

# **Database Systems:**

# **Design, Implementation, and**

# **Management**

## **Ninth Edition**

*Chapter 12*

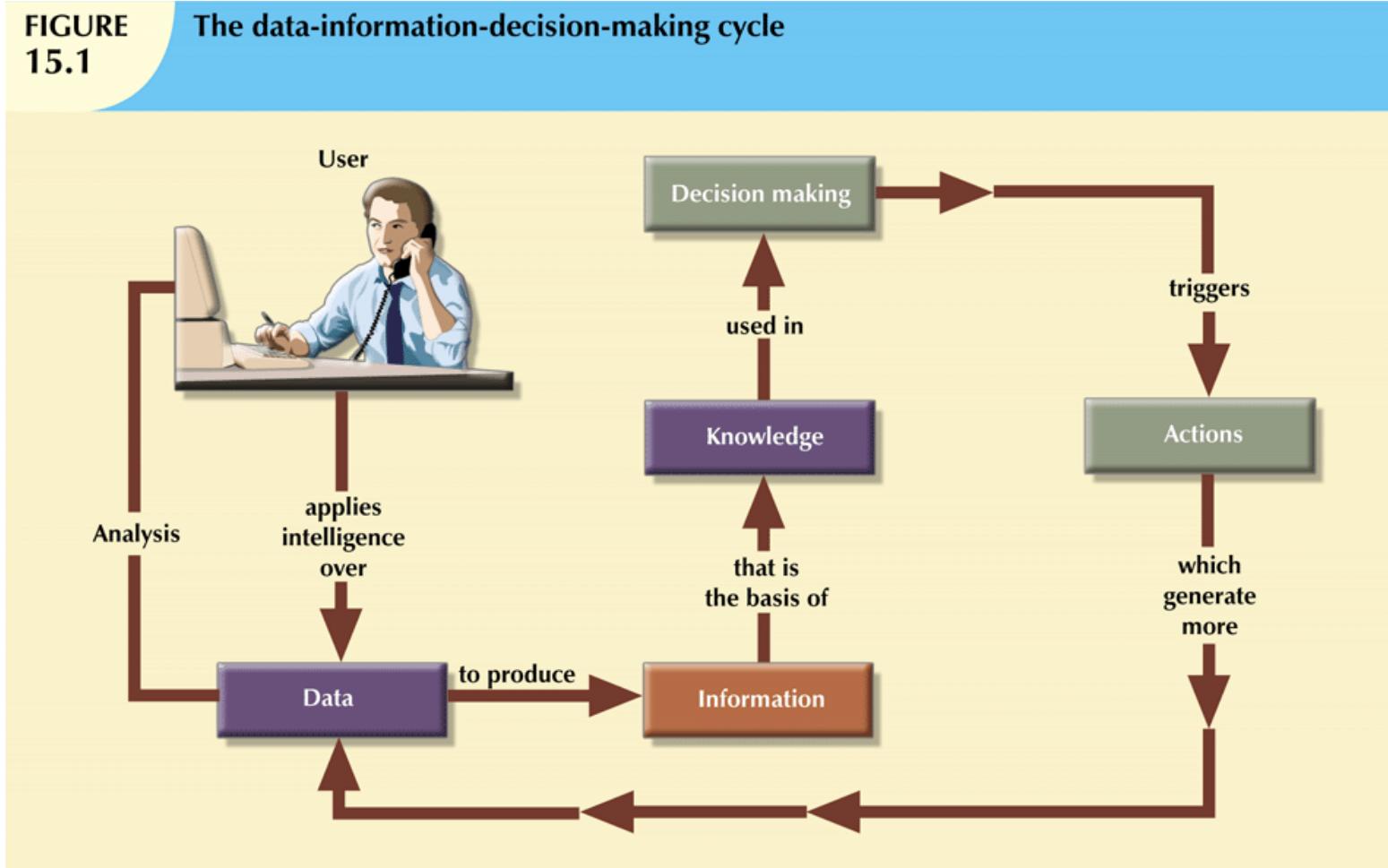
*Database Administration and Security*

# Data as a Corporate Asset

- Data:
  - Valuable asset that requires careful management
  - Valuable resource that translates into information
- Accurate, timely information triggers actions that enhance company's position and generate wealth
- **Dirty data**
  - Data that suffer from inaccuracies and inconsistencies
  - Threat to organizations

**FIGURE  
15.1**

The data-information-decision-making cycle



# Data as a Corporate Asset (cont'd.)

- **Data quality**
  - Comprehensive approach to ensuring the accuracy, validity, and timeliness of the data
- **Data profiling software**
  - Consists of programs that gather statistics and analyze existing data sources
- **Master data management (MDM) software**
  - Helps prevent dirty data by coordinating common data across multiple systems.

