With the help of their data warehouse and sophisticated business intelligence software, eBay has managed to be the online auction site of choice for buyers and sellers alike.
Learning Objectives

1. Describe the concept of business intelligence and how databases serve as a foundation for gaining business intelligence.

2. Explain the three components of business intelligence: information and knowledge discovery, business analytics, and information visualization.
Learning Objectives

1. Describe the concept of business intelligence and how databases serve as a foundation for gaining business intelligence.

2. Explain the three components of business intelligence: information and knowledge discovery, business analytics, and information visualization.
Business Intelligence (BI)

- Business Intelligence (BI) is the use of information systems to gather and analyze information from internal and external sources in order to make better business decisions.

- BI is used to integrate data from disconnected:
  - Reports
  - Databases
  - Spreadsheets

- Integrated data helps to monitor and fine-tune business processes.
BI: Responding to Threats and Opportunities

- BI can help with reacting to various threats and opportunities, including:
  - Unstable markets
  - Global threats
  - Fierce competition
  - Short product life cycles
  - Stringent regulations
  - Wider choices for consumers
BI: Continuous Planning

- Organizations need to continuously monitor and analyze business processes.
- Results lead to ongoing adjustments.
- It involves decision makers from all levels.
Databases: Inputs to BI Applications

- Data and knowledge are among the most important assets for an organization.
- Databases are collections of related data organized in a way that facilitates data searches.
- Uses:
  - Identify customers for personalized communications
  - Database technology fuels electronic commerce on the Web.
Databases: Foundation Concepts

- Database management systems (DBMS)—software to create, store, organize, and retrieve data from one or more databases.
- E.g., Microsoft Access
Main Database Elements

- **Entity**—something you collect data about, such as people or classes.
- **Table**—contains entities. Consists of rows and columns.
- **Row (record)**—a record in a table. One row pertains to one entity instance.
- **Column (attribute)**—one cell in a row. Each attribute contains a piece of information about the entity.
This sample data table for the entity Student includes eight attributes and 11 records.

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Last Name</th>
<th>First Name</th>
<th>Street Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>209345</td>
<td>Judson</td>
<td>Jackie</td>
<td>216 Main</td>
<td>Pullman</td>
<td>WA</td>
<td>99164</td>
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<td>213009</td>
<td>Schirmer</td>
<td>Birgit</td>
<td>233 Webb</td>
<td>Pullman</td>
<td>WA</td>
<td>99163</td>
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<td>Jordan</td>
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<td>Pullman</td>
<td>WA</td>
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<tr>
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<td>Elizabeth</td>
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<td>Pullman</td>
<td>WA</td>
<td>99163</td>
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<td>459987</td>
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<td>Lisa-Marie</td>
<td>1824 Lamont</td>
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<tr>
<td>465711</td>
<td>Ferrell</td>
<td>Lauren</td>
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<td>Lael</td>
<td>200 Hill</td>
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<td>WA</td>
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<tr>
<td>691112</td>
<td>Fuller</td>
<td>Grace</td>
<td>312 Mountain Drive</td>
<td>Pullman</td>
<td>WA</td>
<td>99164</td>
<td>Veterinary Medicine</td>
</tr>
<tr>
<td>910234</td>
<td>Hardin</td>
<td>Ethan</td>
<td>200 Sunset</td>
<td>Pullman</td>
<td>WA</td>
<td>99164</td>
<td>Sociology</td>
</tr>
<tr>
<td>979776</td>
<td>Valacich</td>
<td>James</td>
<td>1212 Valley View</td>
<td>Pullman</td>
<td>WA</td>
<td>99163</td>
<td>Computer Science</td>
</tr>
<tr>
<td>983445</td>
<td>Kabbe</td>
<td>Joshua</td>
<td>825 Skylark</td>
<td>Pullman</td>
<td>WA</td>
<td>99164</td>
<td>Human Resources</td>
</tr>
</tbody>
</table>
Databases: Advantages

- Program–data independence
- Minimal data redundancy
- Improved data consistency
- Improved data sharing
- Increased productivity of application development
- Enforcement of standards
- Increased security
- Improved data quality
- Improved data accessibility
- Reduced program maintenance
Databases: Costs and Risks

