WelTec
Te Whare Wānanga o te Awakairangi

西安科技大学高新学院
XI'AN KEDAGAOXIN UNIVERSITY

IT5507 Fundamentals of Data Science

Chapter 16
Database Administration and Security

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Learning Objectives

- After completing this chapter, you will be able to:
  - Describe the impact of data quality on a company's assets and competitive position
  - Describe the role of the database in supporting operational, tactical, and strategic decision-making
  - Describe the impact that the introduction of a DBMS has on technological, managerial, and cultural aspects of an organization
  - Describe the managerial and technical roles of the database administrator
  - Describe the processes and systems in the information security framework that support the three database security goals
  - Identify the standards, strategies, and tools used in database administration
  - Describe the impact that cloud-based data services have on the role of the DBA
  - Perform various technical tasks of database administration with Oracle

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Data as a Corporate Asset (1 of 3)

- Data is a valuable resource that can translate into information
  - If the information is accurate and timely, it can enhance the company's competitive position and generate wealth
- An organization is subject to a data-information-decision cycle
  - Data user applies intelligence to data to produce information that is the basis of knowledge used in decision making

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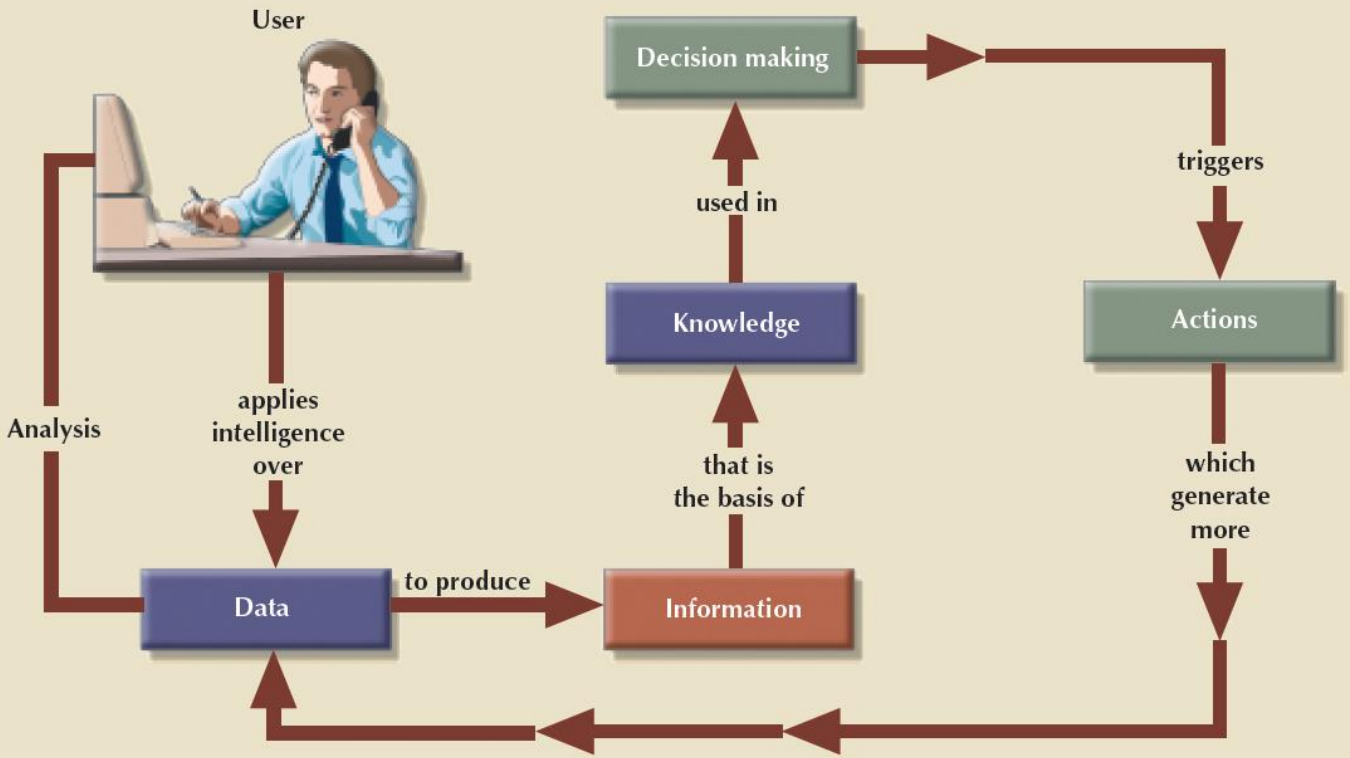
Data as a Corporate Asset (2 of 3)

