Improving Decision Making and Managing Knowledge

Reading:
Laudon & Laudon
chapter 10

Additional Reading:
Brien & Marakas
chapter 9
Outline

- Decision Making and Information Systems
- Systems for Decision Support
- Intelligent Systems for Decision Support
- Systems for Managing Knowledge
Better Decisions in Eastern Mountain Sports

Problem

*Very difficult to get Customer Purchasing Pattern* → Outdated and clumsy information systems, unnecessary labor, poor inventory decisions

Solution

- Deploy a business intelligence system to more efficiently collect and communicate important data
  - After evaluation selected *WebFOCUS* and *iWay middleware*. Other options
- *iWay* extracts point of sales data from legacy enterprise system (IBM AS/400)
- Loads into data mart Server → Series of Executive Dashboards (common data view)
- *WebFOCUS* → Combines data from various sources (Server), accessible from web
  - Dashboards → Key performance indicators Sales, Inventory, Margin levels
  - Color Coded (RGY) System → Over, Under, as per Plan
  - Wikis and blogs → discuss/share tips/tactic/discussions (top selling items/store)
- Demonstrates IT’s role in revamping outdated information systems
- Illustrates digital technology’s role in improving decision making
Business Value of Improved Decision Making

- Measure value of *improved decision making*
- Decisions made at all levels of the firm
  - Some are common, routine, and numerous
  - Improving any single decision – small value, hundreds of thousands of “small” decisions adds up - large annual value

<table>
<thead>
<tr>
<th>Decision</th>
<th>Maker</th>
<th>Number / year</th>
<th>Value of decision</th>
<th>Annual value to firm</th>
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<td>Allocate support to most valuable customers</td>
<td>Accounts manager</td>
<td>12</td>
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<td>Predict call center daily demand</td>
<td>Call Center management</td>
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<td>Decide parts inventory level daily</td>
<td>Inventory manager</td>
<td>365</td>
<td>5,000</td>
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<td>Identify competitive bids from major suppliers</td>
<td>Senior management</td>
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<td>Schedule production to fill orders</td>
<td>Manufacturing manager</td>
<td>150</td>
<td>10,000</td>
<td>1,500,000</td>
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<td>Allocate labor to complete job</td>
<td>Production floor manager</td>
<td>100</td>
<td>4,000</td>
<td>400,000</td>
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</table>
Types of Decisions

- **Unstructured**
  - Decision situations where it is not possible to specify in advance most of the decision procedures to follow
  - Decision maker must provide judgment to solve problem
  - Novel, important, nonroutine
  - No well-understood or agreed-on procedure for making them

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

- **Semi-Structured**
  - Decision procedures that can be pre-specified, but not enough to lead to a definite recommended decision
Senior managers, middle managers, operational managers, and employees have different types of decisions and information requirements.
## Information Systems for Decisions

### Table: Management Information Systems vs. Decision Support Systems

<table>
<thead>
<tr>
<th>Decision support provided</th>
<th>Management Information Systems</th>
<th>Decision Support Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information form and frequency</td>
<td>Provide information about the performance of the organization</td>
<td>Provide information and techniques to analyze specific problems</td>
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<tr>
<td>Information format</td>
<td>Periodic, exception, demand, and push reports and responses</td>
<td>Interactive inquiries and responses</td>
</tr>
<tr>
<td>Information processing methodology</td>
<td>Prespecified, fixed format</td>
<td>Ad hoc, flexible, and adaptable format</td>
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<tr>
<td>Information produced by extraction and manipulation of business data</td>
<td>Information produced by analytical modeling of business data</td>
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Decision Making Process

- **Intelligence**
  - Discovering, identifying, understanding
  - Problems occurring in the organization — Why?
  - Where, what effects it is having on the firm

- **Design**
  - Identifying and exploring various solutions

- **Choice**
  - Choosing among solution alternatives

- **Implementation**
  - Making chosen alternative work and monitoring how well solution is working
Decision Making Process

Four Stages of Decision Making Process

1. Problem discovery: What is the problem?
   - Intelligence

2. Solution discovery: What are the possible solutions?
   - Design

3. Choosing solutions: What is the best solution?
   - Choice

4. Solution testing: Is the solution working? Can we make it work better?
   - Implementation
Quality of Decisions

- **Accuracy**
  - Decision reflects reality

- **Comprehensiveness**
  - Decision reflects a full consideration of the facts and circumstances

