Announcements

- Final Business Papers Due 3/16
Chapter 11

Improving Decision Making and Managing Knowledge
Student Learning Objectives

- What are the different types of decisions, and how does the decision-making process work?
- How do business intelligence and business analytics support decision making?
- How do information systems help people working individually and in groups make decisions more effectively?
Student Learning Objectives

- What are the business benefits of using intelligent techniques in decision making and knowledge management?
- What types of systems are used for enterprise-wide knowledge management, and how do they provide value for businesses?
LEARNING TRACKS AND VIDEO CASES

Learning Tracks

1. Building and Using Pivot Tables
2. The Expert System Inference Engine
3. Challenges of Knowledge Management Systems

Video Cases

Case 1: How IBM’s Watson Became a Jeopardy Champion
Case 2: Alfresco: Open Source Document Management and Collaboration
Case 3: FreshDirect Uses Business Intelligence to Manage Its Online Grocery.
Case 4: Business Intelligence Helps the Cincinnati Zoo Work Smarter

Instructional Video 1: Analyzing Big Data: IBM Watson After Jeopardy
• **Problem:** Wealthier Major League baseball teams operate with an “unfair” advantage—the ability to hire the best players.

• Outdated statistical methods

• **Solutions:** Use player and team data to identify undervalued players.
• **2002 Oakland A’s** operating with one of the smallest budgets in Major League baseball, $41 million, compared with wealthiest team, the New York Yankees, who had a budget of $126 million, used newly improved statistical methods, not yet used by bigger teams, to identify undervalued winning players.

• Demonstrates the use of analysis systems to identify key player characteristics and predict team performance.

• Illustrates how information systems improve decision making.
Moneyball: Data-Driven Baseball

**Business Challenges**
- Limited resources
- Outdated metrics

**People**
- Allocate resources
- Devise recruitment strategy
- Devise game strategy

**Organization**
- Recruit players
- Train players

**Technology**
- Player and game data
- Statistical analysis tools

**Information System**
- Develop better performance metrics
- Use new metrics to evaluate players

**Business Solutions**
- Optimize performance
- Keep costs low
Business Value of Improved Decision Making

- Possible to measure value of improved decision making.

- Decisions made at all levels of the firm.
  - Some are common, routine, and numerous.
  - Although value of improving any single decision may be small, improving hundreds of thousands of “small” decisions adds up to large annual value for the business.
### Business Value of Improved Decision Making

<table>
<thead>
<tr>
<th>Decision</th>
<th>Maker</th>
<th>Number / year</th>
<th>Value of decision</th>
<th>Annual value to firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocate support to most valuable customers.</td>
<td>Accounts manager</td>
<td>12</td>
<td>$100,000</td>
<td>$1,200,000</td>
</tr>
<tr>
<td>Predict call center daily demand.</td>
<td>Call Center management</td>
<td>4</td>
<td>150,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Decide parts inventory level daily.</td>
<td>Inventory manager</td>
<td>365</td>
<td>5,000</td>
<td>1,825,000</td>
</tr>
<tr>
<td>Identify competitive bids from major suppliers.</td>
<td>Senior management</td>
<td>1</td>
<td>2,000,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Schedule production to fill orders.</td>
<td>Manufacturing manager</td>
<td>150</td>
<td>10,000</td>
<td>1,500,000</td>
</tr>
</tbody>
</table>
Types of Decisions

- **Unstructured**
  - Decision maker must provide judgment to solve problem
  - Novel, important, nonroutine
  - No well-understood or agreed-upon procedure for making them

- **Structured**
  - Repetitive and routine
  - Involve definite procedure for handling them so do not have to be treated as new

- **Semistructured**
  - Only part of problem has clear-cut answer provided by accepted procedure
Senior managers, middle managers, operational managers, and employees have different types of decisions and information requirements.