# The Need for and Role of Databases in an Organization

- Database's predominant role is to support managerial decision making at all levels
- DBMS facilitates:
  - Interpretation and presentation of data
  - Distribution of data and information
  - Preservation and monitoring of data
  - Control over data duplication and use
- Three levels to organization management:
  - Top, middle, operational

# Introduction of a Database: Special Considerations

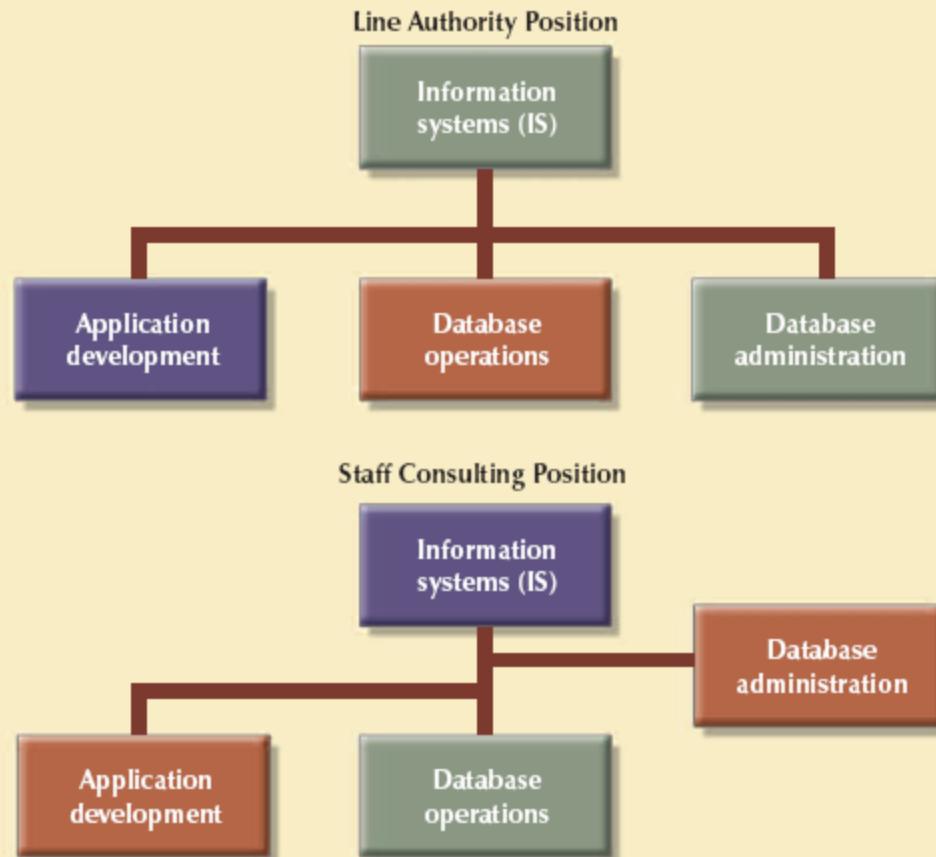
- Introduction of a DBMS is likely to have a profound impact
  - Might be positive or negative, depending on how it is administered
- Three aspects to DBMS introduction:
  - Technological
  - Managerial
  - Cultural
- One role of DBA department is to educate end users about system uses and benefits

# The Evolution of the Database Administration Function

- Data administration has its roots in the old, decentralized world of the file system
- Advent of DBMS produced new level of data management sophistication
  - DP department evolved into information systems (IS) department
- Data management became increasingly complex
  - Development of **database administrator (DBA)** function

