Chapter 8
Database Administration
Objectives

• Discuss the need for database administration
• Explain the DBA’s responsibilities in formulating and enforcing database policies for access privileges, security, disaster planning, and archiving
• Discuss the DBA’s administrative responsibilities for DBMS evaluation and selection, DBMS maintenance, data dictionary management, and training
• Discuss the DBA’s technical responsibilities for database design, testing, and performance tuning
**Introduction**

**FIGURE 8-1: DBA responsibilities**

<table>
<thead>
<tr>
<th>Database Policy Formulation and Enforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access privileges</td>
</tr>
<tr>
<td>Security</td>
</tr>
<tr>
<td>Disaster planning</td>
</tr>
<tr>
<td>Archiving</td>
</tr>
<tr>
<td><strong>Other Database Administrative Functions</strong></td>
</tr>
<tr>
<td>DBMS evaluation and selection</td>
</tr>
<tr>
<td>DBMS maintenance</td>
</tr>
<tr>
<td>Data dictionary management</td>
</tr>
<tr>
<td>Training</td>
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<tr>
<td><strong>Database Technical Functions</strong></td>
</tr>
<tr>
<td>Database design</td>
</tr>
<tr>
<td>Testing</td>
</tr>
<tr>
<td>Performance tuning</td>
</tr>
</tbody>
</table>
Database Policy Formulation and Enforcement

• DBA
  – Formulates database policies
  – Communicates policies to users
  – Enforces policies

• Policies
  – Access privileges
  – Security
  – Disaster planning
  – Archiving
Access Privileges

• DBA
  – Determines access privileges for all users
  – Enters appropriate authorization rules in DBMS
    • SQL GRANT statement

• Access privilege policy
  – Documented by DBA
  – Approved by top-level management
  – Communicated by DBA to all users
Access Privileges (continued)

**FIGURE 8-2**: Permitted and denied access privileges for Sam
FIGURE 8-4: Permitted and denied access privileges for Valerie
Security

- Prevention of unauthorized access, intentional or accidental, to database
- DBA
  - Creates security policies and procedures
  - Obtains management approval of policies and procedures
  - Distributes policies and procedures to authorized users
Security (continued)

• DBMS’s security features
  – Encryption
  – Authentication
  – Authorizations
  – Views
• Additional security programs may be created or purchased
• Monitoring of database usage to detect security violations
FIGURE 8-5: Attempted security violation by Brady, who’s not an authorized user
FIGURE 8-6: Attempted security violation by Paige, who’s authorized to access some customer data but is not authorized to access customer balances
Disaster Planning

- Damage from physical incidents
  - Software/hardware/electrical
  - Natural disasters
- **Disaster recovery plan**: ongoing and emergency actions and procedures to ensure data availability if a disaster occurs
- Hard drive failures
  - **Redundant array of inexpensive/independent drives (RAID)**: database updates replicated to multiple hard drives
Disaster Planning (continued)

• Electrical power loss
  – **Uninterruptible power supply (UPS):** power source and power generator

• Duplicate backup systems
  – **Hot site:** completely equipped with duplicate hardware, software, and data
    • Can switch to hot site in minutes or hours
  – **Warm site:** duplicate hardware and software but not data
    • Takes longer to start processing
Archiving

• Governmental laws and regulations, for example:
  – Sarbannes-Oxley Act
  – Patriot Act
  – HIPAA
• Auditing and financial requirements
• **Data archive** or **archive**: place where record of certain corporate data is kept
  – Stored on mass storage devices
• Copies of archives and database backups must be stored off-site
Archiving (continued)

FIGURE 8-7: Movement of order 21617 from the database to the archive
Other Database Administration Functions

• DBMS evaluation and selection
• DBMS maintenance
• Data dictionary management
• Training
DBMS Evaluation and Selection

- Data definition
- Data restructuring
- Nonprocedural languages
- Procedural languages
- Data dictionary
- Concurrent update
  - Shared lock
DBMS Evaluation and Selection (continued)

• Backup and recovery
• Security
• Integrity
• Replication and distributed databases
• Limitations
  – Local area network (LAN)
• Documentation and training
  – Context-sensitive help
DBMS Evaluation and Selection (continued)

- Vendor support
- Performance
- Portability
  - Intranet
- Cost
- Future plans
- Other considerations
DBMS Maintenance

- Installation of DBMS
- Configuration changes
- Upgrades for new releases
- Problem resolution
- Special one-time processing needs
Data Dictionary Management

• Data dictionary is like database catalog, but with wider range of information
• Establishes naming conventions for tables, fields, indexes, etc.
• Creates data definitions for tables
• Creates data integrity rules and user views
• Updates data dictionary
• Creates and distributes reports from data dictionary
Training

- Training in using DBMS and accessing database
- Training of technical staff responsible for developing and maintaining database applications
- If training is provided by vendor of DBMS, DBA handles scheduling of training
Technical Functions

- Database design
- Testing
- Performance tuning
Database Design

• Establishes sound methodology for database design
• Does physical-level design
• Creates documentation standards
• Reviews changes to requirements and manages modifications to database
Testing

• **Production system or live system**: hardware, software, and database for users

• DBA grants access to production system only to authorized users, except for:
  – Troubleshooting a problem
  – Addition of new or modified programs

• **Test system or sandbox**: used by programmers to develop new programs and modify existing programs
Testing (continued)

FIGURE 8-9: DBA controls the interaction between the test and production systems
Performance Tuning

- DBA attempts to get best performance within funding constraints
- Creating and deleting indexes
- Splitting tables
- Changing table design
- **Denormalizing** converts a table in third normal form to a table not in third normal form
  - Improved performance
Performance Tuning (continued)

