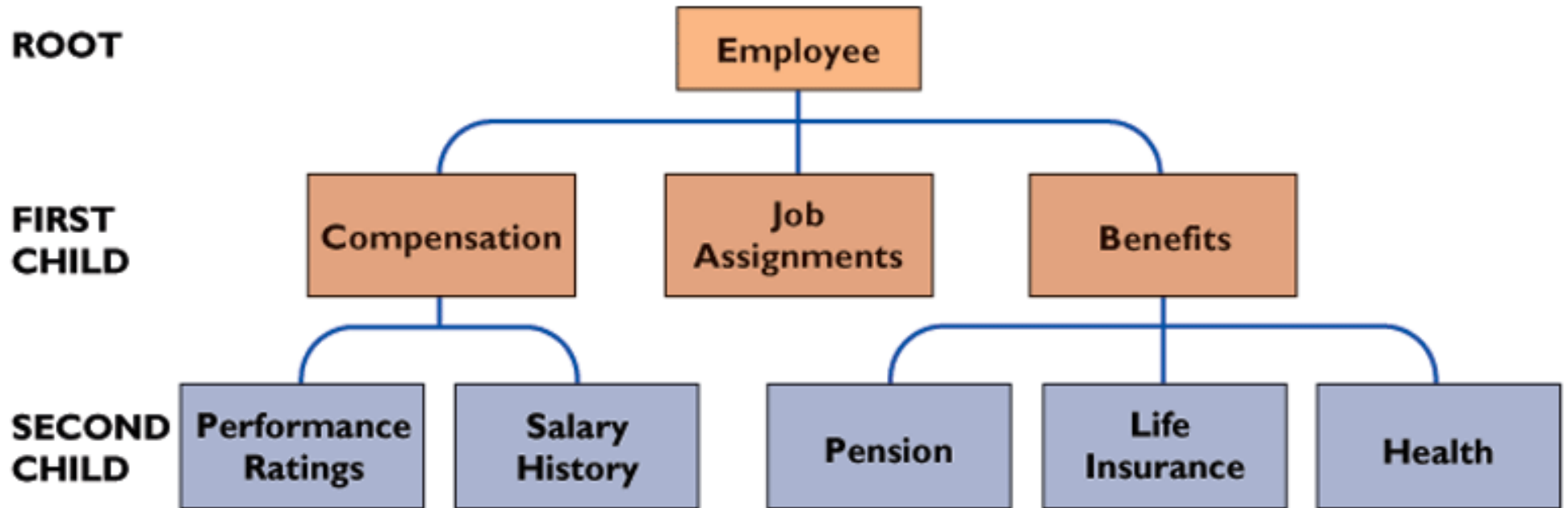
## Hierarchical DBMS

- Το **ιεραρχικό μοντέλο** (hierarchical model) είναι το πρώτο που χρησιμοποιήθηκε, κατά τη δεκαετία του 1960.
- Όλες οι εγγραφές μιας ιεραρχικής βάσης δεδομένων είναι οργανωμένες μεταξύ τους ακολουθώντας μία συγκεκριμένη ιεραρχία.
- Τα δεδομένα (οι εγγραφές) αναπαριστούνται με χρήση δεντρικής δομής δεδομένων.
- **Βασικοί κανόνες διάταξης εγγραφών:**
  - Κάθε μία εγγραφή του δέντρου δύναται να έχει ένα μόνο γονέα.
  - Όλες οι θυγατρικές εγγραφές σε κάθε γονικό κόμβο του δέντρου είναι διατεταγμένες.