**Figure 11-1**

<table>
<thead>
<tr>
<th>Decision Characteristics</th>
<th>Examples of Decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Management</td>
<td>Decide entrance or exit from markets</td>
</tr>
<tr>
<td>Middle Management</td>
<td>Approve capital budget</td>
</tr>
<tr>
<td>Operational Management</td>
<td>Decide long-term goals</td>
</tr>
<tr>
<td>Individual Employees and Teams</td>
<td>Design a marketing plan</td>
</tr>
<tr>
<td></td>
<td>Develop a departmental budget</td>
</tr>
<tr>
<td></td>
<td>Design a new corporate Web site</td>
</tr>
<tr>
<td></td>
<td>Determine overtime eligibility</td>
</tr>
<tr>
<td></td>
<td>Restock inventory</td>
</tr>
<tr>
<td></td>
<td>Offer credit to customers</td>
</tr>
<tr>
<td></td>
<td>Determine special offers to customers</td>
</tr>
</tbody>
</table>
The Decision-Making Process

1. Intelligence
   • Discovering, identifying, and understanding the problems occurring in the organization—why is there a problem, where, what effects it is having on the firm

2. Design
   • Identifying and exploring various solutions

3. Choice
   • Choosing among solution alternatives

4. Implementation
   • Making chosen alternative work and monitoring how well solution is working
The decision-making process can be broken down into four stages.

Figure 11-2
• **High-velocity automated decision making**
  - Humans eliminated
  - For example: Trading programs at electronic stock exchanges

• **Quality of decisions, decision making**
  - Accuracy
  - Comprehensiveness
  - Fairness
  - Speed (efficiency)
  - Coherence
  - Due process
The Business Intelligence Environment

- Six elements in business intelligence environment
  1. Data from business environment
  2. Business intelligence infrastructure
  3. Business analytics toolset
  4. Managerial users and methods
  5. Delivery platform
     - MSS, DSS, ESS
  6. User interface
Business intelligence and analytics requires a strong database foundation, a set of analytic tools, and an involved management team that can ask intelligent questions and analyze data.

Figure 11-3
Business Intelligence and Analytics Capabilities

• Production reports
  • Predefined, based on industry standards

• Parameterized reports
  • For example: pivot tables

• Dashboards/scorecards

• Ad-hoc query/search/report creation

• Drill-down

• Forecasts, scenarios, models
  • “What-if” scenario analysis, statistical analysis
# Examples of Business Intelligence Pre-Defined Reports

<table>
<thead>
<tr>
<th>Business Functional Area</th>
<th>Production Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>Sales forecasts, sales team performance, cross selling, sales cycle times</td>
</tr>
<tr>
<td>Service/Call Center</td>
<td>Customer satisfaction, service cost, resolution rates, churn rates</td>
</tr>
<tr>
<td>Marketing</td>
<td>Campaign effectiveness, loyalty and attrition, market basket analysis</td>
</tr>
<tr>
<td>Procurement and Support</td>
<td>Direct and indirect spending, off-contract purchases, supplier performance</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>Backlog, fulfillment status, order cycle time, bill of materials analysis</td>
</tr>
<tr>
<td>Financials</td>
<td>General ledger, accounts receivable and payable, cash flow, profitability</td>
</tr>
<tr>
<td>Human Resources</td>
<td>Employee productivity, compensation, workforce demographics, retention</td>
</tr>
</tbody>
</table>
Predictive Analytics

- Use statistical analytics and other techniques
- Extracts information from data and uses it to predict future trends and behavior patterns
  - Predicting responses to direct marketing campaigns
  - Identifying best potential customers for credit cards
  - Identify at-risk customers
  - Predict how customers will respond to price changes and new services
- Accuracies range from 65 to 90 percent
Big Data Analytics

• Predictive analytics can use the big data generated from social media, consumer transactions, sensor and machine output, and so on
  • For example: eBay’s Hunch.com to predict user affinities for items not immediately obvious