FIGURE 16.1 THE DATA-INFORMATION-DECISION-MAKING CYCLE



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Data as a Corporate Asset (3 of 3)

- Dirty data
  - Suffers from inaccuracies and inconsistencies
- Data quality
  - Ensures accuracy, validity, and timeliness of data
- Data profiling software
  - Determines data patterns and compares them against standards defined by the organization
- Master data management (MDM) software
  - Helps prevent dirty data by coordinating across multiple systems

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The Need for a Database and Its Role in an Organization (1 of 2)

- Top management level
  - Enable strategic decision making and planning
  - Identify growth opportunities
  - Define and enforce organizational policies
  - Reduce costs and boost productivity
  - Provide feedback
- Middle management level
  - Deliver the data required for tactical planning
  - Monitor the use of resources
  - Evaluate performance
  - Enforce security and privacy of data in the database

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The Need for a Database and Its Role in an Organization (2 of 2)

- Operational management level
  - Represent and support company operations
  - Produce query results within specified performance levels
  - Enhance the company's short-term operations
  - Create query results within specified performance levels
  - Enhance the company's short-term operations

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Introduction of a Database: Special Considerations

- Technological aspect
  - Selecting, installing, configuring, and monitoring the DBMS to ensure that it operates efficiently
- Managerial aspect
  - Careful planning to create an appropriate organizational structure
- Cultural aspect
  - Listening to people's concerns about the system and explaining its uses and benefits

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The Evolution of Database Administration (1 of 4)

- Information systems (IS) department
  - Provides end users with data management support and solutions for information needs
- Database administrator
  - Responsible for control of the centralized and shared database
- Systems administrator
  - General coordinator of all DBAs
- Data administrator (DA) or information resource manager (IRM)
  - Usually reports directly to top management; has a higher degree of responsibility and authority than the DBA

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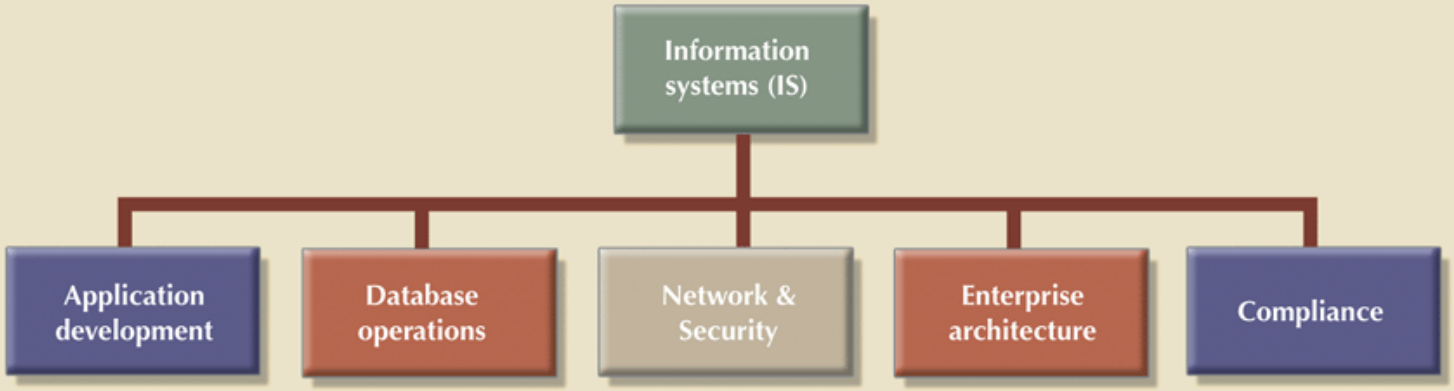
The Evolution of Database Administration (2 of 4)

