



Chapter 11

Building Web-Based and Inter-Organizational Decision Support Systems

*We can use the Internet and World-Wide
Web to extend the reach and range of
Decision Support Systems.*

Introduction

In his 1996 book The Road Ahead, Microsoft Chairman Bill Gates argued the Internet “will carry us into a new world of low-friction, low-overhead capitalism, in which market information will be plentiful and transaction costs low.” To exploit the plentiful market information and generate profits, companies will need to create and use sophisticated Decision Support Systems. These DSS will need to be available to both internal and external stakeholders. For many reasons, the logical environment for building these new Decision Support Systems is the Internet or a Corporate Intranet built using Web technologies.

The dominant information technology platform in companies is changing from main frames and LAN-based, client-server systems to Web and Internet technologies. This technology change is expanding what Peter Keen (1991) called “information reach” and “information range”. The reach of Information and Decision Support Systems has expanded significantly to serve a larger group of internal and external stakeholders. The range and variety of Decision Support Systems that can be developed, delivered, and shared is also becoming much larger. Today, innovative Web-Based examples of all five generic Decision Support Systems, including Communications-Driven, Data-Driven, Document-Driven, Knowledge-Driven and Model-Driven DSS, can be found and more innovative DSS of each type will surely be developed.

Data from DSS vendors, from PricewaterhouseCoopers and from The Conference Board indicate that a technological shift to Web technologies is occurring in many corporations. In 1999, 58% of large corporations had Intranets and 10% had Extranets for business partners. A large majority had Web sites (72%) and used email (92%). The growth of Web-Based DSS was just beginning in 1999; only 8% of firms had Web enabled company data warehouses. Most large firms were planning to create Intranets, establish Extranets, and make company-wide data warehouses accessible on their Intranets and Extranets.

Web technologies are being implemented rapidly so we all need to monitor and explore the possibilities of Web-Based DSS. We need to ask if Web technologies can reduce the cost of building and delivering Decision Support. Managers need to know how we build Web-Based and Inter-Organizational DSS. And managers need to know how we can create DSS that support customers and suppliers. We need to explore the advantages of changing the technology of DSS to Web technologies. From a practical standpoint we need to explore and debate how much knowledge of Web technologies managers need. Also, should managers be maintaining Web sites? Finally, managers and MIS personnel need to “surf” the Web and try a variety of examples of Web-Based and Inter-Organizational DSS.

This chapter focuses on Web technologies and Inter-Organizational DSS, especially topics like designing and managing Web-Based systems; examples of Web-Based DSS software; examples of Web-Based and Inter-Organizational DSS implementations; and advantages and disadvantages of Web-Based and Inter-Organizational DSS.

Key Terms

The World-Wide Web is where the action is in developing Enterprise-Wide and Inter-Organizational Decision Support Systems. When vendors propose a Web-Based DSS they are referring to a computerized system that delivers decision support information or decision support tools to a manager, business analyst, or customer using a "thin-client" Web browser like Netscape Navigator or Internet Explorer. The computer server that is hosting the DSS application is linked to the user's computer by a network using the Transmission Control Protocol/Internet Protocol (TCP/IP). In many companies, a Web-Based DSS is synonymous with an Intranet and an Enterprise-Wide DSS that is supporting large groups of managers in a networked environment with a specialized data warehouse as part of the DSS architecture. This view is too narrow; Web technologies can be used to implement any type of Decision Support System.

Some companies have created Extranets for decision support as well as Intranets. Inter-Organizational DSS serve a company's stockholders, bankers, customers or suppliers. An Inter-Organizational DSS may provide stakeholders with access to a company's Extranet and/or authority or privileges to use specific DSS Intranet capabilities. For example, companies are creating Web-Based, Inter-Organizational DSS that customers can use to evaluate products, control costs or reduce inventories. These DSS systems may be Data-Driven or Document-Driven DSS, Communications-Driven or Group DSS, Model-Driven DSS, or Knowledge-Driven DSS. The target users are managers and knowledge workers in a customer, supplier

or partner organization and retail customers. Some people would say this type of DSS is part of a company's external Intranet or Extranet.