• Public sector’s drive to “smart cities” to inform decisions on:
  • Utility management
  • Transportation operation
  • Healthcare delivery
  • Public safety
Interactive Session: People
Big Data Makes Cities Smarter

• Read the Interactive Session and then discuss the following questions:
  • What technologies is New York employing to improve the quality of life of its citizens?
  • What are the people, organization, and technology issues that should be addressed by “smart city” initiatives?
  • What problems are solved by “smart cities”? What are the drawbacks? Give examples of four decisions that would be improved in a “smart city”.
  • Would you be concerned if social media data was used to supplement public data to help improve the delivery of municipal services? Why or why not?
Location Analytics and GIS

• Location analytics
  • Big data analytics that uses location data from mobile phones, sensors, and maps
    • For example: Helping a utility company view customer costs as related to location

• GIS—Geographic information systems
  • Help decision makers visualize problems with mapping
  • Tie location data about resources to maps
Casual users are consumers of BI output, while intense power users are the producers of reports, new analyses, models, and forecasts.

**Business Intelligence Users**

<table>
<thead>
<tr>
<th>Power Users: Producers (20% of employees)</th>
<th>Casual Users: Consumers (80% of employees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT developers</td>
<td>Customers/Suppliers</td>
</tr>
<tr>
<td>Super users</td>
<td>Operational employees</td>
</tr>
<tr>
<td>Business analysts</td>
<td>Senior managers</td>
</tr>
<tr>
<td>Analytical modelers</td>
<td>Managers/Staff</td>
</tr>
</tbody>
</table>

- **Capabilities**
  - Production Reports
  - Parameterized Reports
  - Dashboards/Scorecards
  - Ad hoc queries; Drill down Search/OLAP
  - Forecasts; What if Analysis; statistical models

**Figure 11-4**
Support for Semi-Structured Decisions

- Decision-support systems (DSS)
  - BI delivery platform for “super-users” who want to create own reports, use more sophisticated analytics and models
  - What-if analysis
  - Sensitivity analysis
  - Backward sensitivity analysis
  - **Pivot tables**: Spreadsheet function for multidimensional analysis
  - Intensive modeling techniques
Sensitivity Analysis

This table displays the results of a sensitivity analysis of the effect of changing the sales price of a necktie and the cost per unit on the product’s break-even point. It answers the question, “What happens to the break-even point if the sales price and the cost to make each unit increase or decrease?”

Figure 11-5
In this pivot table, we are able to examine where an online training company’s customers come from in terms of region and advertising source.

Figure 11-6
Executive support systems

Balanced scorecard method
- Measures four dimensions of firm performance
  - Financial
  - Business process
  - Customer
  - Learning and growth
- Key performance indicators (KPI) used to measure each dimension
In the balanced scorecard framework, the firm’s strategic objectives are operationalized along four dimensions: financial, business process, customer, and learning and growth. Each dimension is measured using several KPIs.

Figure 11-7
• Business performance management (BPM)
  • Management methodology based on firm’s strategies
    • For example: differentiation, low-cost producer, market share growth, scope of operation
  • Translates strategies into operational targets
  • Uses set of KPI (key performance indicators) to measure progress toward targets

• ESS combine internal data with external
  • Financial data, news, and so on

• Drill-down capabilities
Group Decision-Support Systems (GDSS)

- Interactive, computer-based systems that facilitate solving of unstructured problems by a set of decision makers.
- Used in conference rooms with special hardware and software for collecting, ranking, storing ideas and decisions.
- Promote a collaborative atmosphere by guaranteeing contributors’ anonymity.
- Support increased meeting sizes with increased productivity.
- Software follows structured methods for organizing and evaluating ideas.
Intelligent Systems for Decision Support

- Intelligent techniques for enhancing decision making
  - Many based on artificial intelligence (AI)
    - Computer-based systems (hardware and software) that attempt to emulate human behavior and thought patterns
  - Include:
    - Expert systems
    - Case-based reasoning
    - Fuzzy logic
    - Neural networks
    - Genetic algorithms
    - Intelligent agents
Expert systems

Model human knowledge as a set of rules that are collectively called the knowledge base

- From 200 to 10,000 rules, depending on complexity

The system’s inference engine searches through the rules and “fires” those rules that are triggered by facts gathered and entered by the user.