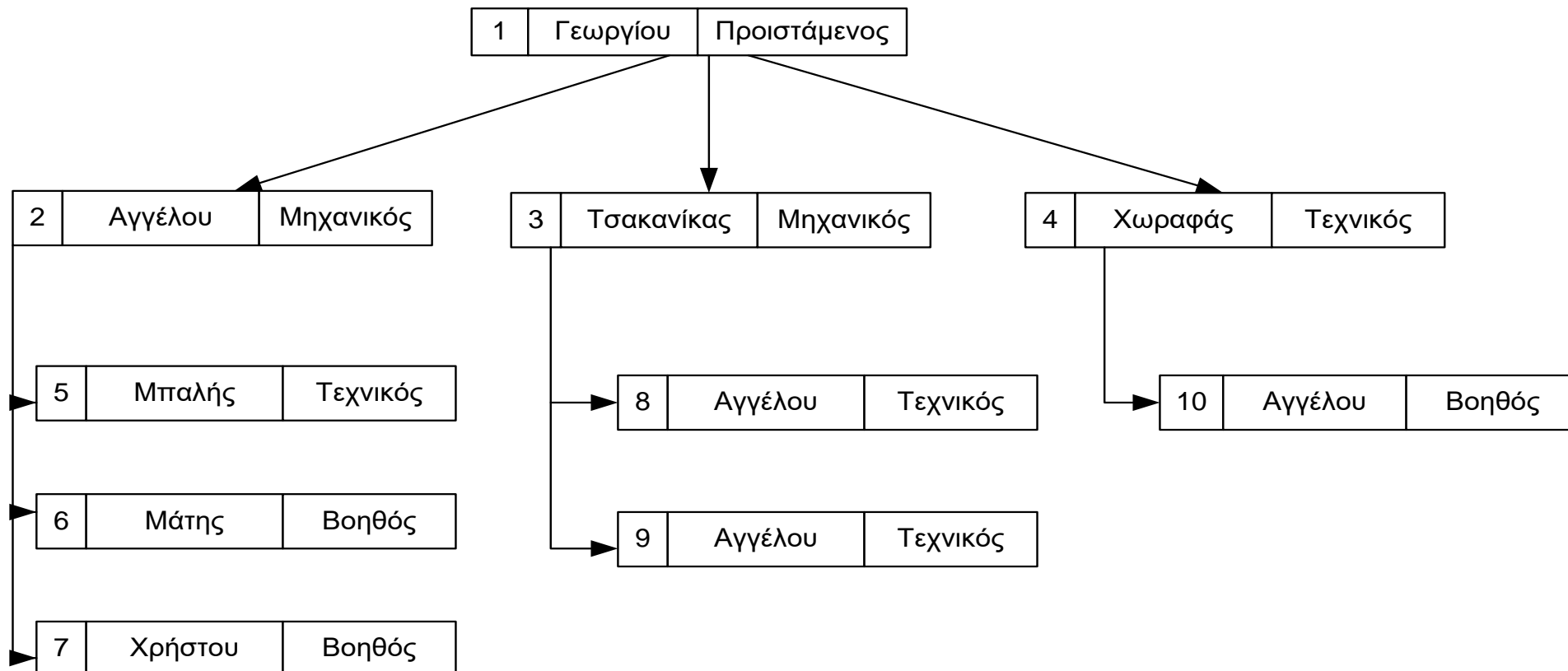


## Example: Hierarchical DBMS





## Example: Hierarchical DBMS



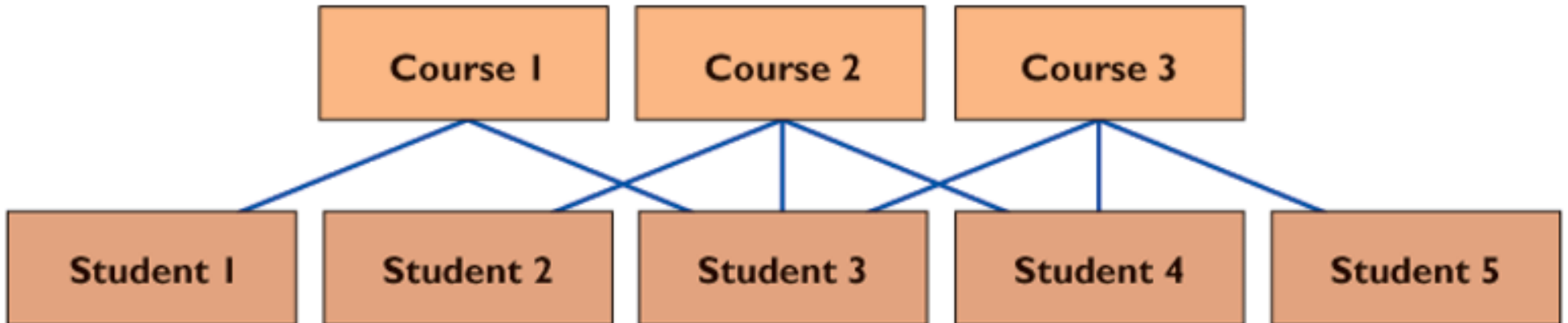


## Networked DBMS

- Οι **δικτυωτές** (networked) βάσεις δεδομένων εμφανίστηκαν στην δεκαετία του 1970, αντικαθιστώντας τις ιεραρχικές βάσεις.
- Το δικτυωτό μοντέλο εμφανίστηκε για να αναιρέσει κάποιους περιορισμούς.
  - Δεν απαιτείται πλέον μία εγγραφή να έχει μόνο μία γονική εγγραφή (parent record) στο δέντρο της δομής της βάσης δεδομένων.
- Η δομή της βάσης δεδομένων δεν είναι δέντρο, αλλά γράφος.
  - Ένας γράφος  $G$  ορίζεται ως ένα σύνολο  $G(V,E)$  όπου  $V$  είναι το σύνολο των κόμβων του και  $E$  είναι το σύνολο των συνδέσεων μεταξύ τους,
  - Στις δικτυωτές βάσεις δεδομένων η δομή αναπαρίσταται με δύο σύνολα:
    - Ένα σύνολο με τις εγγραφές της βάσης που σχηματικά αναπαρίστανται με κόμβους και
    - ένα σύνολο με τις συνδέσεις μεταξύ των εγγραφών/κόμβων.