- Requirement for new, specialized personnel
- Installation and management cost and complexity
- Conversion costs
- Need for explicit backup and recovery
- Organizational conflict
Databases: Effective Management

- **Data model**—a map or diagram that represents entities and their relationships (e.g., entity-relationship diagram).
- **Data type**—each attribute has a specified data type (e.g., text, numbers, or dates).
- **Normalization**—a process to make sure the database will operate efficiently. Helps to eliminate data duplication.
- **Data dictionary** (metadata repository)—a document explaining information for each attribute (e.g., name, whether it is a key, data type, and valid values).
- **Business rules**—prevent illegal or illogical entries from entering the database.
Entering and Querying Data

• Form—user interface for entering data into the database (pre-printed, Web, point-of-sale, and so on)
• Report—compilation of data from a database, organized and produced in printed format
• Report generator—software that helps users quickly build interactive reports and visualizations (e.g., Crystal Reports)
• Query—a command for retrieving specified information from a database.
• Structured Query Language (SQL)—the most common language for querying databases.
• Query by example (QBE)—a simpler query interface using graphical drag-and-drop features.
A computer-based form used for gathering information that could be stored in a database.
Entering and Querying Data

- This sample SQL statement would be used to retrieve the information needed to populate a summary Web page containing all books written by the first author of this textbook, sorted by publication date.

```sql
SELECT AUTHOR, TITLE, PUBLICATION_DATE, PRICE FROM BOOKS WHERE AUTHOR="VALACICH" ORDER BY PUBLICATION_DATE;
```
Entering and Querying Data

- QBE provides a graphical interface to define what information you want to see.
Online Transaction Processing (OLTP)

- Immediate automated responses to the requests of users
- Handles multiple concurrent transactions from customers
- Fixed number of inputs per transaction
- Receiving user information, processing orders, and generating sales receipts (e.g., e-Commerce applications)
Operational Systems and BI

- Data from operational systems are useful inputs to BI applications.
  - Example: grocery checkout system data can be analyzed for spending patterns, effectiveness of sales promotions, or customer profiling.

- Informational systems—systems designed to support decision making based on stable point-in-time or historical data.

- Real-time analytical processing diminishes the performance of transaction processing.
  - Therefore, organizations replicate transactions on a second database server for analytical processing.
## Operational vs. Informational Systems

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Operational System</th>
<th>Informational System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary purpose</td>
<td>Run the business on a current basis</td>
<td>Support managerial decision making</td>
</tr>
<tr>
<td>Type of data</td>
<td>Current representation of state of the business</td>
<td>Historical or point-in-time (snapshot)</td>
</tr>
<tr>
<td>Primary users</td>
<td>Online customers, clerks, salespersons, administrators</td>
<td>Managers, business analysts, and customers (checking status and history)</td>
</tr>
<tr>
<td>Scope of usage</td>
<td>Narrow and simple updates and queries</td>
<td>Broad and complex queries and analyses</td>
</tr>
<tr>
<td>Design goal</td>
<td>Performance</td>
<td>Ease of access and use</td>
</tr>
</tbody>
</table>
Master Data Management

- Master data is the data that is deemed most important in the operation of a business.
- It includes data about customers, suppliers, inventory, employees, and so on.
- Important to have a “single version of the truth”
- BI applications base analyses on the single version of the truth by accessing multiple databases or using a *data warehouse*.
Data Warehouses

- Data warehouses integrate multiple databases and other information sources into a single repository.
- For direct querying, analysis, or processing
- Purpose: put key business information into the hands of decision makers.
- Take up hundreds of gigabytes (even terabytes) of data
Extraction, Transformation, and Loading (ETL)

ETL is used to consolidate data from operational systems into a data warehouse.
Data Marts

- A data mart is a data warehouse that is limited in scope.
- Each data mart is customized for decision support of a particular end-user group.
- It is popular for small and medium-sized businesses and departments within larger organizations.
- Data marts can be deployed on less powerful hardware.
Learning Objectives

1. Describe the concept of business intelligence and how databases serve as a foundation for gaining business intelligence.