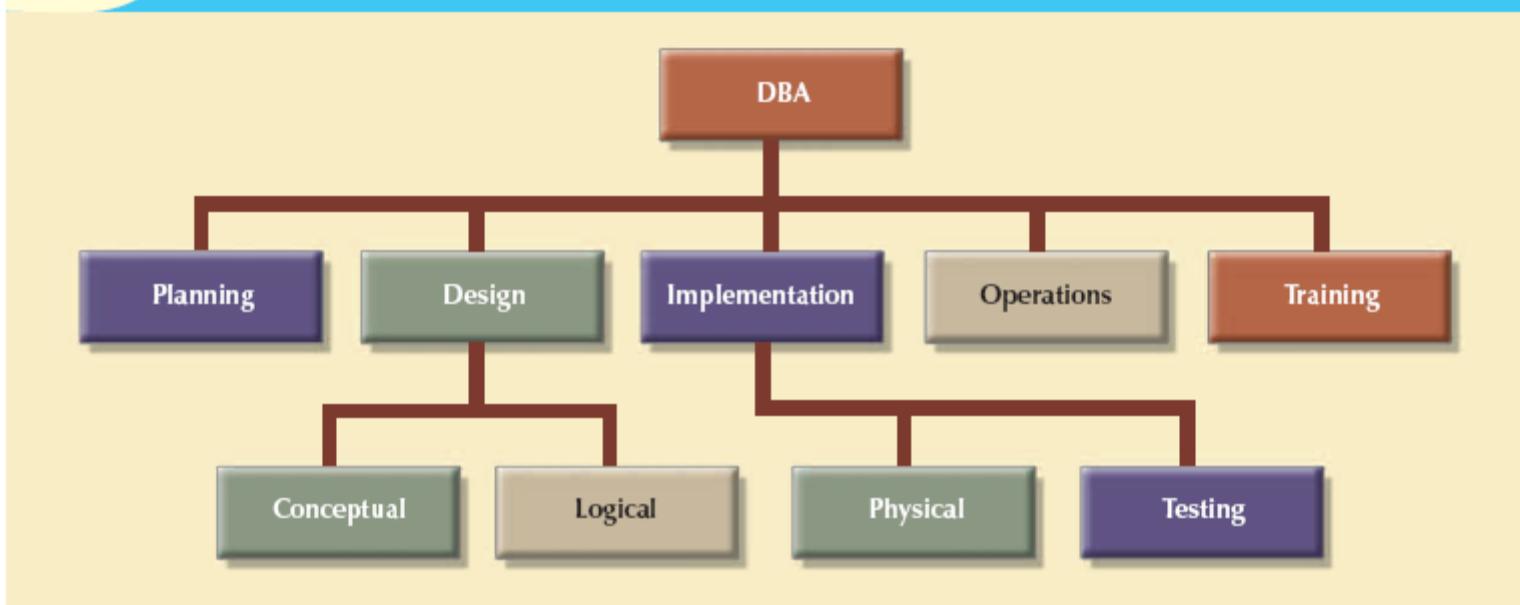
**FIGURE  
15.3**

The placement of the DBA function



**FIGURE  
15.4**

A DBA functional organization

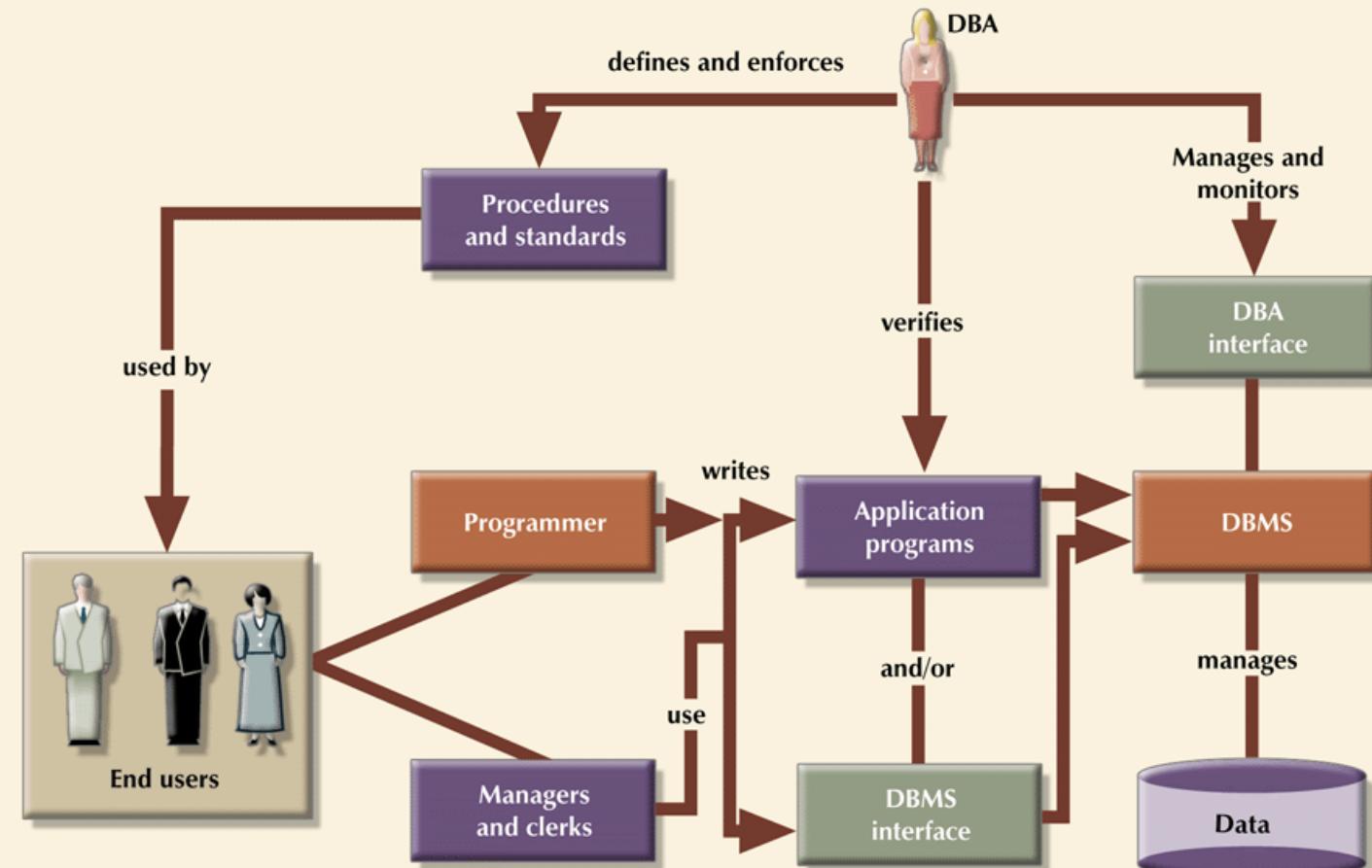


# The Database Environment's Human Component

- Even most carefully crafted database system cannot operate without human component
- Effective data administration requires both technical and managerial skills
- DA must set data administration goals
- DBA is focal point for data/user interaction
- Need for diverse mix of skills