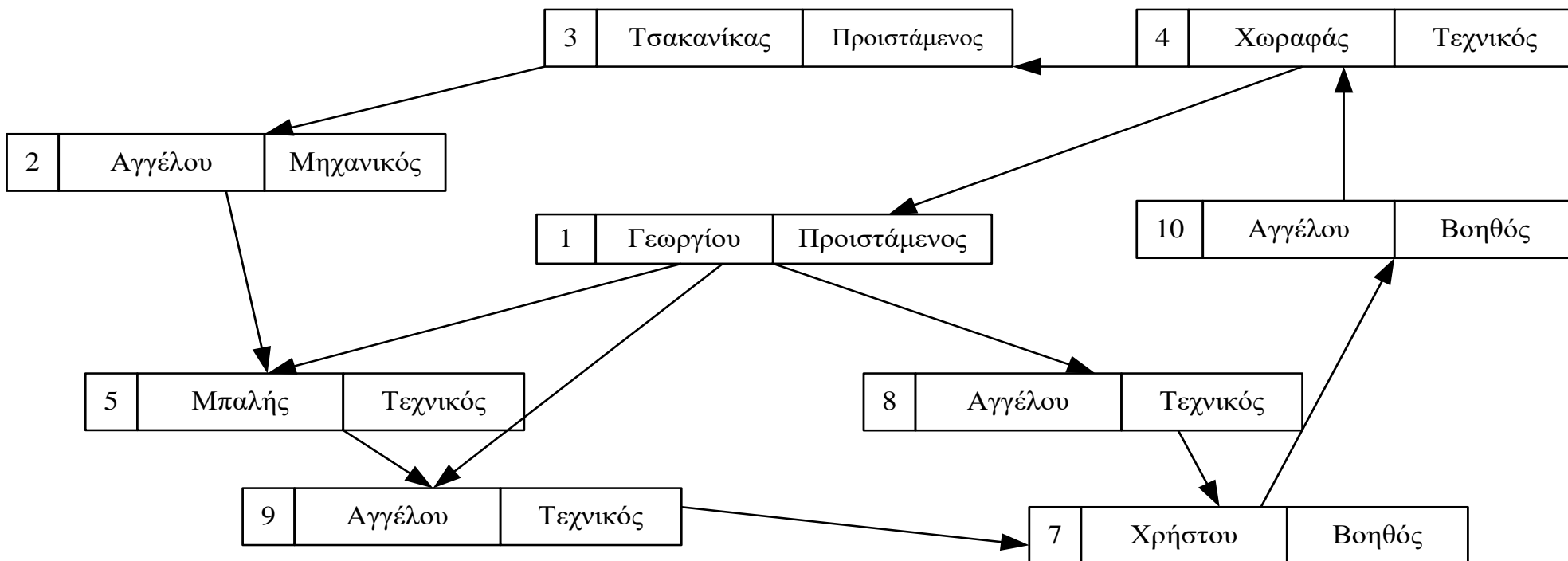


## Example: Networked DBMS





# Example: Networked DBMS





# The most common type of these systems is the Relational DBMS

## Characteristics

- Represents data as two-dimensional tables called relations
- Relates data across tables based on common data element (foreign key)
- Reduces data redundancy
- Eliminates data inconsistency
- Increases access and availability of data
- Allows central management of data, data usage and security

Table (Relation)

Columns (Attributes, Fields)

	Order_ Number	Order_ Date	Delivery_ Date	Part_ Number	Part_ Quantity
ORDER	1634	02/02/04	02/22/04	152	2
	1635	02/12/04	02/28/04	137	3
	1636	02/13/04	03/01/04	145	1

Rows (Tuples, Records)

	Part_ Number	Part_ Description	Unit_ Price	Supplier_ Number
PART	137	Door latch	22.50	4058
	145	Door handle	26.25	2038
	150	Door seal	6.00	4058
	152	Compressor	70.00	1125

	Supplier_ Number	Supplier_ Name	Supplier_ Address
SUPPLIER	4058	CBM Inc.	44 Winslow, Gary, IN 44950
	2038	Ace Inc.	Rte. 101, Essex, NJ 07763
	1125	Bryant Corp.	51 Elm, Rochester, NY 11349