2. Explain the three components of business intelligence: information and knowledge discovery, business analytics, and information visualization.
Business Intelligence Components

- Three types of tools
  - Information and knowledge discovery
  - Business analytics
  - Information visualization

- Information and Knowledge Discovery
  - Search for hidden relationships.
  - Hypotheses are tested against existing data.
    - For example: Customers with a household income over $150,000 are twice as likely to respond to our marketing campaign as customers with an income of $60,000 or less.
## Ad Hoc Reports and Queries

<table>
<thead>
<tr>
<th>Report/Query</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduled reports</td>
<td>Reports produced at predefined intervals—daily, weekly, or monthly—to support routine decisions</td>
</tr>
<tr>
<td>Key-indicator reports</td>
<td>Reports that provide a summary of critical information on a recurring schedule</td>
</tr>
<tr>
<td>Exception reports</td>
<td>Reports that highlight situations that are out of the normal range</td>
</tr>
<tr>
<td>Drill-down reports</td>
<td>Reports that provide greater detail, so as to help analyze why a key indicator is not at an appropriate level or an exception occurred</td>
</tr>
<tr>
<td>Ad hoc queries</td>
<td>Queries answering unplanned information requests to support a nonroutine decision; typically not saved to be run again</td>
</tr>
</tbody>
</table>
Online Analytical Processing (OLAP)

- Complex, multidimensional analyses of data beyond simple queries
- OLAP server — main OLAP component
- Key OLAP concepts:
  - Measures and dimensions
  - Cubes, slicing, and dicing
  - Data mining
  - Association discovery
  - Clustering and classification
  - Text mining and Web content mining
  - Web usage mining
Measures and Dimensions

- **Measures** (facts)—values or numbers to analyze.
  - Examples: sum of sales, number of orders placed

- **Dimensions**—groupings of data, providing a way to summarize the data.
  - Examples: region, time, product line

- Dimensions are organized as hierarchies (general-to-detailed).
  - Examples: year–month–day, state–county–city

- **Drill-down**—viewing measures at lower levels of hierarchy.

- **Roll-up**—viewing measures at higher levels of hierarchy.
Cubes

- Cube—an OLAP data structure organizing data via multiple dimensions.

- Cubes can have any number of dimensions.

A cube with three dimensions
Slicing and Dicing

- Slicing and dicing—analyzing the data on subsets of the dimensions

![Diagram showing a 3D cube with dimensions for years, products, and regions.](image)
Data Mining

- Used for discovering “hidden” predictive relationships in the data
  - Patterns, trends, or rules
  - Example: identification of profitable customer segments or fraud detection
  - Any predictive models should be tested against “fresh” data.
- Data-mining algorithms are run against large data warehouses.
  - Data reduction helps to reduce the complexity of data and speed up analysis.
Association Discovery

- Association discovery—Technique used to find associations or correlations among sets of items.
  - Support and confidence indicate if findings are meaningful
- Sequence Discovery—Used to discover associations over time

Coffee → Sugar [Support 20%, Confidence 80%]
Clustering and Classification

- **Clustering**
  - Grouping of related records based on similar values for attributes
  - Groups are not known beforehand
    - Example: clustering frequent fliers based on segments flown

- **Classification**
  - Groups (classes) are known beforehand.
  - Example: A bank specifies classes of customers who differ in their risk categories (likelihood of defaulting on a loan).
  - Records are segmented into the different groups
    - Often using decision trees
Text and Web Content Mining

- **Text mining**—use of analytical techniques to extract information from textual documents.
  - Textual documents can include: Letters, e-mails, customer calls, internal communications, blog posts, wikis, Web pages, marketing materials, patent filings, and so on
  - Text mining systems analyze a document’s linguistic structures and key words.

- **Web content mining**—extract textual information from Web documents.
  - Web crawler searches sites and documents
Text mining the Internet

- Ranked Documents:
  1. Doc A
  2. Doc B
  3. Doc C
  4. ...