FIGURE 16.2 THE IS DEPARTMENT'S INTERNAL ORGANIZATION



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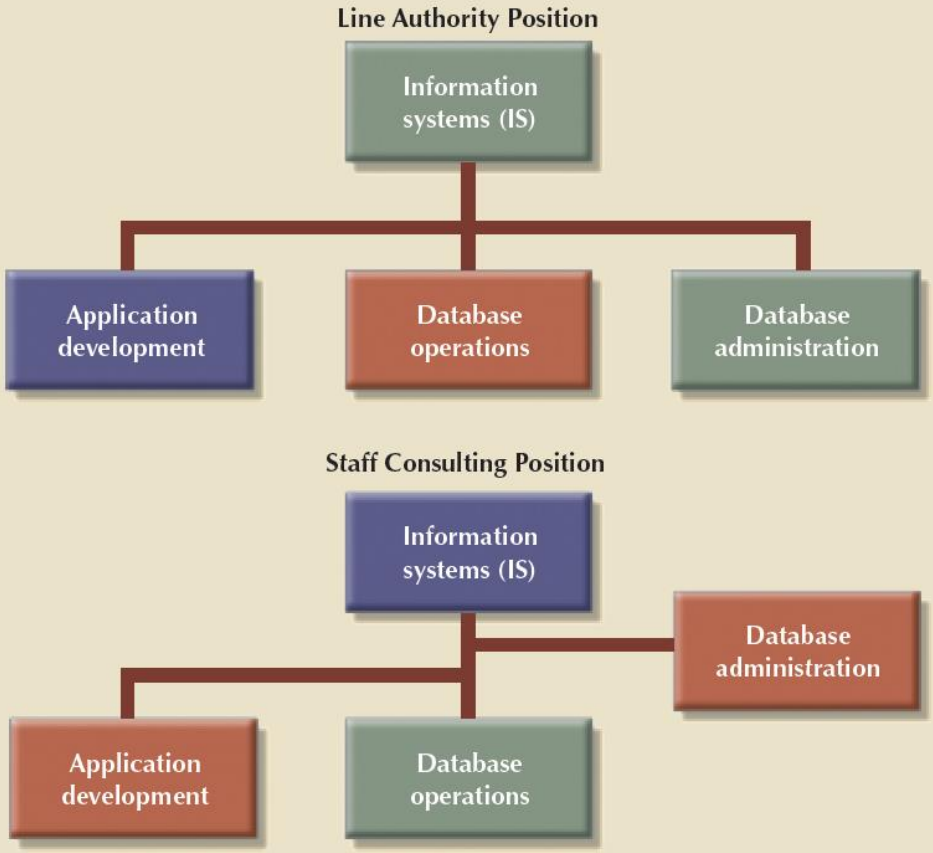
The Evolution of Database Administration (3 of 4)

FIGURE 16.3 THE PLACEMENT OF THE DBA FUNCTION



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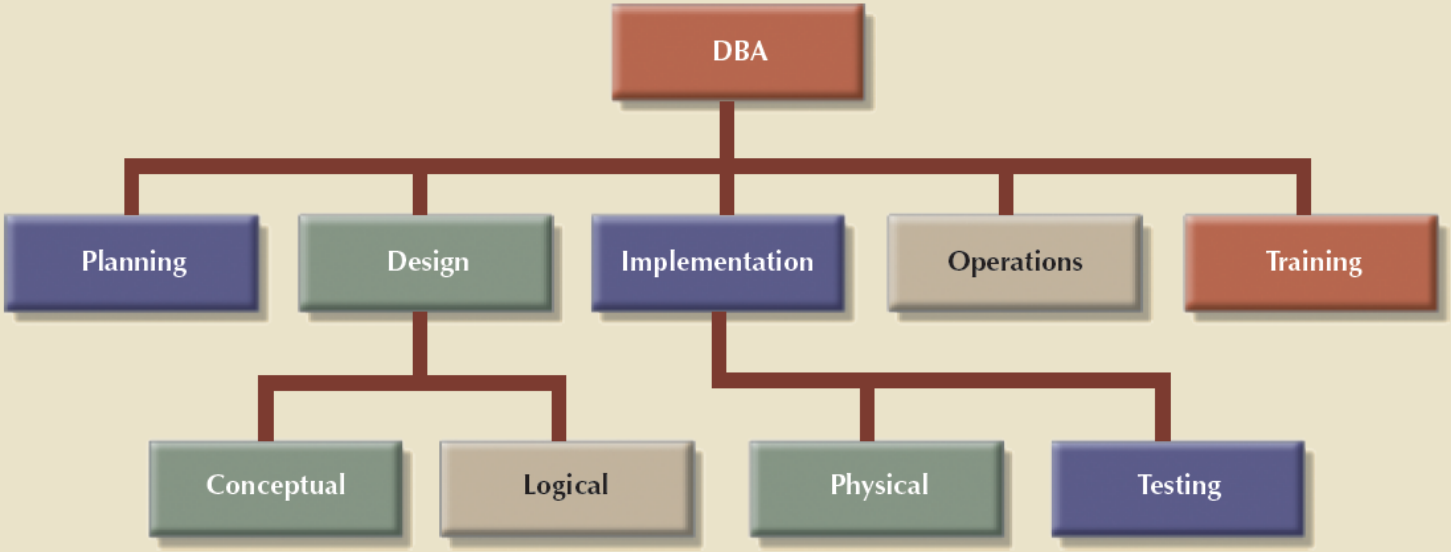
The Evolution of Database Administration (4 of 4)