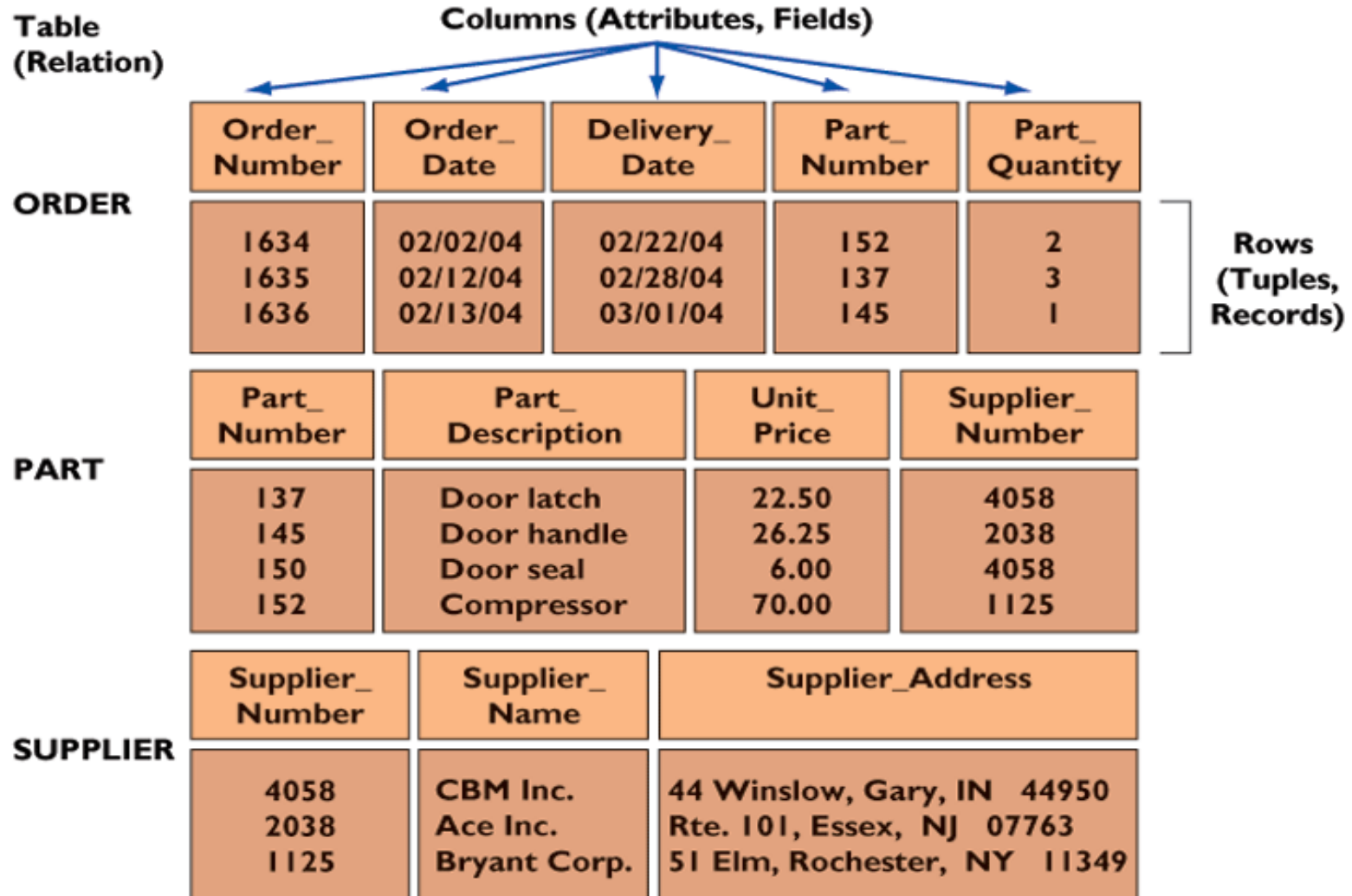
## Database transactions

### Three basic operations:

- **Select:** Creates subset of database that meet specific criteria
- **Join:** Combines relational tables to provide users with information
- **Project:** Enables users to create new tables containing only relevant information



# The most common type of these systems is the Relational DBMS







# How do databases keep all these records in order ? Through the use of two keys: the Primary Key ...

## Definition

- Every database table should have one or more columns designated as the primary key
- The value this key holds should be unique for each record in the database
- The database will enforce the uniqueness of the primary key. Inserting a record into a table with a primary key that duplicates an existing record, will fail

Table

Columns (Attributes, Fields)

Order_ Number	Order_ Date	Delivery_ Date	Part_ Number	Part_ Quantity
1634	02/02/04	02/22/04	152	2
1635	02/12/04	02/28/04	137	3
1636	02/13/04	03/01/04	145	1

ORDER

Part_ Number	Part_ Description	Unit_ Price	Supplier_ Number
137	Door latch	22.50	4058
145	Door handle	26.25	2038
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PART

Supplier_ Number	Supplier_ Name	Supplier_ Address
4058	CBM Inc.	44 Winslow, Gary, IN 44950
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1125	Bryant Corp.	51 Elm, Rochester, NY 11349

SUPPLIER

Rows (Tuples, Records)



## ... and the Foreign Keys

Table

Columns (Attributes, Fields)

ORDER

Order_ Number	Order_ Date	Delivery_ Date	Part_ Number	Part_ Quantity
1634	02/02/04	02/22/04	152	2
1635	02/12/04	02/28/04	137	3
1636	02/13/04	03/01/04	145	1

Rows  
(Tuples,  
Records)

PART

Part_ Number	Part_ Description	Unit_ Price	Supplier_ Number
137	Door latch	22.50	4058
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SUPPLIER