As noted, only 8% of firms had Web enabled company data warehouses in 1999. A company Intranet based on Web technologies can provide even more extensive management information and Decision Support than a data warehouse. Also, an Intranet can provide decision support to a wide variety of internal users. An Intranet is a secure, internal organizational network that uses TCP/IP with at least one Web server. It is important that an Intranet is secure and accessible by only an organization's members or others who have specific authorization. A firewall and password protection should limit access to the network. An Intranet is an internal information system based on Internet technology, Web services, and HTML and PDF publishing.

An Intranet is used to share corporate information, including DSS capabilities. Most Intranets have a main page called a portal. A portal is a simple, personalized Web front-end that provides access to information from the Global Internet as well as a wide variety of corporate systems, including document servers, business intelligence systems, Groupware databases, and enterprise resource planning systems.

The above terms are evolving as quickly as the Web itself and they are not used consistently by authors. We need to accept that conceptual ambiguity for the foreseeable future.

Designing and Developing Web-Based DSS

A decision-oriented diagnosis approach is important for Web-Based and Inter-organizational DSS. Simply making an existing DSS accessible using a Web browser or accessible to customers or other external stakeholders will often lead to unsatisfactory results. Once diagnosis is complete, a feasibility analysis is definitely needed for an enterprise-wide and any other potentially large-scale DSS. A systematic development approach must be explicitly chosen and managers must be involved in the development process.

Developing the user interface, models and data store for Web-Based DSS remain major tasks. A user interface remains important in a Web development environment and it probably becomes more important because so many users of various levels of sophistication can potentially access some or all DSS capabilities. The representations available to user interface designers of Web-Based DSS are comparable to those for standalone DSS, but the available operations expand enormously with the additions of hyperlinks and the availability of external data and document sources. Control and memory aids also change somewhat in a Web development environment.

The actual architecture implemented is usually simple. Most Web-Based DSS are built using a three or four-tier architecture. A person using a Web browser sends a request using the hypertext transfer protocol (HTTP) to a Web server. The Web server processes the request using a program or script. The script may implement or link to a model, process a database request, or format a document. The results are returned to the user's Web browser for display (see Figure 11.1). Web applications are designed to allow any authorized user, with a WWW browser and an Internet

connection, to interact with them. The application code usually sits on a remote server and the user interface is presented at the client's WWW browser.

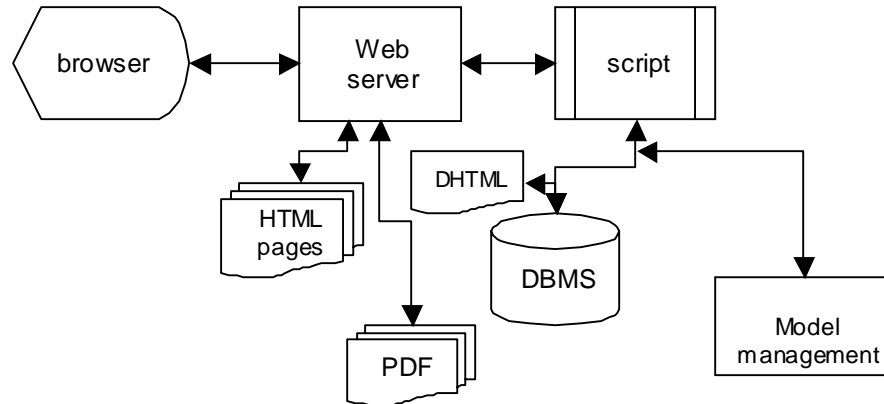


Figure 11.1 Web-Based DSS architecture

The tools for building Web-Based DSS are new and increasingly complex. Many people have heard of Hypertext Markup Language (HTML), but it is only a small part of the development tool set. MIS staff and managers are bombarded with acronyms and terms like Extensible Markup Language (XML), Common Gateway Interface Scripts (CGI), Java applets, JavaScript code in HTML pages, and ActiveX components. Let's briefly explore some of these tools.

HyperText Markup Language (HTML) is designed to specify the logical organization of a document with hypertext extensions for hypertext links and user interaction. The HTML standards are available at <http://w3.org>. HTML is not a programming language. It can be used for receiving input and showing output from a decision aid programmed in a programming language, such as Java or JavaScript. The most useful tags for entering input and displaying output are the Form tags. A tutorial for them can be found at <http://htmlgoodies.earthweb.com/tutors/fm.html>. More HTML tutorials can be found at the [HTML/Programming](#) page at DSSResources.COM.