- **Fairness**
  - Decision faithfully reflects the concerns and interests of affected parties

- **Speed (efficiency)**
  - Decision making is efficient with respect to time and other resources

- **Coherence**
  - Decision reflects rational process that can be explained to others and made understandable

- **Due Process**
  - Decision is the result of a known process and can be appealed to a higher authority
Systems for Supporting Decisions

- Management Information Systems (MIS)
- Decision Support Systems (DSS)
- Executive Support Systems (ESS)
  - Becoming widely used by managers, analysts, knowledge workers
  - Also known as ‘everyone info system’, EIS, Enterprise IS
  - Spread into ranks of middle management, business professionals
  - One popular EIS software package → only 3% users are top executives
  - Conoco’s EIS → most senior managers and over 4000 world employees

- Group Decision Support Systems (GDSS)
- Intelligent Techniques
Systems For Supporting Decisions

- Management Information Systems
  - Help managers monitor and control a business by providing information on the firm’s performance
  - Typically produce fixed and regularly scheduled reports based on data from TPS

- MIS Reporting Alternatives
  - Periodic Scheduled Reports
    - Prespecified format on a regular basis
  - Exception Reports
    - Reports about exceptional conditions
    - May be produced regularly or when exception occurs
  - Demand Reports and Responses
    - Information available when demanded
  - Push Reporting
    - Information pushed to manager’s networked station, webcasting
MIS Reporting Alternatives

- Push Reporting
Online Analytical Processing

- **OLAP**
  - Dynamic nature of business, web enabled software products that supports OLAP
  - Enables managers and analysts to examine and manipulate large amounts of detailed and consolidated data from many perspectives
  - Done interactively in real time with rapid response

- Basic Analytical Operations
  - **Consolidation**
    - Aggregation of data
  - **Drill-down**
    - Display detail data that comprise consolidated data
  - **Slicing and Dicing**
    - Ability to look at the database from different viewpoints
Systems For Supporting Decisions

- **Decision Support Systems**
  - Support semi-structured and unstructured problem analysis
  - Earliest DSS were model-driven
  - Data-driven DSS
    - Use OLAP & data mining to analyze large pools of data in corporate systems

- **Using DSS**
  - **What-if Analysis**
    - End user makes changes to variables, or relationships among variables, and observes the resulting changes in the values of other variables
  - **Sensitivity Analysis**
    - Value of only one variable is changed repeatedly and the resulting changes in other variables are observed
  - **Goal-Seeking**
    - Reverse direction of analysis done in ‘what-if’ analysis
    - Set a target value for a variable and then repeatedly change other variables until the target value is achieved
    - Also called ‘how can’ analysis
  - **Optimization**
    - More complex extension of goal-seeking analysis
    - Goal is to find the optimum value for one or more target variables given certain constraints
    - One or more other variables are changed repeatedly until the best values for the target variables are discovered (Microsoft Excel → Solver)
Components of DSS

- **DSS Database**
  - Collection of current or historical data from a number of applications or groups

- **DSS Software System**
  - Software tools that are used for data analysis
    - OLAP tools
    - Data mining tools
    - Mathematical and analytical models

- **DSS User Interface**

*The main components of the DSS are the DSS database, the DSS software system, and the user interface. The DSS database may be a small database residing on a PC or a large data warehouse.*
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?”

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<tr>
<td></td>
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<td>Sales Price</td>
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<td>17</td>
<td>1188</td>
</tr>
<tr>
<td>18</td>
<td></td>
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Components of DSS

- Using Spreadsheet Tables to Support Decision Making
  - Spreadsheet tables can answer multiple dimensions of questions
    - Time of day and average purchase
    - Payment type and average purchase
    - Payment type, region, and source
  - Pivot table
    - Displays two or more dimensions of data in a convenient format
Components of DSS

- Sample List of Transactions for Online Management Training Inc. on October 28, 2007

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<tr>
<th>Cast ID</th>
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<th>Payment</th>
<th>Source</th>
<th>Amount</th>
<th>Product</th>
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</tr>
</tbody>
</table>
Components of DSS

- Pivot Table
- Examines the Regional Distribution of Customers
- Created using Excel 2007
Components of DSS

- Pivot Table
- Examines Customer Regional Distribution and Advertising Source

It appears nearly 30 percent of the customers respond to e-mail campaigns, and there are some regional variations.
Data Visualization Systems

- **DVS**
  - DSS that represents complex data using interactive 3D graphical forms such as charts, graphs, and maps
  - DVS tools help users to interactively sort, subdivide, combine, and organize data while it is in its graphical form