**FIGURE  
15.6**

A summary of DBA activities



# The DBA's Managerial Role

- DBA responsible for:
  - Coordinating, monitoring, allocating resources
    - Resources include people and data
  - Defining goals and formulating strategic plans
- Interacts with end user by providing data and information
- Enforces **policies, standards, procedures**

# The DBA's Managerial Role (cont'd.)

- Manages security, privacy, integrity
- Ensures data can be fully recovered
  - In large organizations, **database security officer (DSO)** responsible for disaster management
- Ensures data is distributed appropriately
  - Makes it easy for authorized end users to access the database

**TABLE  
15.3**

**DBA Activities and Services**

DBA ACTIVITY	DBA SERVICE
Planning	End-user support
Organizing	Policies, procedures, and standards
Testing	Data security, privacy, and integrity
Monitoring	Data backup and recovery
Delivering	Data distribution and use

# The DBA's Technical Role

- Evaluates, selects, and installs DBMS and related utilities
- Designs and implements databases and applications
- Tests and evaluates databases and applications

# The DBA's Technical Role (cont'd.)

- Operates DBMS, utilities, and applications
- Trains and supports users
- Maintains DBMS, utilities, and applications

# Security

- Securing data entails securing overall information system architecture
- **Confidentiality:** data protected against unauthorized access
- **Integrity:** keep data consistent and free of errors or anomalies
- **Availability:** accessibility of data by authorized users for authorized purposes

# Security Policies

- Database security officer secures the system and the data
  - Works with the database administrator
- **Security policy:** collection of standards, policies, procedures to guarantee security
  - Ensures auditing and compliance
- Security audit process identifies security vulnerabilities
  - Identifies measures to protect the system

# Security Vulnerabilities

- **Security vulnerability:** weakness in a system component
  - Could allow unauthorized access or cause service disruptions
- **Security threat:** imminent security violation
  - Could occur at any time
- **Security breach** yields a database whose integrity is either:
  - Preserved
  - Corrupted

**TABLE  
15.4**

**Sample Security Vulnerabilities and Related Measures**

SYSTEM COMPONENT	SECURITY VULNERABILITY	SECURITY MEASURES
People	<ul style="list-style-type: none"><li>• User sets a blank password.</li><li>• Password is short or includes birth date.</li><li>• User leaves office door open all the time.</li><li>• User leaves payroll information on screen for long periods of time.</li></ul>	<ul style="list-style-type: none"><li>• Enforce complex password policies.</li><li>• Use multilevel authentication.</li><li>• Use security screens and screen savers.</li><li>• Educate users about sensitive data.</li><li>• Install security cameras.</li><li>• Use automatic door locks.</li></ul>
Workstation and Servers	<ul style="list-style-type: none"><li>• User copies data to flash drive.</li><li>• Workstation is used by multiple users.</li><li>• Power failure crashes computer.</li><li>• Unauthorized personnel can use computer.</li><li>• Sensitive data stored in laptop computer.</li><li>• Data lost due to stolen hard disk/laptop.</li><li>• Natural disasters—earthquake, flood, etc.</li></ul>	<ul style="list-style-type: none"><li>• Use group policies to restrict use of flash drives.</li><li>• Assign user access rights to workstations.</li><li>• Install uninterrupted power supplies (UPSs).</li><li>• Add security lock devices to computers.</li><li>• Implement a “kill” switch for stolen laptops.</li><li>• Create and test data backup and recovery plans.</li><li>• Insure system against natural disasters—use co-location strategies.</li></ul>

**TABLE  
15.4****Sample Security Vulnerabilities and Related Measures (continued)**

SYSTEM COMPONENT	SECURITY VULNERABILITY	SECURITY MEASURES
Operating System	<ul style="list-style-type: none"><li>• Buffer overflow attacks.</li><li>• Virus attacks.</li><li>• Root kits and worm attacks.</li><li>• Denial of service attacks.</li><li>• Trojan horses.</li><li>• Spyware applications.</li><li>• Password crackers.</li></ul>	<ul style="list-style-type: none"><li>• Apply OS security patches and updates.</li><li>• Apply application server patches.</li><li>• Install antivirus and antispyware software.</li><li>• Enforce audit trails on the computers.</li><li>• Perform periodic system backups.</li><li>• Install only authorized applications.</li><li>• Use group policies to prevent unauthorized installs.</li></ul>
Applications	<ul style="list-style-type: none"><li>• Application bugs—buffer overflow.</li><li>• SQL injection, session hijacking, etc.</li><li>• Application vulnerabilities—cross-site scripting, nonvalidated inputs.</li><li>• E-mail attacks: spamming, phishing, etc.</li><li>• Social engineering e-mails.</li></ul>	<ul style="list-style-type: none"><li>• Test application programs extensively.</li><li>• Built safeguards in code.</li><li>• Do extensive vulnerability testing in applications.</li><li>• Install spam filter/antivirus for e-mail system.</li><li>• Use secure coding techniques (see <a href="http://www.owasp.org">www.owasp.org</a>).</li><li>• Educate users about social engineering attacks.</li></ul>
Network	<ul style="list-style-type: none"><li>• IP spoofing.</li><li>• Packet sniffers.</li><li>• Hacker attacks.</li><li>• Clear passwords on network.</li></ul>	<ul style="list-style-type: none"><li>• Install firewalls.</li><li>• Virtual Private Networks (VPN).</li><li>• Intrusion Detection Systems (IDS).</li><li>• Network Access Control (NAC).</li><li>• Network activity monitoring.</li></ul>
Data	<ul style="list-style-type: none"><li>• Data shares are open to all users.</li><li>• Data can be accessed remotely.</li><li>• Data can be deleted from shared resource.</li></ul>	<ul style="list-style-type: none"><li>• Implement file system security.</li><li>• Implement share access security.</li><li>• Use access permission.</li><li>• Encrypt data at the file system or database level.</li></ul>