Supplier_ Number	Supplier_ Name	Supplier_ Address
4058	CBM Inc.	44 Winslow, Gary, IN 44950
2038	Ace Inc.	Rte. 101, Essex, NJ 07763
1125	Bryant Corp.	51 Elm, Rochester, NY 11349

### Definition

- These keys are table columns, used to create relationships between tables
- Unlike primary keys, they do not need to be unique
- The database will enforce *referential integrity* by ensuring that e.g. all of the values in the Part\_Number column of the ORDER table have corresponding entries in the PART table



# Database transactions are most commonly based on commands written in Structured Query Language (SQL)

## Definition

SQL commands can be divided into two main sublanguages:

- The Data Definition Language (DDL) contains the commands used to create and destroy databases and database objects
- After the database structure is defined with DDL, database administrators and users can utilize the Data Manipulation Language (DML) to insert, retrieve and modify the data contained within it

## Usage

- Nowadays, there are a large number of graphical user interfaces (GUIs) that simplify database administration tasks
- The user interface translates mouse clicks and text entries into SQL and then “speaks” to the database in SQL



# Three basic transactions

**ORDER**

Order_ Number	Order_ Date	Delivery_ Date	Part_ Number	Part_ Quantity
1634	02/02/04	02/22/04	152	2
1635	02/12/04	02/28/04	137	3
1636	02/13/04	03/01/04	145	1

**PART**

Part_ Number	Part_ Description	Unit_ Price	Supplier_ Number
137	Door latch	22.50	4058
145	Door handle	26.25	2038
150	Door seal	6.00	4058
152	Compressor	70.00	1125

**SUPPLIER**

Supplier_ Number	Supplier_ Name	Supplier_ Address
4058	CBM Inc.	44 Winslow, Gary, IN 44950
2038	Ace Inc.	Rte. 101, Essex, NJ 07763
1125	Bryant Corp.	51 Elm, Rochester, NY 11349

Select Part\_ Number = 137 or 152

Join by Supplier\_ Number

Part_ Number	Supplier_ Number	Supplier_ Name	Supplier_ Address
137	4058	CBM Inc.	44 Winslow, Gary, IN 44950
152	1125	Bryant Corp.	51 Elm, Rochester, NY 11349

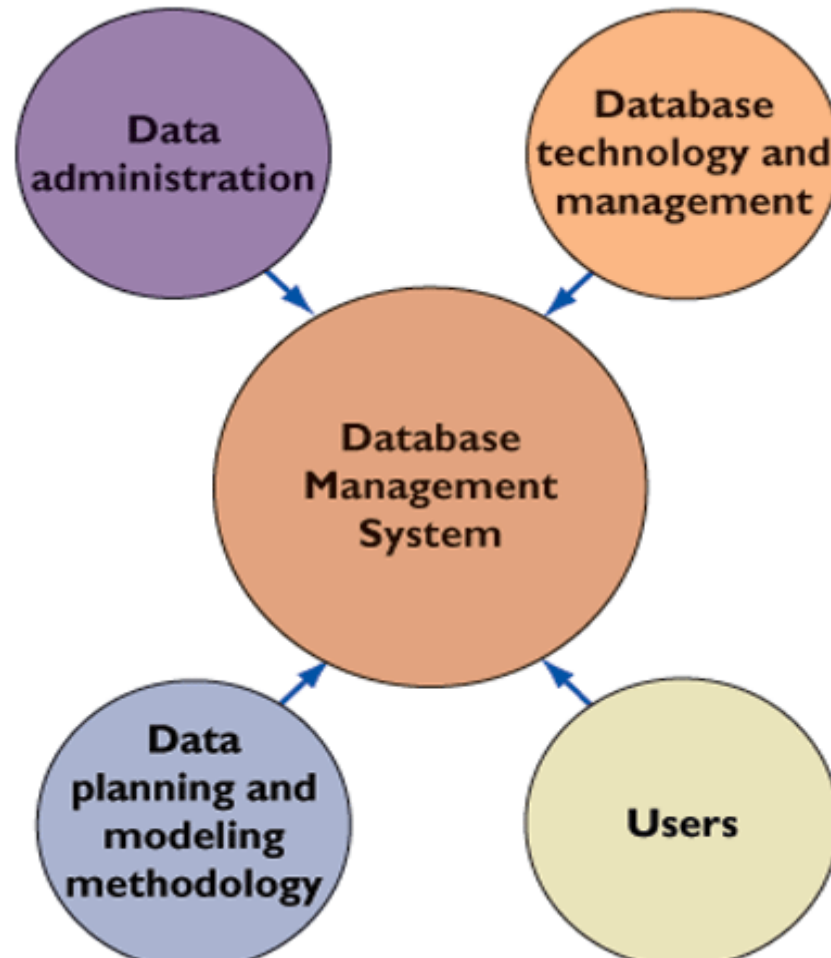
Project selected columns

The background of the slide is a photograph of several rolled-up banknotes, likely Euro, standing upright on a sandy beach. The scene is brightly lit, suggesting a sunny day, with the ocean visible in the background.