Useful for dealing with problems of classification in which there are relatively few alternative outcomes and in which these possible outcomes are all known in advance.
An expert system contains a set of rules to be followed when used. The rules are interconnected; the number of outcomes is known in advance and is limited; there are multiple paths to the same outcome; and the system can consider multiple rules at a single time. The rules illustrated are for a simple credit-granting expert system.

Figure 11-8
Case-based reasoning

- Knowledge and past experiences of human specialists are represented as cases and stored in a database for later retrieval.
- System searches for stored cases with problem characteristics similar to new one, finds closest fit, and applies solutions of old case to new case.
- Successful and unsuccessful applications are tagged and linked in database.
- Used in medical diagnostic systems, customer support.
Case-based reasoning represents knowledge as a database of past cases and their solutions. The system uses a six-step process to generate solutions to new problems encountered by the user.

**Figure 11-9**
Fuzzy logic

- Rule-based technology that represents imprecision in categories (e.g., “cold” versus “cool”) by creating rules that use approximate or subjective values
- Describes a particular phenomenon or process linguistically and then represents that description in a small number of flexible rules
- Provides solutions to problems requiring expertise that is difficult to represent in the form of IF-THEN rules
  - For example: Sendai, Japan subway system uses fuzzy logic controls to accelerate so smoothly that standing passengers need not hold on
The membership functions for the input called temperature are in the logic of the thermostat to control the room temperature. Membership functions help translate linguistic expressions, such as warm, into numbers that the computer can manipulate.

Figure 11-10
• Neural networks

  • Use hardware and software that parallel the processing patterns of a biological brain.

  • “Learn” patterns from large quantities of data by searching for relationships, building models, and correcting over and over again the model’s own mistakes.

  • Humans “train” the network by feeding it data for which the inputs produce a known set of outputs or conclusions.

  • Machine learning

  • Useful for solving complex, poorly understood problems for which large amounts of data have been collected.
A neural network uses rules it “learns” from patterns in data to construct a hidden layer of logic. The hidden layer then processes inputs, classifying them based on the experience of the model. In this example, the neural network has been trained to distinguish between valid and fraudulent credit card purchases.

Figure 11-11
• Genetic algorithms
  • Find the optimal solution for a specific problem by examining very large number of alternative solutions for that problem.
  • Based on techniques inspired by evolutionary biology: inheritance, mutation, selection, and so on.
  • Work by representing a solution as a string of 0s and 1s, then searching randomly generated strings of binary digits to identify best possible solution.
  • Used to solve complex problems that are very dynamic and complex, involving hundreds or thousands of variables or formulas.
This example illustrates an initial population of “chromosomes,” each representing a different solution. The genetic algorithm uses an iterative process to refine the initial solutions so that the better ones, those with the higher fitness, are more likely to emerge as the best solution.

**Figure 11-12**

### The Components of a Genetic Algorithm

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
<th>Weight</th>
<th>Fitness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long</td>
<td>Wide</td>
<td>Light</td>
<td>55</td>
</tr>
<tr>
<td>Short</td>
<td>Narrow</td>
<td>Heavy</td>
<td>49</td>
</tr>
<tr>
<td>Long</td>
<td>Narrow</td>
<td>Heavy</td>
<td>36</td>
</tr>
<tr>
<td>Short</td>
<td>Medium</td>
<td>Light</td>
<td>61</td>
</tr>
<tr>
<td>Long</td>
<td>Medium</td>
<td>Very light</td>
<td>74</td>
</tr>
</tbody>
</table>

A population of chromosomes

Decoding of chromosomes

Evaluation of chromosomes
Intelligent Systems for Decision Support

- **Intelligent agents**
  - Programs that work in the background without direct human intervention to carry out specific, repetitive, and predictable tasks for user, business process, or software application
  - Shopping bots
  - Procter & Gamble (P&G) programmed group of semiautonomous agents to emulate behavior of supply-chain components, such as trucks, production facilities, distributors, and retail stores and created simulations to determine how to make supply chain more efficient
Intelligent agents are helping Procter & Gamble shorten the replenishment cycles for products, such as a box of Tide.