- Clustered Documents:
  - Cluster A
  - Cluster B

- Networked Documents:
  - Doc A
  - Doc B
  - Doc C
  - Doc E
  - Doc D
Textual Analysis Benefits

- Marketing—learn about customers’ thoughts, feelings, and emotions.
- Operations—learn about product performance by analyzing service records or customer calls.
- Strategic decisions—gather competitive intelligence.
- Sales—learn about major accounts by analyzing news coverage.
- Human resources—monitor employee satisfaction or compliance to company policies (important for compliance with regulations such as the Sarbanes-Oxley Act).
Web Usage Mining

- Used by organizations such as Amazon.com
- Used to determine patterns in customers’ usage data.
  - How users navigate through the site
  - How much time they spend on different pages
- Clickstream data—recording of the users’ path through a Web site.
- Stickiness—a Web page’s ability to attract and keep visitors.
Presenting Results
Business Analytics

- BI applications to support human and automated decision making
  - Business Analytics—predict future outcomes
  - Decision Support Systems (DSS)—support human unstructured decision making
  - Intelligent systems
  - Enhancing organizational collaboration
Decision Support Systems (DSS)

- Decision-making support for recurring problems
- Used mostly by managerial level employees (can be used at any level)
- Interactive decision aid
- What-if analyses
  - Analyze results for hypothetical changes
  - Example: Microsoft Excel
Architecture of a DSS

Decision Support System

Input
- Data
- Models
  - Data Entry and Data Manipulation

Process
- Decision Support System Programs
  - Interactive Processing of Data and Models
    - Examples:
      - Simulations
      - Optimization
      - Forecasting

Output
- Decision Support System Data
- Decision Support System Models
- Output:
  - Graphical Reports
  - Textual Reports
  - Feedback to System Operator
# Common DSS Models

<table>
<thead>
<tr>
<th>Area</th>
<th>Common DSS Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate level</td>
<td>Corporate planning, venture analysis, mergers and acquisitions</td>
</tr>
<tr>
<td>Accounting</td>
<td>Cost analysis, discriminant analysis, breakeven analysis, auditing, tax computation and analysis, depreciation methods, budgeting</td>
</tr>
<tr>
<td>Finance</td>
<td>Discounted cash flow analysis, return on investment, buy or lease, capital budgeting, bond refinancing, stock portfolio management, compound interest, after-tax yield, foreign exchange values</td>
</tr>
<tr>
<td>Marketing</td>
<td>Product demand forecast, advertising strategy analysis, pricing strategies, market share analysis, sales growth evaluation, sales performance</td>
</tr>
<tr>
<td>Human resources</td>
<td>Labor negotiations, labor market analysis, personnel skills assessment, employee business expenses, fringe benefit computations, payroll and deductions</td>
</tr>
<tr>
<td>Production</td>
<td>Product design, production scheduling, transportation analysis, product mix, inventory levels, quality control, plant location, material allocation, maintenance analysis, machine replacement, job assignment, material requirements planning</td>
</tr>
<tr>
<td>Management science</td>
<td>Linear programming, decision trees, simulation, project evaluation and planning, queuing, dynamic programming, network analysis</td>
</tr>
<tr>
<td>Statistics</td>
<td>Regression and correlation analysis, exponential smoothing, sampling, time-series analysis, hypothesis testing</td>
</tr>
</tbody>
</table>
Intelligent Systems

• Artificial intelligence (AI)

• Simulation of human intelligence

• Reasoning and learning, as well as gaining sensing capabilities, such as seeing, hearing, walking, talking, and feeling
Artificial Intelligence
Expert Systems

- Use reasoning methods
- Provide advice like a human expert
- Manipulate knowledge rather than information
- System asks series of questions
- Inferencing/pattern matching
  - Matching user responses with predefined rules
  - If-then format
- Fuzzy logic
  - Represent rules using approximations
Architecture of an Expert System

- **Input**
  - Request for Help
  - Answers to Questions

- **Process**
  - Expert System Programs
  - Pattern Matching
  - Knowledge Base of Facts and Rules