# Database Security

- Refers to the use of DBMS features and other measures to comply with security requirements
- DBA secures DBMS from installation through operation and maintenance
- **Authorization management:**
  - User access management
  - View definition
  - DBMS access control
  - DBMS usage monitoring

# Database Administration Tools

- Two main types of data dictionaries:
  - Integrated
  - Standalone
- **Active data dictionary** is automatically updated by the DBMS with every database access
- **Passive data dictionary** requires running a batch process
- Main function: store description of all objects that interact with database

# Database Administration Tools (cont'd.)

- Data dictionary that includes data external to DBMS becomes flexible tool
  - Enables use and allocation of all of an organization's information
- Metadata is often the basis for monitoring database use
  - Also for assigning access rights to users
- DBA uses data dictionary to support data analysis and design

# CASE Tools

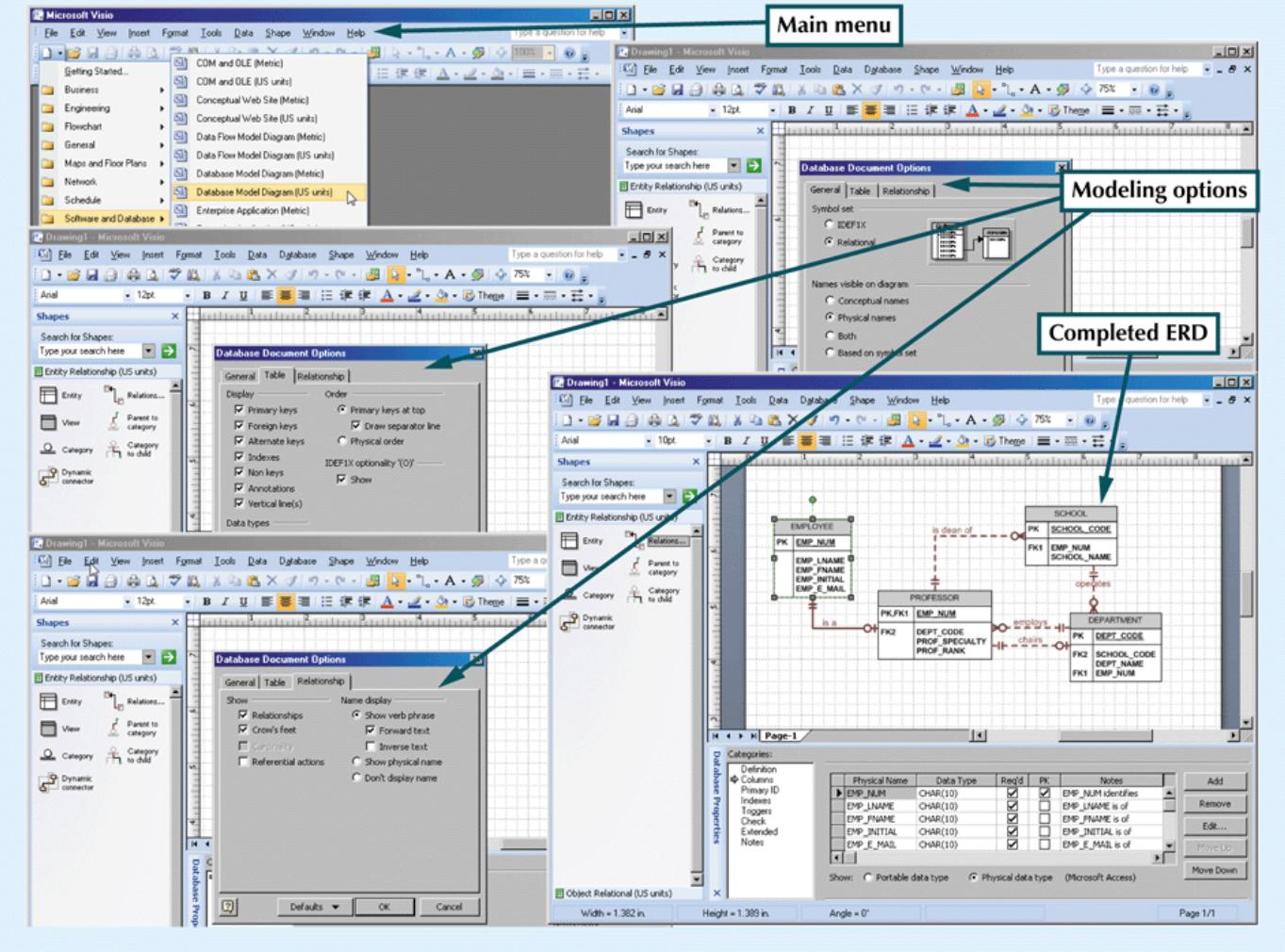
- **Computer-aided systems engineering**
  - Automated framework for SDLC
  - Structured methodologies and powerful graphical interfaces
- **Front-end CASE tools** provide support for planning, analysis, and design phases
- **Back-end CASE tools** provide support for coding and implementation phases