Extensible Markup Language (XML) is a general syntax for describing hierarchical data. It is applicable to a wide range of DSS applications, including applications with databases, web documents, and searching. It is similar to HTML; however, in XML you can create your own tags to show a document's structure. For example, in a document consisting of employee information, we could have tags like <name> </name>, <position> </position>, and <streetaddress> </streetaddress>. In HTML, we could only separate the information with
 or <p></p> tags. XML allows Decision Support Systems to process documents, data, and information faster and more efficiently.

Common Gateway Interface (CGI) applications are server-executed programs used to dynamically create HTML documents. Many World Wide Web sites use CGI applications for dynamic web page creation, for taking values from Web forms, and for providing a Web-based interface to other applications, such as databases. CGI programs provide the back-end processing for many Web-Based Decision Aids and DSS.

Java is a general-purpose programming language. In "The Java Language: A White Paper," (Sun, The Java Language: An Overview, 1996) Sun describes Java as "A simple, object-oriented, distributed, interpreted, robust, secure, architecture neutral, portable, high-performance, multithreaded, and dynamic language." It is related to C and C++ but some capabilities are omitted and a few ideas from other languages are included. Java is a high-level programming language. Compiled Java code is architecture-neutral, so Java applications are ideal for diverse operating system environments like the Internet. The Java language provides a powerful addition to the DSS development tools for programmers. The official Java web site is <http://java.sun.com/>. The largest directory of Java applets and Java-related web sites is <http://www.gamelan.com/>.

JavaScript is a programming language that is highly integrated with Web browser objects. JavaScript is downloaded as part of an HTML page and the Web browser processes it after it is received. JavaScript programs consist of functions that are called as a result of Web browser events. Some examples of JavaScript Decision Aids are available at <http://dssresources.com/decisionaids/>. A tutorial introduction to JavaScript is at <http://javascript.internet.com/>.

ActiveX controls are reusable software components developed by Microsoft. These controls can be used to quickly add specialized functionality to Web sites, desktop applications, and development tools. According to Webopedia, ActiveX is an "outgrowth of two other Microsoft technologies called OLE (Object Linking and Embedding) and COM (Component Object Model)". Most developers focus on ActiveX controls. An ActiveX control is similar to a Java applet. Related to ActiveX is VBScript. It enables one to embed interactive elements in HTML documents. Microsoft's Internet Explorer supports Java, JavaScript, and ActiveX, and Netscape's Navigator supports only Java and JavaScript, although plug-ins can provide support of VBScript and ActiveX.

Many desktop productivity tools like Microsoft Access, Excel and PowerPoint have the capability to create Web documents. These HTML generator tools can let managers and analysts share decision support materials prepared on their personal PCs with others in their company. In general, managers need to become more involved in the development of Web sites and DSS applications on Intranets and Extranets.

A number of specialized tools can help implement Web-Based DSS including Microsoft Front Page, Cold Fusion from Allaire (www.allaire.com) and Web DSS development software like dbProbe (internetivity.com). These tools can assist some experienced developers, but they can actually result in poorly developed DSS when used by people inexperienced in building DSS. End-users will build Web-Based DSS using Front Page or even Cold Fusion, but these DSS will have probably have detractors than advocates.

When a company embarks on building Web-Based DSS some problems can be anticipated and minimized. First, Web-Based DSS applications will probably encounter some peak load problems. During the business day many managers will want to access the Corporate Intranet and so a “high performance” hardware architecture that can expand to serve a large number of concurrent users is needed. This load problem is associated with the “scalability” of the hardware and software and the planning of the developers.

Second, the Web is a “stateless” environment that does not automatically keep track of configuration settings, transaction information or any other data for the next page request. To avoid requiring users to re-enter information such as user name and password, Web-Based DSS applications must keep state information from one Web page to another. This creates new security issues for companies wishing to make sensitive internal data accessible to users. User authorization and authentication are challenging in the Web environment because of the large number of potential users.

Third, we are all having trouble keeping up with changing Web technologies. We need to learn rapidly in this environment. Both managers and technical staff need to learn about Web technologies and then be prepared to keep up with new developments as they occur. Despite these problems or challenges the Web is and should be the platform of choice for new Decision Support Systems.