<table>
<thead>
<tr>
<th>CustomerNum</th>
<th>CustomerName</th>
<th>Street</th>
<th>City</th>
<th>State</th>
<th>Zip</th>
<th>Balance</th>
<th>CreditLimit</th>
<th>RepNum</th>
</tr>
</thead>
<tbody>
<tr>
<td>148</td>
<td>Al's Appliance and Sport</td>
<td>2837 Greenway</td>
<td>Fillmore</td>
<td>FL</td>
<td>33336</td>
<td>$6,550.00</td>
<td>$7,500.00</td>
<td>20</td>
</tr>
<tr>
<td>282</td>
<td>Brookings Direct</td>
<td>3827 Devon</td>
<td>Grove</td>
<td>FL</td>
<td>33321</td>
<td>$431.50</td>
<td>$10,000.00</td>
<td>35</td>
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<tr>
<td>356</td>
<td>Ferguson’s</td>
<td>382 Wildwood</td>
<td>Northfield</td>
<td>FL</td>
<td>33146</td>
<td>$5,785.00</td>
<td>$7,500.00</td>
<td>65</td>
</tr>
<tr>
<td>408</td>
<td>The Everything Shop</td>
<td>1828 Raven</td>
<td>Crystal</td>
<td>FL</td>
<td>33503</td>
<td>$5,285.25</td>
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<tr>
<td>462</td>
<td>Bargains Galore</td>
<td>3829 Central</td>
<td>Grove</td>
<td>FL</td>
<td>33321</td>
<td>$3,412.00</td>
<td>$10,000.00</td>
<td>65</td>
</tr>
<tr>
<td>524</td>
<td>Kline’s</td>
<td>838 Ridgeland</td>
<td>Fillmore</td>
<td>FL</td>
<td>33336</td>
<td>$12,762.00</td>
<td>$15,000.00</td>
<td>20</td>
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<tr>
<td>608</td>
<td>Johnson’s Department Store</td>
<td>372 Oxford</td>
<td>Sheldon</td>
<td>FL</td>
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<td>$2,106.00</td>
<td>$10,000.00</td>
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<tr>
<td>687</td>
<td>Lee’s Sport and Appliance</td>
<td>282 Evergreen</td>
<td>Altonville</td>
<td>FL</td>
<td>32543</td>
<td>$2,851.00</td>
<td>$5,000.00</td>
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<tr>
<td>725</td>
<td>Deerfield’s Four Seasons</td>
<td>282 Columbia</td>
<td>Sheldon</td>
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<td>33553</td>
<td>$248.00</td>
<td>$7,500.00</td>
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<tr>
<td>842</td>
<td>All Season</td>
<td>28 Lakeview</td>
<td>Grove</td>
<td>FL</td>
<td>33321</td>
<td>$8,221.00</td>
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**FIGURE 8-10: Customer table for Premiere Products**
FIGURE 8-11: Result of splitting the Customer table into two tables

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### Performance Tuning (continued)

#### FIGURE 8-11: Result of splitting the Customer table into two tables (continued)

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<td>20</td>
</tr>
</tbody>
</table>
Performance Tuning (continued)

FIGURE 8-12: Including part descriptions in the OrderLine table, which creates a first normal form table

<table>
<thead>
<tr>
<th>OrderNum</th>
<th>PartNum</th>
<th>Description</th>
<th>NumOrdered</th>
<th>QuotedPrice</th>
</tr>
</thead>
<tbody>
<tr>
<td>21608</td>
<td>AT94</td>
<td>Iron</td>
<td>11</td>
<td>$21.95</td>
</tr>
<tr>
<td>21610</td>
<td>DR93</td>
<td>Gas Range</td>
<td>1</td>
<td>$495.00</td>
</tr>
<tr>
<td>21610</td>
<td>DW11</td>
<td>Washer</td>
<td>1</td>
<td>$399.99</td>
</tr>
<tr>
<td>21613</td>
<td>KL62</td>
<td>Dryer</td>
<td>4</td>
<td>$329.95</td>
</tr>
<tr>
<td>21614</td>
<td>KT03</td>
<td>Dishwasher</td>
<td>2</td>
<td>$595.00</td>
</tr>
<tr>
<td>21617</td>
<td>BV06</td>
<td>Home Gym</td>
<td>2</td>
<td>$794.95</td>
</tr>
<tr>
<td>21617</td>
<td>CD52</td>
<td>Microwave Oven</td>
<td>4</td>
<td>$150.00</td>
</tr>
<tr>
<td>21619</td>
<td>DR93</td>
<td>Gas Range</td>
<td>1</td>
<td>$495.00</td>
</tr>
<tr>
<td>21623</td>
<td>KV29</td>
<td>Treadmill</td>
<td>2</td>
<td>$1,290.00</td>
</tr>
</tbody>
</table>
Summary

- Database administrator (DBA) is responsible for supervising the database and use of the DBMS.
- DBA formulates and enforces policies about which users can access database, portions they may access, and the manner in which they can access it.
- DBA formulates and enforces policies about security by using DBMS’s security features, special security programs, and monitoring database usage.
- DBA creates and implements backup and recovery procedures as part of a disaster recovery plan.
Summary (continued)

- DBA formulates and enforces policies that govern management of an archive for data
- DBA leads evaluation and selection of new DBMS
- DBA installs and maintains DBMS
- DBA maintains data dictionary, establishes naming conventions for its content, and provides information from it to others
- DBA provides database and DBMS training and coordinates and schedules training by outside vendors
Summary (continued)

• DBA verifies all information-level database designs, completes all physical-level database designs, and creates documentation standards; also evaluates changes in requirements

• DBA controls production system, which is accessible only to authorized users; other than under exceptional situations, programmers access a separate test system

• DBA tunes database design to improve performance; includes creating and deleting indexes, splitting tables, and denormalizing tables