# CASE Tools (cont'd.)

- Typical CASE tool has five components
  - Graphics for diagrams
  - Screen painters and report generators
  - Integrated repository
  - Analysis segment
  - Program documentation generator

**FIGURE  
15.7**

An example of a CASE tool: Visio Professional



# Developing a Data Administration Strategy

- **Information engineering (IE)** translates strategic goals into data and applications
- **Information systems architecture (ISA)** is the output of IE process
- Implementing IE is a costly process
  - Provides a framework that includes use of computerized, automated, and integrated tools
- Success of information systems strategy depends on critical success factors
  - Managerial, technological, and corporate culture

# The DBA at Work: Using Oracle for Database Administration

- Technical tasks handled by the DBA in a specific DBMS:
  - Creating and expanding database storage structures
  - Managing database objects
  - Managing end-user database environment
  - Customizing database initialization parameters
- All DBMS vendors provide programs to perform database administrative tasks

# Oracle Database Administration Tools

FIGURE  
15.9

The Oracle Enterprise Manager interface



# The Default Login

- Must connect to the database to perform administrative tasks
  - Username with administrative privileges
- Oracle automatically creates SYSTEM and SYS user IDs with administrative privileges
- Define preferred credentials by clicking on **Preferences** link, then **Preferred Credentials**
- Username and passwords are database-specific

# Ensuring an Automatic RDBMS Start

- DBA ensures database access is automatically started when computer turned on
- A *service* is a Windows system name for a special program that runs automatically
  - Part of the operating system
- **Database instance:** separate location in memory reserved to run the database
  - May have several databases running in memory at the same time

# Creating Tablespaces and Datafiles

- Database composed of one or more tablespaces
- **Tablespace** is a logical storage space
  - Physically stored in one or more datafiles
- **Datafile** physically stores the database's data
  - Each datafile can reside in a different directory on the hard disk
- Database has 1:M relationship with tablespaces
- Tablespace has 1:M relationship with datafiles

**FIGURE  
15.12**

## The Oracle Storage Manager

The screenshot shows the Oracle Enterprise Manager 11g Database Control interface for managing tablespaces. The title bar reads "Oracle Enterprise Manager (SYS) - Tablespaces - Windows Internet Explorer". The main menu includes "Setup", "Preferences", "Help", "Logout", and "Database". The sub-menu "Database" is selected. The URL in the address bar is "Database Instance: gradora.cisora1.bizlab.mtsu.edu > Tablespace". The status bar indicates "Logged in As SYS".

The "Tablespaces" page displays a table of database tablespaces. The table has columns: Select, Name, Allocated Size(MB), Space Used(MB), Allocated Space Used(%), Free Space(MB), Status, Datafiles, Type, Extent Management, and Segment Management.

Select	Name	Allocated Size(MB)	Space Used(MB)	Allocated Space Used(%)	Free Space(MB)	Status	Datafiles	Type	Extent Management	Segment Management
<input checked="" type="radio"/>	SYSAUX	899.4	852.9	94.8	46.4	✓	1	PERMANENT LOCAL	AUTO	
<input type="radio"/>	SYSTEM	710.0	703.9	99.1	6.1	✓	1	PERMANENT LOCAL	MANUAL	
<input type="radio"/>	TEMP	3,845.0	0.0	0.0	3,845.0	✓	1	TEMPORARY LOCAL	MANUAL	
<input type="radio"/>	UNDOTBS1	6,510.0	18.2	0.3	6,491.8	✓	1	UNDO LOCAL	MANUAL	
<input type="radio"/>	USERS	5,037.2	4,710.3	93.5	326.9	✓	1	PERMANENT LOCAL	AUTO	