FIGURE 16.4 A DBA FUNCTIONAL ORGANIZATION



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The Database Environment's Human Component (1 of 3)

- Even the most carefully crafted database system cannot operate without human assistance
  - Effective data administration requires both technical and managerial skills
- Administration goals are defined by various data issues
  - "Sharability" and time availability
  - Consistency and integrity
  - Security and privacy
  - Quality standards
  - Extent and type of use

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The Database Environment's Human Component (2 of 3)

Table 16.1: Contrasting DA and DBA Activities and Characteristics	
Data Administrator (DA)	**Database Administrator (DBA)**
Performs strategic planning	Controls and supervises
Sets long-term goals	Executes plans to reach goals
Sets policies and standards	Enforces policies and procedures Enforces programming standards
Job is broad in scope	Job is narrow in scope
Focuses on the long term	Focuses on the short term (daily operations)
Has a managerial orientation	Has a technical orientation
Is DBMS-independent	Is DBMS-specific

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The Database Environment's Human Component (3 of 3)

Table 16.2: Desired DBA Skills	
Managerial	**Technical**
Broad business understanding	Broad data-processing background and up-to-date knowledge of database technologies
Coordination skills	Understanding of Systems Development Life Cycle
Analytical skills	Structured methodologies • Data flow diagrams • Structure charts • Programming languages
Conflict resolution skills	Knowledge of Database Life Cycle
Communication skills (oral and written)	Database modeling and design skills • Conceptual • Logical • Physical
Negotiation skills	Operational skills: database implementation, data dictionary management, security, and so on
Experience: 10 years in a large DP department	Experience: 10 years in a large DP department

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The DBA's Managerial Role (1 of 2)

- Important roles
  - Offer end-user support
  - Enforce policies, procedures, and standards for correct data creation, usage, and distribution within the database
  - Provide data security, privacy, and integrity
  - Supply data backup and recovery
    - Disaster management: planning, organizing, and testing of database contingency plans and recovery procedures
  - Ensure data is distributed to the right people, at the right time, and in the right format

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The DBA's Managerial Role (2 of 2)

- Backup and recovery measures must include at least:
  - Periodic data and application backups
  - Proper backup identification
  - Convenient and safe backup storage
  - Physical protection of both hardware and software
  - Personal access control to the software of a database installation
  - Insurance coverage for the data in the database
- Additional points
  - Data recovery and contingency plans must be tested, evaluated, and practiced frequently
  - A backup and recovery plan is not likely to cover all information system components

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The DBA's Technical Role

- Areas of operation
  - Evaluate, select, and install DBMS and related utilities
  - Design and implement databases and applications
  - Test and evaluate databases and applications
  - Operate the DBMS, utilities, and applications
  - Train and support users
  - Maintain the DBMS, utilities, and applications

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Security

- Confidentiality
  - Protecting data against unauthorized access
- Compliance
  - Activities that meet data privacy and security reporting guidelines
- Integrity
  - Keeping data consistent and free of errors or anomalies
- Availability
  - Accessibility of data whenever required by authorized users and for authorized purposes

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Security Policies

- Collection of standards, policies, and procedures created to guarantee security
  - Ensures auditing and compliance
- Security audit process
  - Identifies security vulnerabilities
  - Finds measures to protect the system

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Security Vulnerabilities

- Weakness in a system component that could allow unauthorized access or cause service disruptions
  - Categories: technical, managerial, cultural, and procedural
  - Security threat: imminent security violation
  - Security breach: occurs when a security threat is exploited and could lead to a database whose integrity is preserved or corrupted
    - Preserved or corrupted

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Database Security

- DBMS features and related measures that comply with the security requirements
  - Authorization management: procedures to protect database security and integrity
    - User access management
    - View definition
    - DBMS access control
    - DBMS usage monitoring
      - Audit log: automatically records description of database operations performed by all users