## **Business Impact – Creating a Database Environment**



**There are certain key organizational elements linked to the creation of a database environment**

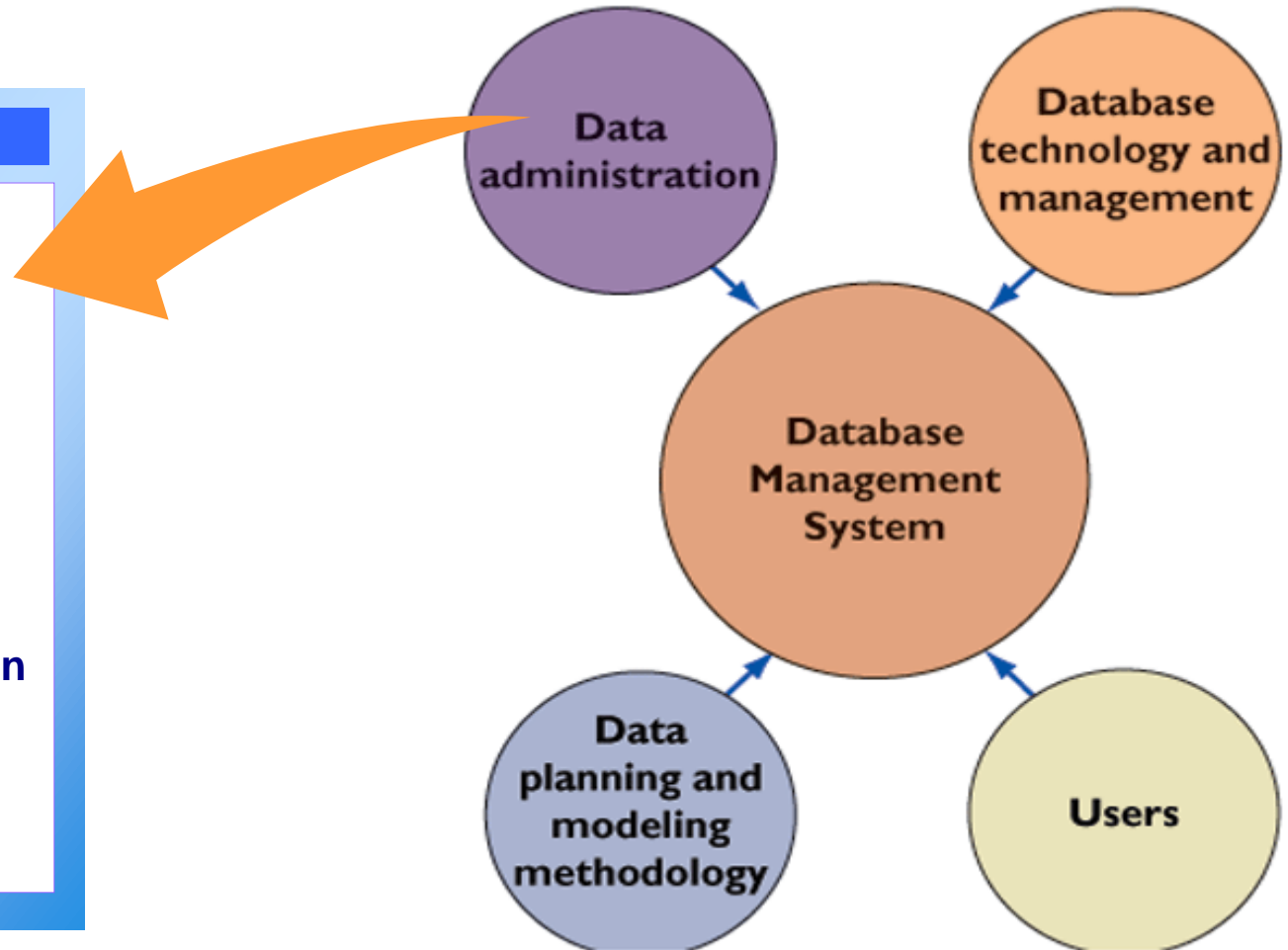




## Organizational element #1: Data Administration

**Issues**

- **Develop information policies**
- **Define information requirements**
- **Monitor use of information**