- **Geographic Information Systems**
  - DSS that uses geographic databases to construct and display maps and other graphics displays
  - That support decisions affecting the geographic distribution of people and other resources
  - Often used with Global Position Systems (GPS) devices
South Carolina used a GIS-based program called HAZUS to estimate and map the regional damage and losses resulting from an earthquake of a given location and intensity.
Customer Decision Support System

CDSS

- Support customers in the decision-making process
  - Include → Search engines, intelligent agents, online catalogs, Web directories, newsgroups, e-mail, etc.
- Many firms have customer Web sites where all the information, models, or other analytical tools for evaluating alternatives are concentrated in one location
  - Example - T. Rowe Price online tools, guides for college planning, retirement planning, estate planning, etc.
  - Buying Digital Camera, Mobile, …
Executive Support System

ESS

- Bring together data from many different internal and external sources, often through a portal
- Combine many features of MIS and DSS
- Used to monitor organizational performance, track activities of competitors, identify changing market conditions, spot problems, identify opportunities, and forecast trends
- Provide top executives with immediate and easy access to information
- About the factors that are critical to accomplishing an organization’s strategic objectives (Critical success factors)
- So popular, expanded to managers, analysts and other knowledge workers
- Information presented in forms tailored to the preferences of the executives using the system
  - Customizable graphical user interfaces
  - Exception reporting
  - Trend analysis
  - Drill down capability
Intelligent Techniques

- Many based on artificial intelligence (AI)
  - Computer-based systems (hardware and software) that attempt to emulate human behavior and thought patterns

- Attributes of Intelligent behavior
  - Think and reason
  - Use reason to solve problems
  - Learn or understand from experience
  - Acquire and apply knowledge
  - Exhibit creativity and imagination
  - Deal with complex or perplexing situations

- Include:
  - Expert systems
  - Case-based reasoning
  - Fuzzy logic
  - Neural networks
  - Genetic algorithms
  - Intelligent agents
Intelligent Systems for Decision Support

- **Expert Systems**
  - A knowledge-based information system (KBIS) that uses its knowledge about a specific, complex application to act as an expert consultant to end users.
  - **KBIS** is a system that adds a knowledge base to the other components on an IS.
  - Model *human knowledge as a set of rules* that are collectively called the knowledge base.
    - 200 – 10,000 rules, depending on complexity of decision making process.
  - **Inference engine** → Strategy to search and conclude decision.
  - Inference engine searches through the rules and fires those rules that are triggered by facts gathered and entered by the user.
Intelligent Systems for Decision Support

Rules in Expert System

An expert system rules are interconnected; the number of outcomes is known in advance; there are multiple paths to same outcome; and the system can consider multiple rules at a single time. The rules illustrated are for a simple credit-granting expert system.
Intelligent Systems for Decision Support

Benefits of Expert System
- Faster and more consistent than human expert
- Can have the knowledge of several experts
- Does not get tired or distracted by overwork or stress
- Helps preserve and reproduce the knowledge of experts

Limitations of Expert System
- Limited focus – Subjective problems
- Inability to learn – Must be taught new knowledge
- Maintenance problems
- Developmental costs – Cost of knowledge engineers, expert time
- Can only solve specific types of problems in a limited domain of knowledge
Suitability Criteria for Expert System

- Types of problems are most suitable for expert system solutions?
  - **Domain**: subject area relatively small and limited to well-defined area
  - **Expertise**: solutions require the efforts of an expert
  - **Complexity**: solution of the problem is a complex task that requires logical inference processing (not possible in conventional information processing)
  - **Structure**: solution process must be able to cope with ill-structured, uncertain, missing and conflicting data
  - **Availability**: an expert exists who is articulate and cooperative

- Hundreds of rules (assumptions, facts), several months to develop
  - Experts → within minutes

- How to develop Expert System?
  - Easiest approach → Expert System Shells
  - Software package without kernel (knowledge base)
  - Rule editors, Inference generators
Intelligent Systems for Decision Support

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.
Intelligent Systems for Decision Support

Case based Reasoning

Knowledge → Database of past cases and their solutions
Six-step process to generate solutions to new problems encountered by the user

1. User describes the problem
2. System searches database for similar cases
3. System asks user additional questions to narrow search
4. System finds closest fit and retrieves solution
5. System modifies the solution to better fit the problem
6. System stores problem and successful solution in the database
Intelligent Systems for Decision Support

