Chapter 8
Constructing a Decision Support System and DSS Research

- What must be done to acquire a DSS?
- DSS must be custom tailored

8.1 Opening Vignette: Hospital Healthcare Services Uses DSS

- **Jewish Hospital Healthcare Services (JHHS)**
  - **Regional healthcare provider in Louisville, KY**
  - **7 facilities, 1,000 patient beds, 3,500 employees**
  - **Total information management and computer services costs = 3 % of the operating budget**
  - **SAS development tool 1991**
  - **JHHS managers can take clinical and financial files from the mainframe to perform analysis**
  - **Nursing acuity system linked to the nurse staffing scheduling system**

- **1992 various DSS applications in**
  - **Productivity**
  - **Cost accounting**
  - **Patient mix**
  - **Nurse staff scheduling**
  - **Several different mainframe and PC software packages**
- **Early 1992, integrated mainframe-based DSS development tool MAPS**
    - **Modeling**
    - **Forecasting**
    - **Planning**
    - **Communications**
    - **Database management systems**
    - **Graphics**
  - **Productivity DSS in MAPS**
  - **Faster and easy to interpret**

8.2 Introduction

- **System Development Issues**
  - **Various commercial development software packages on different platforms**
  - **Different software packages for different DSS applications**
  - **Development packages for the mainframe applications PCs**
  - **Diverse applications in different functional areas**
  - **Vendors assisted in DSS construction**

DSS Construction is Complicated

- Technical Issues
- Behavioral Issues
- Many Different Approaches

TABLE 8.1 Toward a Broader View of Decision Making

Narrow View	Broader View
Single decision-maker	Multiple decision-makers
Single decision process	Multiple decision processes separated in place and time influence a single decision
Efficacy of computer models	Multiple influences on decision choice
Reliance on quantifiable information	Importance of qualitative, "soft" information
Reliance on rational factors	Importance of politics, cultural norms, and so on
Optimizing and efficiency as goal	Other criteria such as fairness, legitimacy, human relations, power enhancement
Decision-makers want the same	Sometimes, decision-makers want to further goals as the organization their own ends or are indifferent to organizational goals
Single goal for decision	Multiple conflicting goals
Choice is the major problem	Support is needed for other phases of decision processes such as intelligence, design, implementation

TABLE 8.1 Toward a Broader View of Decision Making (continued)

Narrow View	Broader View
Decision situations are unique	Many decisions are repetitive; the ability to learn from past approaches to structured and unstructured decision situations is important
Decisions are made with some intent in mind	Some decisions are arbitrary, mindless, or capricious
Decision processes always result in decisions	Some decision processes are initiated to prepare for "potentially" needed decisions; others to ratify past decisions
Goals, possible actions, consequences of actions can be determined (the problem is structurable)	Problems are often unstructured

Source: E. A. Stohr and B. R. Konsynski (eds.), *Information Systems and Decision Processes*, Los Alamitos, CA: IEEE Society Press, 1992. (© 1992 IEEE.)

8.3 Development Strategies

1. Customized DSS in general-purpose programming language
2. Fourth-generation language
3. DSS integrated development tool (generator or engine)
4. Domain-specific DSS generator
5. CASE methodology
6. Integrate several of the above approaches

8.4 The DSS Development Process

- Prototyping
- Not all activities are performed for every DSS
- Process summary (Figure 8.1)

- **Phase A: Planning**
  - **Need assessment and problem diagnosis**
  - **Define objectives and goals of the DSS**
  - **What are the key decisions?**
- **Phase B: Research**
  - **Identification of a relevant approach for addressing user needs and available resources**