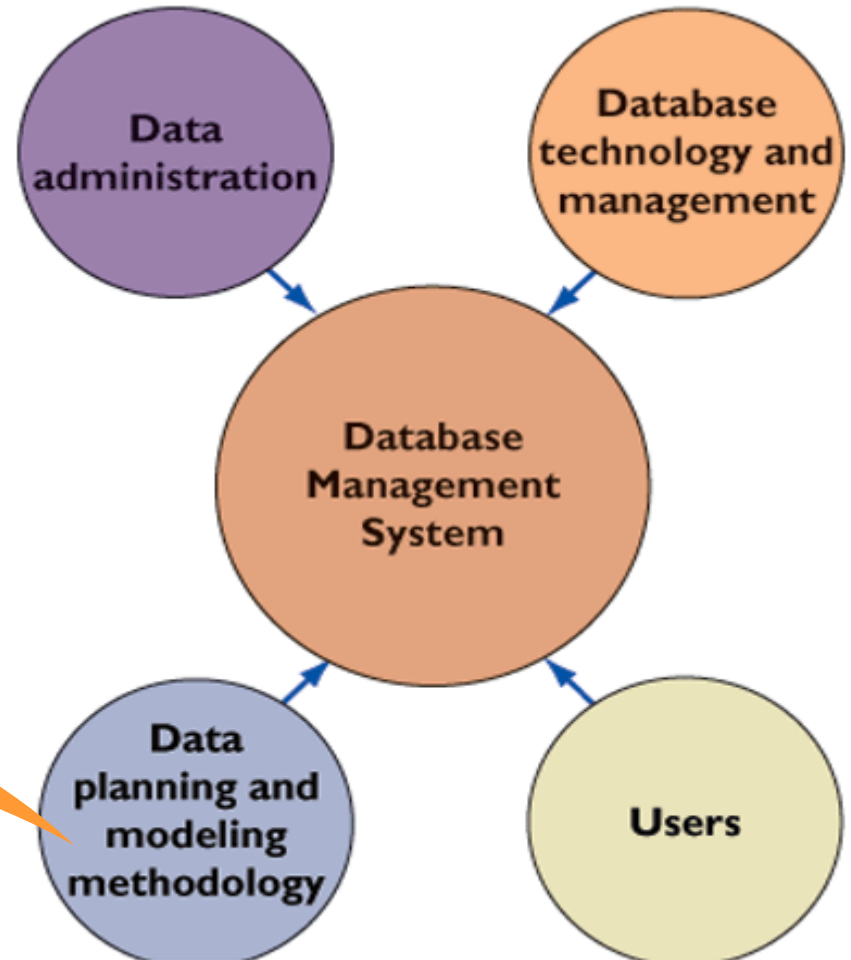




## Organizational element #2: Data Planning and Modeling Methodology

**Issues**

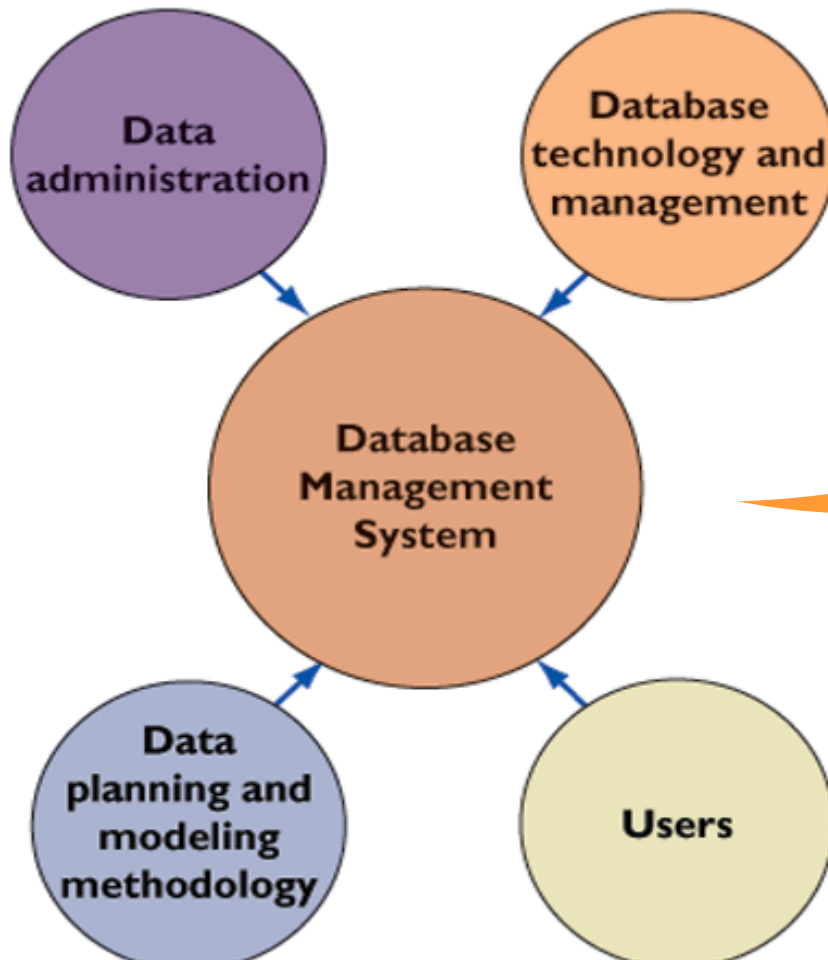
- Plan for enterprise-wide use for data
- If a relational DBMS is used, identify key entities, attributes, and relationships that constitute the organization's data







## Organizational elements #3 and #4: Database Technology and Management - Users



Issues
<ul style="list-style-type: none"><li>• DBMS software and staff are required</li><li>• Database design group defines and organizes structure and content of database</li><li>• Establish physical database, logical relations, access and security rules</li></ul>