Fuzzy Logic

- Method of reasoning that resembles human reasoning
- Allows for approximate values and inferences and incomplete or ambiguous data instead of relying only on crisp data
- Uses terms such as “very high” rather than precise measures
- Rule-based technology that represents imprecision in categories (e.g. “cold” vs. “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 crisp IF-THEN rules
  - Example - Sendai, Japan subway system uses fuzzy logic controls to accelerate so smoothly that standing passengers need not hold on
  - Incremental changes in the input to produce Smooth changes in the output instead of discontinuous ones
Intelligent Systems for Decision Support

Neural Network

- Computing systems modeled after the brain’s mesh-like network of interconnected processing elements, called neurons
- Interconnected processors operate in parallel and interact with each other
- “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 may “train” the network by feeding it data for which the inputs produce a known set of outputs or conclusions
- Useful for solving complex, poorly understood problems for which large amounts of data have been collected
Intelligent Systems for Decision Support

How Neural Network Works?

- In this example, the neural network has been trained to distinguish between valid and fraudulent credit card purchases.

Input Layer

Hidden Layer

Output Layer

Data
- Age
- Income
- Purchase history
- Frequency of purchases
- Average purchase size

Results
- Valid purchase
- Fraudulent purchase
Genetic Algorithms

- Darwinian (survival of the fittest), randomizing, and other mathematical functions

- Based on techniques inspired by evolutionary biology: inheritance, mutation, selection, etc.

- To simulate an evolutionary process that can yield increasingly better solutions to a problem

- 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
How Genetic Algorithms Works?

- Initial population of *chromosomes*, each representing a different solution
- Genetic algorithm → Iterative process to refine the initial solutions
- Better ones, those with the higher fitness, are more likely to emerge as the best solution

<table>
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</table>

*A population of chromosomes*
Intelligent Systems for Decision Support

Intelligent Agents

- A software surrogate for an end user or a process that fulfills a stated need or activity

- 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 - Uses its built-in and learned knowledge base

- Also called software robots or 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 Systems for Decision Support

Intelligent Agents

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.
Intelligent Systems for Decision Support

- **Major Types of Intelligent Agents**

  - **Interface Tutors** → observe user computer operations, correct user mistakes, and provide hints and advice on efficient software use
    - *Wizards* found in *Microsoft Office* & well known software
  
  - **Presentation** → show information in a variety of forms and media based on user preferences
  
  - **Network Navigation** → discover paths to information and provide ways to view information based on user preferences
  
  - **Role-Playing** → play what-if games and other roles to help users understand information and make better decisions
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 in firms
- Structured → Structured text documents (reports, presentations)
- Semistructured → E-mail, voice mail, digital pictures, bulletin-board postings
- 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
- Searching, Storing, Locating employees with such expertise
Systems for Managing Knowledge

➢ Enterprise-Wide Content Management Systems
  ■ Capabilities for knowledge capture, storage
  ■ Repositories for documents and best practices
  ■ Capabilities for collecting and organizing semi-structured knowledge such as e-mail

➢ Classification schemes
  ■ Key problem in managing knowledge, categorize
  ■ Each knowledge object must be tagged for retrieval
  - BAE Systems → Employed Autonomy Content Management System
    - Aggregates stru/unstructured content from emails, resumes, profiles, and over 10,000 news feed per day
    - Automatically categorizes and tags the contents and alerts about 130,000 employees
    - Reduced time spent in retrieving information by 90%
Systems for Managing Knowledge

Enterprise-Wide Content Management Systems

- Capabilities for classifying, organizing, and managing structured and Semi-structured knowledge
- Makes it available throughout the enterprise

- Create/Capture
- Tag
- Store/Retrieve
- Manage/Review
- Distribute/Publish

Unified repository

- Reports/presentations
- Best practices
- Memos
- PowerPoint slides
- E-mail
- Graphics
- Video
- News feeds
Systems for Managing Knowledge

- Enterprise-Wide Knowledge Management Systems
  - 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
    - Blogs
    - Wikis (tracking changes and reverting to earlier versions)
    - Social bookmarking
Enterprise Knowledge Network Systems

- A knowledge network maintains a database of firm experts, as well as accepted solutions to known problems
- Facilitates the communication between employees looking for knowledge and experts who have that knowledge
- Solutions created in this communication - added to a database of solutions in the form of frequently asked questions (FAQs), best practices, or other documents