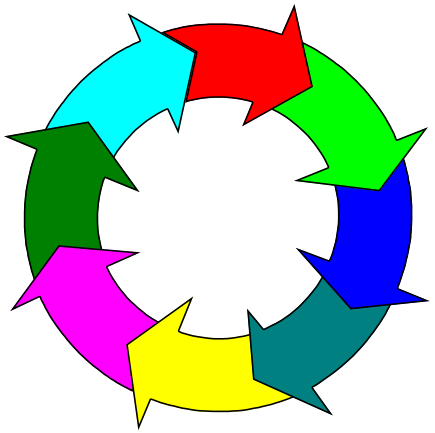
- **Phase C: System Analysis and Conceptual Design**
  - **Determination of the best construction approach and specific resources required to implement**
  - **Includes**
    - **Technical resources**
    - **Staff resources**
    - **Financial resources**
    - **Organizational resources**
  - **Conceptual design followed by a feasibility study**

- **Phase D: Design**
  - **Determine detailed specifications of system**
    - **Components**
    - **Structure**
    - **Features**
  - **Select appropriate software or write them**
- **Phase E: Construction**
  - **Technical implementation of the design**
  - **Tested and improve continuously**
  - **Interface DSS with other systems**

- **Phase F: Implementation**
  - **Testing**
  - **Evaluating**
  - **Demonstration**
  - **Orientation**
  - **Training**
  - **Deployment**
- **Phase G: Maintenance and Documentation**
  - **Planning for ongoing system and user support**
  - **Develop proper documentation**
- **Phase H: Adaptation**
  - **Recycle through the earlier steps**

8.5 The Development Process: Life Cycle versus Prototyping

- Life-cycle approach
- Evolutionary prototyping approach (iterative process)



The System Development Life Cycle (SDLC) Approach and DSS

- **Inappropriate for Most DSS**
- **Users and Managers may not understand their information and modeling needs**

The Evolutionary Prototyping Approach

- **Build a DSS in a series of short steps with immediate feedback from users**
  - **1.Select an important subproblem to be built first**
  - **2.Develop a small but usable system to assist the decision maker**
  - **3.Evaluate the system constantly**
  - **4.Refine, expand, and modify the system in cycles**
- **Repeat**
  - **Stable and comprehensive system evolves**

Advantages of Prototyping

- Short development time
- Short user reaction time (feedback from user)
- Improved users' understanding of the system, its information needs, and its capabilities.
- Low cost.

- Disadvantages and Limitations
  - Gains might be lost through cycles
- Combining prototyping with the critical success method (Figure 8.3)

8.6 Team-Developed Versus User-developed DSS

- DSS 1970s and early 1980s

- Large-scale, complex systems
- Primarily provided organizational support
- Team efforts

User-Developed System Due to the Development of

- Personal computers
- Computer communication networks
- PC-mainframe communication
- Friendly development software
- Reduced cost of software and hardware
- Increased capabilities of personal computers
- Enterprise-wide computing
- Easy accessibility to data and models
- Client/server architecture

Balance

8.7 Team-Developed DSS

- Substantial effort
- Extensive planning and organization
- Some generic activities

- Group of people to build and to manage it. Size depends on
  - effort
  - tools

Organizational Placement of the DSS Development Group

1. In the information services (IS) department
2. Highly placed executive staff group
3. Finance or other functional area
4. Industrial engineering department
5. Management Science group
6. Information center group

8.8 End-user Computing and User-Developed DSS

- **End-user Computing (end-user development) the development and use of computer-based information systems by people outside the formal information systems areas**
- **End-users**
  - **At any level of the organization**
  - **In any functional area**
  - **Levels of computer skill vary**
  - **Growing**

User-Developed DSS Advantages

1. Short delivery time
2. Eliminate extensive and formal user requirements specifications
3. Reduce some DSS implementation problems
4. Low cost

User-Developed DSS Risks

1. Poor Quality
2. Quality Risks
   - Substandard or inappropriate tools and facilities
   - Development process risks
   - Data management risks
3. Increased Security Risks
4. Problems from Lack of Documentation and Maintenance Procedures

DSS In Focus 8.3: Example of Risk in User-developed DSS

Using a spreadsheet package, in 1996, a California executive predicted $55 million in sales over the first two years for a computer his company planned to introduce. Based on this projection, other managers began making plans for hiring additional staff and expanding inventories. Unfortunately, the sales projections were wrong because the executive had forgotten to include a price discount planned for a key component. On closer examination of the model, he discovered the sales estimates were inflated by $8 million because of an error in the pricing formula. Had the executive's mistake not been detected, the actual profit margins would have been considerably lower than the projection.