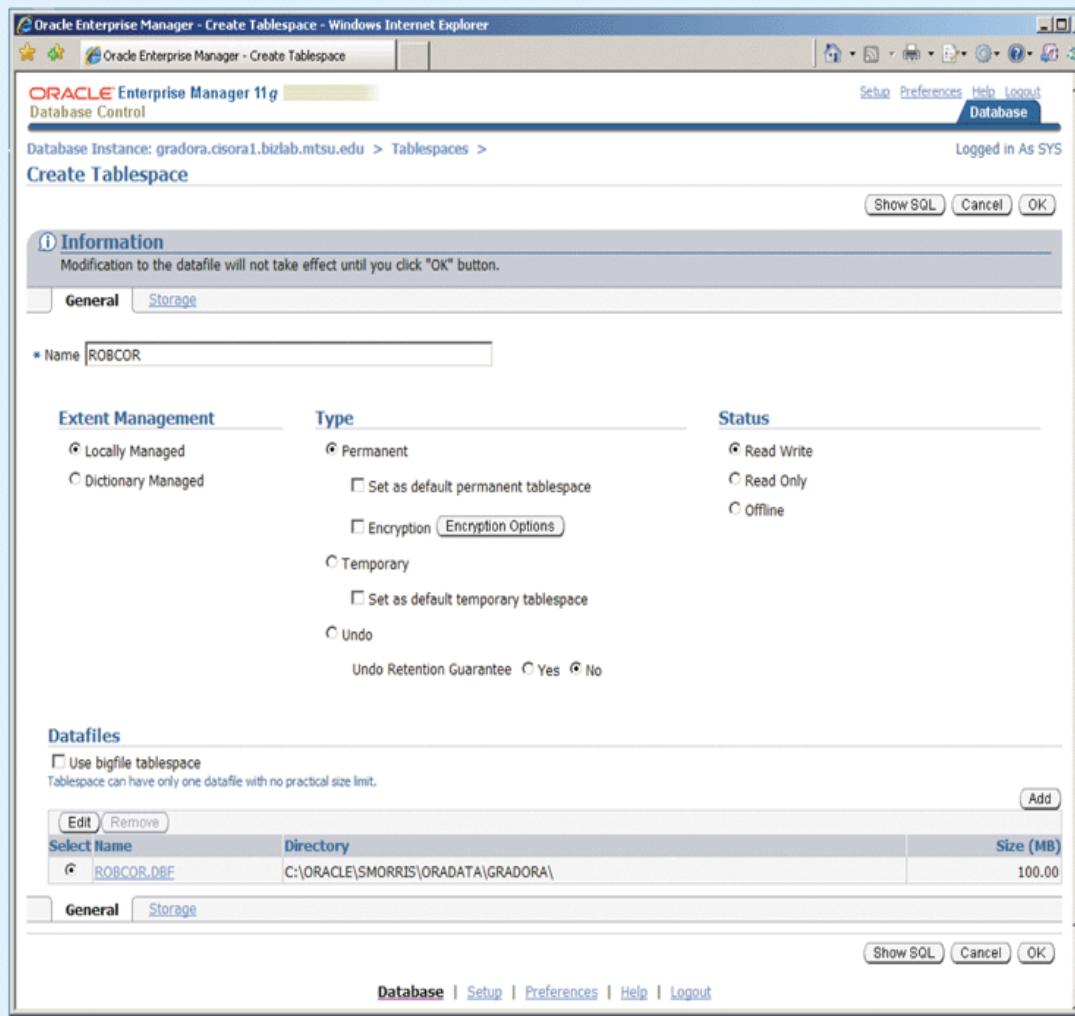
Below the table, summary statistics are provided:

- Total Allocated Size (MB): **17,001.6**
- Total Used (MB): **6,285.3**
- Total Allocated Free Space (MB): **10,716.2**

At the bottom, there are links for "Database", "Setup", "Preferences", "Help", and "Logout". A copyright notice at the very bottom states: "Copyright © 1996, 2007, Oracle. All rights reserved. Oracle, JD Edwards, PeopleSoft, and Retek are registered trademarks of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners. About Oracle Enterprise Manager".

**FIGURE  
15.13**

### Creating a new tablespace



# Managing the Database Objects: Tables, Views, Triggers, and Procedures

- **Database object:** any object created by end users
- **Schema:** logical section of the database that belongs to a given user
  - Schema identified by a username
  - Within the schema, users create their own tables and other objects
- Normally, users are authorized to access only the objects that belong to their own schemas

# Managing Users and Establishing Security

- **User:** uniquely identifiable object
  - Allows a given person to log on to the database
- **Role:** a named collection of database access privileges
  - Authorizes a user to connect to the database and use system resources
- **Profile:** named collection of settings
  - Controls how much of a resource a given user can use

**FIGURE**  
**15.14**

## The Oracle Schema Manager

The screenshot shows the Oracle Enterprise Manager 11g Schema Manager interface. The title bar reads "Oracle Enterprise Manager (SYS) - Tables - Windows Internet Explorer". The main menu bar includes "Setup", "Preferences", "Help", "Logout", and "Database". A status bar at the top right says "Logged in As SYS" and "Recycle Bin". The main content area is titled "Tables". On the left, there is a "Search" section with fields for "Schema" (set to "SYS") and "Object Name", and a "Go" button. Below the search is a note about search behavior. Under "Selection Mode", it is set to "Single". At the top of the main table area are buttons for "Edit", "View", "Delete With Options", "Actions", "Create Like", and "Go". To the right of the table is a vertical "Object Type" dropdown menu with various options like Table, Array Type, Database Link, etc., with "Table" currently selected. The main table lists 21 entries, all belonging to the "SYS" schema:

Select	Schema	Table Name	Tablespace	Partitioned	Rows	Last Analyzed
<input checked="" type="radio"/>	SYS	ACCESS\$	SYSTEM	NO	93840	Jul 1, 2009 10:04:31 AM CDT
<input type="radio"/>	SYS	ALERT_QT	SYSAUX	NO	0	Aug 25, 2008 11:52:00 AM CDT
<input type="radio"/>	SYS	APPLYS_CONF_HDLR_COLUMNS	SYSTEM	NO	0	Aug 25, 2008 11:52:00 AM CDT
<input type="radio"/>	SYS	APPLYS_CONSTRAINT_COLUMNS	SYSTEM	NO	0	Aug 25, 2008 11:52:00 AM CDT
<input type="radio"/>	SYS	APPLY\$_DEST_OBJ	SYSTEM	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_DEST_OBJ_CMAP	SYSTEM	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_DEST_OBJ_OPS	SYSTEM	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_ERROR	SYSAUX	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_ERROR_HANDLER	SYSTEM	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_ERROR_TXN	SYSTEM	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_SOURCE_OBJ	SYSTEM	NO	0	Aug 25, 2008 11:52:30 AM CDT
<input type="radio"/>	SYS	APPLY\$_SOURCE_SCHEMA	SYSTEM	NO	0	Aug 25, 2008 11:52:31 AM CDT
<input type="radio"/>	SYS	APPLY\$_VIRTUAL_OBJ_CONS	SYSTEM	NO	0	Aug 25, 2008 11:52:31 AM CDT
<input type="radio"/>	SYS	APPROLES\$	SYSTEM	NO	0	Aug 25, 2008 11:52:31 AM CDT
<input type="radio"/>	SYS	AQ\$_ALERT_QT_G	SYSAUX	NO	0	Aug 25, 2008 11:52:31 AM CDT
<input type="radio"/>	SYS	AQ\$_ALERT_QT_H	SYSAUX	NO	0	Aug 25, 2008 11:52:31 AM CDT
<input type="radio"/>	SYS	AQ\$_ALERT_QT_I	SYSAUX	NO	0	Aug 25, 2008 11:52:31 AM CDT
<input type="radio"/>	eve	AQ\$_ALERT_QT_C	SYSAUX	NO	0	Aug 25, 2008 10:04:55 AM CDT

# Customizing the Database Initialization Parameters

- Fine-tuning requires modification of database configuration parameters
  - Some are changed in real time using SQL
  - Some affect database instance
  - Others affect entire RDBMS and all instances
- Initialization parameters reserve resources used by the database at run time
- After modifying parameters, may need to restart the database

**FIGURE  
15.17**

## The Oracle Enterprise Manager – Initialization Parameters page

The screenshot shows the Oracle Enterprise Manager (SYS) - Initialization Parameters page in a Windows Internet Explorer browser window. The title bar reads "Oracle Enterprise Manager (SYS) - Initialization Parameters - Windows Internet Explorer". The main content area is titled "Initialization Parameters" with tabs for "Current" and "SPFile". A message states: "The parameter values listed here are currently used by the running instance(s). You can change static parameters in SPFILE mode." Below this is a search bar with dropdowns for "Name", "Basic", "Modified", "Dynamic", and "Category" (All), and a "Go" button. A checkbox "Apply changes in current running instance(s) mode to SPFILE. For static parameters, you must restart the database." is checked. A "Save to File" button is visible. The main table lists 288 parameters, with the first few rows shown below:

Name	Help	Revisions	Value	Comments	Type	Basic	Modified	Dynamic	Ca
audit_file_dest	(i)		C:\ORACLE\SMORRIS\ADMIN		String	✓	✓		Se
audit_trail	(i)		DB		String	✓			Au
diagnostic_dest	(i)		C:\ORACLE\SMORRIS		String	✓	✓		Mi
dispatchers	(i)		(PROTOCOL=TCP) (SERVICE=		String	✓	✓		Sh
log_archive_format	(i)		ARC%S_%R.%T		String	✓			Se
compatible	(i)		11.1.0.0.0		String	✓	✓		Mi
control_files	(i)		'C:\ORACLE\SMORRIS\ORADATA\GRADORA\CONTROL02.CTL', 'C:\ORACLE\SMORRIS\ORADATA\GRADORA\CONTROL03.CTL', 'C:\ORACLE\SMORRIS\ORADATA\GRADORA\CONTROL01.CTL'		String	✓	✓		Fil Co
db_block_size	(i)		4096		Integer	✓	✓		Me
db_domain	(i)		cisora1.bizlab.mtsu.edu		String	✓	✓		Da
db_name	(i)		gradora		String	✓	✓		Da
db_recovery_file_dest	(i)		C:\oracle\smorris\flash_recov		String	✓	✓		Ba
db_recovery_file_dest_size	(i)		1G		Big Integer	✓	✓		Re
open_cursors	(i)		300		Integer	✓	✓		Cu