- **Output**
  - Recommendations and Advice
## Summary of ES Characteristics

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Request for help, answers to questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing</td>
<td>Pattern matching and inferencing</td>
</tr>
<tr>
<td>Outputs</td>
<td>Recommendation or advice</td>
</tr>
<tr>
<td>Typical users</td>
<td>Midlevel managers (although an ES could be used at any level of the organization)</td>
</tr>
</tbody>
</table>
Neural Networks

- Approximation of human brain functioning
- Training to establish common patterns
  - Based on past information
- New data compared to patterns
- Example: loan processing
Example: Neural Network System

![Diagram of a neural network system with inputs, process, and output. The inputs include Age, Income, Debt Level, Financial History, Job Status, Length of Employment, Home Ownership, Assets, Investments, Marital Status, Spouse Income, Dependents, Health, etc. The process involves nodes for Age, Income, Debt Level, Length of Employment, Home Ownership, Investments, Marital Status, Financial History, Job Status, Spouse Income, and Home Ownership. The output shows a recommendation for Approve Loan or Reject Loan.]
Intelligent Agent Systems

- Program working in the background
- Bot (software robot)
- Provides service when a specific event occurs
Types of Intelligent Agent Systems

- User agents
  - Performs a task for the user

- Buyer agents (shopping bots)
  - Search for the best price

- Monitoring and sensing agents
  - Keep track of information and notifies users when it changes

- Data-mining agents
  - Continuously browse data warehouses to detect changes

- Web crawlers (aka Web spiders)
  - Continuously browses the Web

- Destructive agents
  - Designed to farm e-mail addresses or deposit spyware
Knowledge Management Systems

- Generating value from knowledge assets
- Collection of technology-based systems
- Knowledge assets
  - Skills, routines, practices, principles, formulas, methods, heuristics, and intuitions
  - Used to improve efficiency, effectiveness, and profitability
  - Documents storing both facts and procedures
    - Examples: Databases, manuals, diagrams, books, and so on
Knowledge Asset Categories

- **Explicit knowledge assets**
  - Can be documented

- **Tacit knowledge assets**
  - Located in one’s mind
  - Often reflect an organization’s best practices
Benefits and Challenges of Knowledge-Based Systems

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced innovation and creativity</td>
<td>Getting employee buy-in</td>
</tr>
<tr>
<td>Improved customer service, shorter product</td>
<td>Focusing too much on technology</td>
</tr>
<tr>
<td>development, and streamlined operations</td>
<td></td>
</tr>
<tr>
<td>Enhanced employee retention</td>
<td>Forgetting the goal</td>
</tr>
<tr>
<td>Improved organizational performance</td>
<td>Dealing with knowledge overload and obsolescence</td>
</tr>
</tbody>
</table>

Social network analysis can help to analyze collaborative patterns.
Web-Based Knowledge Portals

Knowledge repository
Information Visualization

- Display of complex data relationships using graphical methods
  - Enables managers to quickly grasp results of analyses
  - Visual analytics
  - Dashboards
  - Geographic information systems
Hard vs. Soft Data

- Executives require both hard and soft data
  - Hard data
    - Facts and numbers
    - Generated by organizational databases and other systems
  - Soft data
    - Nonanalytical information
      - Example: latest news stories
    - Web-based news portals
      - Customizable
      - Delivery to different media
Digital Dashboards

Employee Absenteeism Summary

Company Average

Absenteeism Drill Down

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>10</td>
<td>11</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>Professional</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Clerical</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Sales</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Support</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

Exit | Next Screen | Drill Down | Exit | Prior Screen | E-Mail
Dashboards use various graphical elements to highlight important information.
Thematic Maps

- A thematic map showing car thefts in a town
Visual Analytics

- Interpreting complex output from BI systems is challenging
- Visual analytics combines various analysis techniques and interactive visualization
  - Combination of
    - Human intelligence and reasoning capabilities
    - Technology’s retrieval and analysis capabilities
  - Helps to make sense of “noisy” data or unexpected patterns
Geographic Information System (GIS)

- A GIS is a system for creating, storing, analyzing, and managing geographically referenced information.
- A GIS provides a user with a blank map of an area.
- A user can add information stored in different layers.
- Example: Google Earth
## Industry Uses of GIS