Issues in Reducing End-User Computing Risks

- Error detection
- Use of auditing techniques
- Determine the proper amount of controls
- Investigate the reasons for the errors
- Solutions

8.9 DSS Technology Levels and Tools

- **Three Levels of DSS Technology**
  - **Specific DSS [the application]**
  - **DSS Integrated Tools (generators) [Excel]**
  - **DSS Primary Tools [programming languages]**
- **Plus**
  - **DSS Integrated Tools**
- **Now all with Web Hooks and easy GUI interfaces**
- **Relationships Among the Three Levels (Figure 8.6)**

8.10 Selection of DSS Development Tools

- **Questions**
  - a) Which tool(s) to use?
  - b) Which hardware?
  - c) Which operating system?
  - d) Which network(s) to run it on?
- **Options**
  - Mainframe DSS Software
  - PC DSS Software
  - (Unix) Workstation Software

Complexity of the Software Selection Process

1. DSS information requirement and outputs are not completely known
2. Hundreds of software packages
3. Software packages evolve very rapidly
4. Frequent price changes
5. Several people involved

6. One language for several DSS? Tool requirements may change
7. Dozens of criteria, some intangible, some conflict
8. Technical, functional, end-user, and managerial issues
9. Published evaluations are subjective and superficial
10. Trade off between open and closed environments

DSS Generator Selection

- **Some DSS generators are better for certain types of applications than others**

8.11 Developing DSS

- Putting the System Together
- Development tools and generators
- Use of highly automated tools
- Use of prefabricated pieces

- Both increase the builder's productivity

DSS Development System Includes

- Request (query) handler
- System analysis and design facility
- Dialog management system
- Report generator
- Graphics generator
- Source code manager

- Model base management system
- Knowledge management system
- Object-oriented tools
- Standard statistical and management science tools
- Special modeling tools
- Programming languages
- Document imaging tools

DSS Development System Components

- Some may be integrated into a DSS generator
- Others may be added as needed
- Components used to build a new DSS
- Core of the system includes a development language or a DSS generator
- Construction is done by combining programming modules
- Windows environment handles the

8.12 DSS Research Directions*

The DSS of the Future

1. **Intelligent DSS can be proactive**
2. **Future DSS should be creative**
3. **DSS will become decision-paced**
4. **Larger role for management science, cognitive psychology, behavioral theory, information economics, computer science, and political science**
5. **Latest advances in computer technology improving DSS**

* Source: Based on J. J. Elam, J. C. Henderson, P. G. W. Keen and B. Konsynski, A Vision for Decision Support Systems, Special Report, University of Texas, Austin, TX, 1986.

6. Improved DSS apply to more unstructured problems
7. Must be able to create alternatives independently
8. Much longer-range perspective of DSS research
9. Research on interactions between individuals and groups
10. More examination of the human component of DSS: learning and empowerment.
11. The integration of DSS with other systems (ES, CBIS)
12. Expansion of the model management concept

13. Enhancement of DSS theory (decision quality measurement, learning, and effectiveness)
14. New theories for of organizational decision making and group decision making
15. Enhancement of DSS applications with values, ethics, and aesthetics
16. Major research thrust in human-machine interfaces and their impacts on creativity and learning
17. Exploration to find the appropriate architectures for decision makers to use ES
18. Organizational impacts of DSS

Extensive DSS Research

1. Broader view of decision making
2. Behavioral research
3. Research based on team theory
4. Stimulus-based DSS
5. Qualitative DSS
6. Usefulness of DSS
7. DSS and the Internet
8. Profile of DSS Research