Managing Web-Based and Inter-Organizational DSS

Companies are using both traditional Electronic Data Interchange (EDI) and newer Web-Based extranet technologies to build “trading communities”. These inter-organizational systems can support both transaction processing and cooperative or shared decision-making. Despite the possibilities, a number of real-world issues like re-engineering or redesigning business processes and encouraging trading partners to participate in e-business relationships remain major challenges. Managers in interdependent organizations need to cooperate to build shared DSS and suppliers need to consider what types of DSS can assist their customers. Also, managers must confront a variety of business, technical and legal issues and impediments if they want to build effective Inter-Organizational DSS.

The first major business issue that must be confronted is who will use the system -- customers, suppliers or both? Then managers need to ask a number of more specific questions: What is the cost of the proposed Web-Based, Inter-Organizational DSS and who will pay the cost? Then managers need to ask: “Do we need to reengineer or redesign our processes? Does the Internet increase the speed of decisions and transactions and create efficiencies for our business? Will the use of networks, Web-Based DSS and the Internet create new value for customers?” Too many **No** answers to the above questions and proposed DSS projects will certainly fail.

In terms of technical issues, managers need to ask if the initiating company has the staff and technology in place to build the proposed Inter-Organizational systems. Someone needs to determine what hardware and software partners and participants will need to acquire. Technical issues can be overcome if potential problems and needs are identified early in the development process.

Finally, from a legal perspective managers need to determine what material can be made available to external users, especially customers and suppliers, to support their decision-making. And managers should ask: Do we have privacy or liability issues or copyright issues associated with the proposed DSS project?

Advanced Inter-Organizational Systems

The most advanced Inter-Organizational systems (IOS) use the public Internet to create communications links. The systems may involve any stakeholder with access to the Internet and authority or privileges to use specific capabilities. These advanced systems are associated with electronic commerce, DSS and Extranets. The increasing importance of easy and efficient access to information has led many companies especially large ones to move toward more advanced Inter-Organizational systems. The increasing use of the Internet is significantly decreasing the costs of complex networks between suppliers, customers and manufacturers/retailers. The networked economy is creating electronic business communities -- networks of suppliers, distributors, commerce providers, customers, and even competitors, according to the Alliance for Converging Technologies. The mission of the Alliance is to help companies collectively produce products and services by exchanging information online (see Tapscott, 1998).

Web technologies offer firms the opportunity to gather market intelligence and monitor consumer choices through customers' revealed preferences in navigational and purchasing behavior on the Web. Inter-Organizational DSS reduce costs to suppliers by letting them electronically access on-line databases of bid opportunities, online abilities to submit bids, and online review of awards. The Web facilitates cooperative processes and can include buyers, suppliers, and partners in redesigned business processes.

With Web-Based DSS supporting value chains, the supply-chain management system and the customer support system can be integrated. Integration can provide sharing of manufacturing, inventory and sales data. With such a system suppliers build to order and do not stock inventory based on projections. A collaborative Extranet supports relationships with key accounts. With an Extranet departmental peers in customer and supplier organizations are connected for real-time collaboration. A well-designed Extranet with Web-Based DSS should reduce cycle time and promote greater creativity in solving shared business problems.

Some Examples

According to InternetWeek (www.internetweek.com), PCS Health Systems, a prescription management company, issues plastic information cards to health-plan members. When a patient fills a prescription, the pharmacist inputs patient information from the card, and PCS provides information such as eligibility, drug interactions and whether other drugs are preferred. Then the prescription can be dispensed, and PCS records the transaction and bills the health plan. PCS provides analytics to its clients, the health plan managers, to help them understand how well their plan is performing. Clients use Web browsers to connect to the PCS network. Ron Merlino, senior VP of technology infrastructure at PCS, said in Fall 2000 that PCS is giving more managers in client organizations access to data mining and analytical tools.

Retailer Dayton Hudson has spent several years working to move its suppliers to EDI-based supply chains. It has standardized transactions on the delivery of Advanced Ship/Manifest (ANS) documents based on Universal Product Codes (UPCs) to enable the retailer to keep track of its shipments and inventory. The retailer's EDI purchase order rollout began in January 1998, and the system currently supports 3,800 vendors with over one million UPCs cross-referenced. (Check <http://www.internetwk.com/news0299/news022399-5.htm>) This large database provides extensive DSS possibilities similar to those in place at Wal-Mart and other retailers.