<table>
<thead>
<tr>
<th>Industry</th>
<th>Sample Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Analyze crop yield by location, soil erosion, or differences in fertilizer needs (precision farming)</td>
</tr>
<tr>
<td>Banking</td>
<td>Identify lucrative areas for marketing campaigns</td>
</tr>
<tr>
<td>Disaster response</td>
<td>Analyze historical events, set up evacuation plans, and identify areas most likely to be affected by disasters</td>
</tr>
<tr>
<td>Insurance</td>
<td>Risk analysis (e.g., earthquake insurance)</td>
</tr>
<tr>
<td>Government</td>
<td>Urban planning, zoning, and census planning</td>
</tr>
<tr>
<td>Law enforcement</td>
<td>Analyze high-crime areas</td>
</tr>
<tr>
<td>Marine biology</td>
<td>Track movement of fish swarms</td>
</tr>
<tr>
<td>Media</td>
<td>Create maps to visualize locations of events and analyze circulation</td>
</tr>
<tr>
<td>Mining and drilling</td>
<td>Locate potential areas for extraction of natural resources</td>
</tr>
<tr>
<td>Real estate</td>
<td>Create maps to visualize locations of properties</td>
</tr>
<tr>
<td>Retail</td>
<td>Analyze sales, inventory, customers, and so on by location; identify new retail locations; and visualize and present business data</td>
</tr>
<tr>
<td>Transportation and logistics</td>
<td>Route planning</td>
</tr>
</tbody>
</table>


## Various Ways of Representing Geospatial Data

<table>
<thead>
<tr>
<th>Mapping</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features and patterns (i.e., distribution of features)</td>
<td>Earthquake epicenters (features) and areas where the hazard may be highest (patterns).</td>
</tr>
<tr>
<td>Quantities</td>
<td>The number of young families with a high income in a census district.</td>
</tr>
<tr>
<td>Densities</td>
<td>Number of high-income family per square mile in a census district.</td>
</tr>
<tr>
<td>What’s inside</td>
<td>Does a luxury real estate development fall within a 15-minute driving radius of a store?</td>
</tr>
<tr>
<td>What’s nearby</td>
<td>How many Starbucks stores are within 5 miles of my new coffee shop?</td>
</tr>
<tr>
<td>Change</td>
<td>How have store sales changed after a large ad campaign?</td>
</tr>
</tbody>
</table>

Source: Based on ESRI, [http://www.gis.com/content/what-can-you-do-gis](http://www.gis.com/content/what-can-you-do-gis).
End of Chapter Content
Managing in the Digital World:
Providing Business Intelligence to eBay Customers

- Founded in 1995
- 89 million users
- Sales of $60 billion (2008)
- Problems
  - Shill bidding
  - Sellers who don’t send and so on
- How to determine patterns of fraudulent behavior?
NET STATS

The Demise of Broadcast TV

- August 2009, Internet users in the United States consumed more than 11 billion video streams, averaging more than 81 streams (or 205 minutes) per viewer.

- Online viewing allows people to watch programs anywhere at any time.

- Mobile phone TV watching is increasing.

- The “traditional” TV industry has to find ways to sustain their business model.
POWERFUL PARTNERSHIPS
Adobe’s John Warnock and Chuck Geschke

- Warnock and Geschke worked together at Xerox’ Palo Alto Research Center (PARC)
- Developed PostScript
  - Technology that simplifies printing documents directly from computers
- Warnock and Geschke left Xerox in 1982 to found Adobe Systems, Inc.
- Geschke was kidnapped in 1992.
- Adobe is one of the biggest software companies in the world.
- Products include:
  - Acrobat, ColdFusion, Dreamweaver, Flash, Photoshop, and many others
Health care is increasingly reliant on information technology.
- Many doctors carry PDAs/laptops to access patient records or drug information.

Electronic patient records are moving towards the Web.
- Examples: Google health and Microsoft HealthVault

Other applications
- WebMD
- Diagnosis and monitoring
  - EEG, EKG, computer tomography
  - Digital x-rays
- Tele-medicine
  - Remote diagnosis and surgery