8.13 The DSS of the Future

DSS Trends

1. PC-based DSS continues to grow
2. For institutionalized DSS: trend is toward distributed DSS
3. For pooled interdependent decision support, group DSS
4. Decision support system products are incorporating artificial intelligence: intelligent DSS
5. Focused versions of DSS toward specific sets of users or applications (EIS, GSS)
6. DSS groups moving into mainstream support
7. Continued development of user-friendly capabilities
8. The DSS software market continues to develop and mature

Sprague and Watson [1996]

Challenges of DSS

- Integrated Architecture
- Connectivity
- Document Data Management
- More Intelligence

– Sprague and Watson [1996]

Highlights / Summary

- DSS are complex and their construction can be
- DSS Technologies
- Iterative (prototyping) approach
- DSS teams or individuals.
- End user computing allows decision makers to build their own DSS
- Most DSS are constructed with DSS development generators or with nonintegrated 4GL development tools
- Many DSS are also constructed in integrated software suites on personal computers.
- Tool and generator selection can be tricky.
- DSS research continues

Debate

Debate the issues (advantages and risks) in end-user DSS development. Use examples from the literature to back up your arguments.

Internet Assignments

1. Explore software vendors. Find vendors, download demos, identify user groups, and prepare a report.

   Group 1--Spreadsheet and modeling tools

   Group 2--Database related tools

   Group 3--Graphics and user interface tools.

Questions for the Opening Vignette

1. Describe the steps in Figure 8.1 that you can identify for the JHHS Vignette.
2. Why was a quantitative cost/benefit analysis not done?
3. Comment on the various DSS tools and generators. Can you classify them?
4. Why was the high level of trust and credibility in the integrity of the provided information important?
5. Discuss the benefits of the DSS.

CASE APPLICATION 8.1: Wesleyan University--DSS for Student Financial Aid

Questions

1. **Why was there a need for a DSS?**
2. **What kind of generators and tools were used during construction?**
3. **Identify some DSS capabilities that were used.**

APPENDIX 8-A: Prototyping

- **Process of building a "quick and dirty" version of an information system**
  - **Throwaway**
  - **Evolutionary**

Evolutionary Steps

1. Identify user's information and operating requirements in a "quick and dirty" manner.
2. Develop a working prototype that performs only the most important function (e.g., using a sample database).
3. Test and evaluate (done by user and builder).
4. Redefine information needs and improve the system.

- Repeat the last two steps several times

The Primary Features of Prototyping

1. Learning is explicitly integrated into the design process
2. Short intervals between iterations
3. User involvement is very important (*joint application development (JAD) method)*
4. Initial prototype must be low cost
5. Prototyping essentially bypasses the life-cycle stage of information requirements definition

APPENDIX 8-B: Specific Tactics Within Different Quality-control Approaches Aimed at Reducing the Risks of User-developed DSS

User-developed DSS Risks	Quality-control Approaches	Specific Tactics
• Incorrect problem specifications • Piecemeal and incremental • development approach Modeling errors	• Analyst reviews and audits	• Formation of quality assurance teams
• Threats to data security and integrity • Device/software incompatibility • Misconceived investment of organizational resources	• Organizational and management policies	• Data management policies • Hardware/software standards • Formal justification policies

• Incorrect problem specifications • Insufficient search for solution • Modeling errors • Piecemeal development approach • Threats to data integrity and security	• Support and training	• Organizational consultants • Training in end-user computing • and DP concepts
• Poor data integrity • Calculation errors • Poor data security	• Hardware/software • Auditing techniques	• Software for spreadsheet audits • Software/hardware for access and monitoring

(*Source*: M. Alavi, "End-User Developed DSS: Steps Towards Quality Control," *Proceedings: Managers, Micros and Mainframe,* NYU Symposium, New York, May 1985. Used with permission.)