Figure 11-13

1. Software agents schedule deliveries from suppliers. If a supplier can’t deliver on time, agents negotiate with other suppliers to create an alternative delivery schedule.

2. Software agents collect real-time sales data on each P&G product from multiple retail stores. They relay the data to P&G production for replenishing orders and to sales and marketing for trend analysis.

3. Software agents schedule shipments from distributors to retailers, giving priority to retailers whose inventories are low. If a shipment to a retailer is delayed, agents find an alternative trucker.
Knowledge Management

- Business processes developed for creating, storing, transferring, and applying knowledge
- Increases the ability of organization to learn from environment and to incorporate knowledge into business processes and decision making
- Knowing how to do things effectively and efficiently in ways that other organizations cannot duplicate is major source of profit and competitive advantage
Three kinds of knowledge

- **Structured**: structured text documents
- **Semistructured**: e-mail, voice mail, digital pictures, and so on
- **Tacit knowledge (unstructured)**: knowledge residing in heads of employees, rarely written down

Enterprise-wide knowledge management systems

- Deal with all three types of knowledge
- General-purpose, firm-wide systems that collect, store, distribute, and apply digital content and knowledge
Enterprise-Wide Knowledge Management Systems

- Enterprise content management systems
  - Capabilities for knowledge capture, storage
  - Repositories for documents and best practices
  - Capabilities for collecting and organizing semistructured knowledge such as e-mail

- Classification schemes
  - Key problem in managing knowledge
  - Each knowledge object must be tagged for retrieval
An enterprise content management system has capabilities for classifying, organizing, and managing structured and semistructured knowledge and making it available throughout the enterprise.
Systems for Managing Knowledge

- Digital asset management systems
  - Manage unstructured digital data like photographs, graphic images, video, audio

- Knowledge network systems (Expertise location and management systems)
  - Provide online directory of corporate experts in well-defined knowledge domains
  - Use communication technologies to make it easy for employees to find appropriate expert in firm.
• Collaboration tools
  
  • **Social bookmarking:** Allows users to save their bookmarks publicly and tag with keywords.
  
    • Folksonomies
  
• Learning management systems (LMS)
  
  • Provide tools for management, delivery, tracking, and assessment of various types of employee learning and training.
Knowledge Work Systems (KWS)

- Specialized systems for knowledge workers
- Requirements of knowledge work systems:
  - Specialized tools
    - Powerful graphics, analytical tools, and communications and document management
  - Computing power to handle sophisticated graphics or complex calculations
  - Access to external databases
  - User-friendly interfaces
Knowledge work systems require strong links to external knowledge bases in addition to specialized hardware and software.

Figure 11-15
Knowledge Work Systems (KWS)

Examples of knowledge work systems
- Computer-aided design (CAD) systems
- Virtual reality (VR) systems
  - Virtual Reality Modeling Language (VRML)
- Augmented reality (AR) systems
- Investment workstations
Interactive Session: Technology
Firewire Surfboards Lights Up with CAD?

Read the Interactive Session and then discuss the following questions:

• Analyze Firewire using the value chain and competitive forces models.

• What strategies is Firewire using to differentiate its product, reach its customers, and persuade them to buy its products?

• What is the role of CAD in Firewire’s business model?

• How did the integration of online custom board design software (CBD), CAD, and computer numerical control (CNC) improve Firewire’s operations?