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Database Administration Tools

- There are many sophisticated data administration tools
  - Monitoring
  - Load testing
  - Performance tuning
  - SQL code optimization
  - Bottleneck identification and remediation
  - Modeling and design
  - Data extraction, transformation, and loading

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The Data Dictionary (1 of 2)

- Main types
  - Integrated: included with the DBMS
  - Standalone: third-party systems
  - Active: automatically updated by the DBMS with every database access
  - Passive: requires running a batch process
- Main function: store description of all objects that interact with the database
  - Provides database designers and end users with a much-improved ability to communicate
  - Helps the DBA resolve data conflicts

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The Data Dictionary (2 of 2)

- Key element of information resource management
  - Can be described as the information resource dictionary
- Metadata is the basis for monitoring database use and for assigning access rights to users
  - Information stored in the data dictionary is usually based on a relational table format, thus enabling the DBA to query the database with SQL commands
- DBA uses data dictionary to support data analysis and design

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CASE Tools (1 of 2)

- Computer-aided systems engineering (CASE) tools
  - Automated framework for the Systems Development Life Cycle (SDLC)
  - Use structured methodologies and powerful graphical interfaces
- Classified according to extent of support provided
  - Front-end CASE tools: planning, analysis, and design phases
  - Back-end CASE tools: coding and implementation phases

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CASE Tools (2 of 2)

- Components of a CASE tools
  - Graphics
  - Screen painters and report generators
  - Integrated repository
  - Analysis segment
  - Program documentation generator

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Developing a Data Administration Strategy

- Information engineering (IE)
  - Translates strategic goals into data and applications
- Information systems architecture (ISA)
  - Helps plan, develop, and control future information systems
- Critical success factors
  - Management commitment
  - Thorough analysis of the company situation
  - End-user involvement
  - Defined standards
  - Training
  - A small pilot project

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The DBA's Role in the Cloud

- Significant impact on role of DBAs
  - Tasks split between internal DBA and cloud service provider
- Cloud service partner company provides:
  - DBMS installation and updates
  - Server/network management
  - Backup and recovery operations

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The DBA at Work: Using Oracle for Database Administration

- Tools and procedures
  - Supply Oracle database administration tools
  - Ensure the RDBMS starts automatically
  - Create tablespaces and datafiles
    - Tablespace: logical storage space
    - Datafile: physically stores the database's data
  - Manage users and establish security
    - User: allows a given person to log on to the database
    - Role: authorizes a user to connect to the database and use its system resources
    - Profile: controls how much of the database resource a given user can access

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Customizing the Database Initialization Parameters

- Fine-tuning a database is an important task that usually requires modification of parameters
  - Initialization parameters reserve resources used by the database at run-time
  - Restart may be required after modifying parameters database
- The DBA is responsible for a wide range of tasks
  - Quality and completeness of administration tools go a long way toward making the DBA's job easier
  - The DBA must become familiar with the tools and technical details of the RDBMS to perform tasks properly and efficiently

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Summary (1 of 3)

- Data management is a critical activity for any organization, so data must be treated as a corporate asset
- Data quality is a comprehensive approach to ensure the accuracy, validity, and timeliness of data
- The DBMS is the most commonly used tool for corporate data management
- The database administrator (DBA) is responsible for managing the corporate database
- The DA and DBA functions tend to overlap

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Summary (2 of 3)

- A DBA's managerial services include supporting end users; defining and enforcing policies, procedures, and standards for the database; ensuring data security, privacy, and integrity; providing data backup and recovery services; and monitoring distribution and use of the data in the database
- The DBA's technical role requires involvement in at least the following activities: evaluating, selecting, and installing the DBMS; designing and implementing databases and applications; testing and evaluating databases and applications; operating and maintaining the DBMS, utilities, and applications; and training and supporting users
- Security refers to activities and measures that ensure the confidentiality, integrity, and availability of an information system and its main asset, data
- A security vulnerability is a weakness in a system component that could be exploited to allow unauthorized access or service disruption

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Summary (3 of 3)

- The development of a data administration strategy is closely related to the company's mission and objectives
- To help translate strategic plans into operational plans, the DBA has access to an arsenal of database administration tools, including a data dictionary and computer-aided systems engineering (CASE) tools
- With the introduction of reliable cloud-based data services, the role of the DBA has expanded beyond corporate walls

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