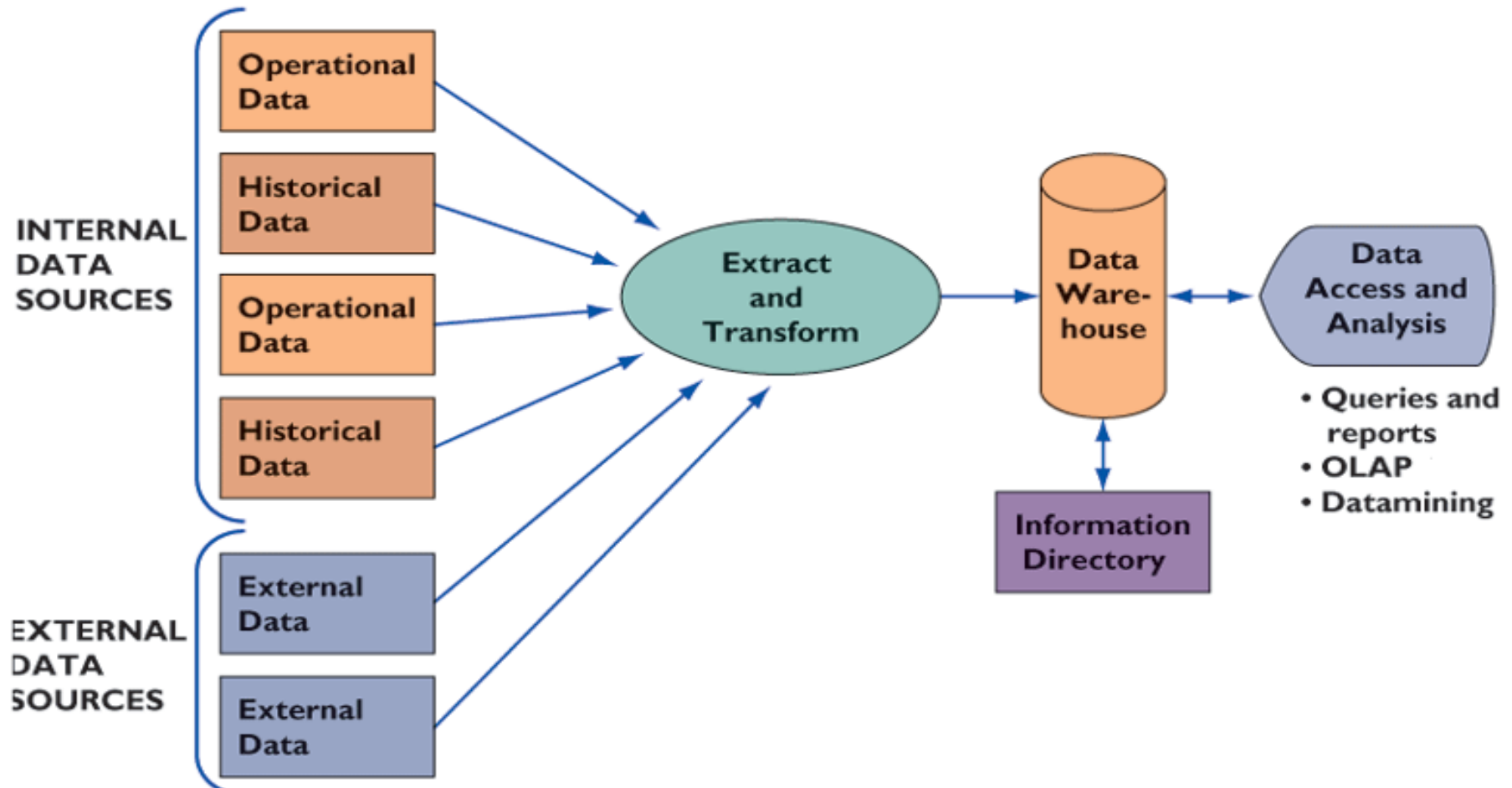


## A new trend in creating database environments is that of *data warehousing* and *data mining*

- A *Data Warehouse* stores current and historical data for reporting and analysis
- *Data mining* refers to techniques for finding hidden patterns / relationships in large pools of data in order to infer rules for predicting future trends



**A data warehouse enables modeling and remodeling of business data, as well as enabling access to data without affecting performance of underlying operational legacy systems**



A background image showing several rolled-up banknotes, likely Euro, standing upright on a sandy beach. The scene is brightly lit, suggesting a sunny day. The banknotes are the primary focus on the left side of the slide.

# Closing Remarks



## Key learning points

### Issues

- **Designing and deploying a database environment across an organization is the job of the whole organization – not just of its IT department**
- **The reason for that is that modeling the data flow within an organization can be a major catalyst for improving an organization's decision-making capabilities**
- **In terms of selecting the right technology solution, the selection depends on the type of the data to be stored, the compatibility with existing hardware and software installations and the provided flexibility in organizing the corporate data**