Examples of Web-Based DSS Development Software

The DSS Vendors page at URL <http://dssresources.com/vendorlist/> includes more than 50 companies that market DSS products. Many of these vendors have Web-Based DSS products. The following paragraphs discuss a few vendors that have on-line examples or demonstrations of Web-Based DSS development software.

Booz-Allen has a Purchasing Analysis Tool called SS/DSS. It includes structured and flexible tools that allow analysis of historic purchasing data; predefined graphs and reports for performing analysis within and across business units; and a flexible Java-based OLAP tool for drill-down, pivot, filter, and selection on a purchasing database.

Comshare has a product called DecisionWeb that uses Java applets. Web-OLAP is a product from Information Advantage and Sterling Software. Information Advantage was a leader in developing Web DSS/OLAP applications.

InterNetivity, Inc. has a product called dbProbe 4.0. Written in Java, dbProbe is a cross-platform, corporate-wide tool for sales analysis, statistical analysis, financial analysis, inventory analysis or any data warehouse application that needs multidimensional data analysis. You can visit the dbProbe Solutions Gallery at <http://www.internetivity.com/site/products.html>. This product is an excellent example of what is possible with Java applets.

Pilot Software (<http://www.pilotsw.com/>) includes Internet capabilities in the Pilot Decision Support Suite. At the Web site you can see a screen shot of Pilot Internet Publisher (PIP) Version 6.0. Internet Publisher delivers decision support solutions on the World-Wide Web to users at company and remote locations through Web browser interfaces.

Cognos (<http://www.cognos.com/>) DecisionStream is an application designed to build dimensional data marts. It integrates with Cognos Business Intelligence Web tools like Impromptu Web Query. There are two main parts to the DecisionStream architecture: a design client running on Windows or NT, and a Server Engine running on UNIX or NT. Figure 11.2 shows a screen shot from Cognos DecisionStream Designer.

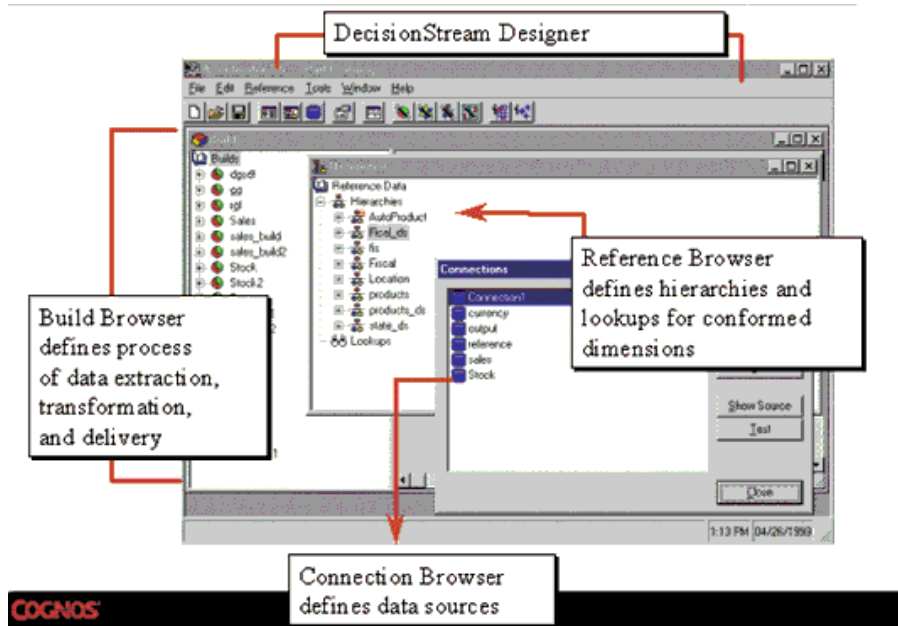


Figure 11.2 – Cognos DecisionStream Designer

Hyperion (<http://www.hyperion.com/>) Web Gateway is a development platform for building Web-based analytic applications. It enables high-speed, interactive read-write access to Hyperion Essbase OLAP server across the World Wide Web. According to materials at the website, “The more than 800 licensees of Hyperion Web Gateway have built applications ranging from performance measurement to risk analysis to preparing the Federal Budget.” Figure 11.3 shows an example of an ad-hoc analysis built using the Web Gateway product.

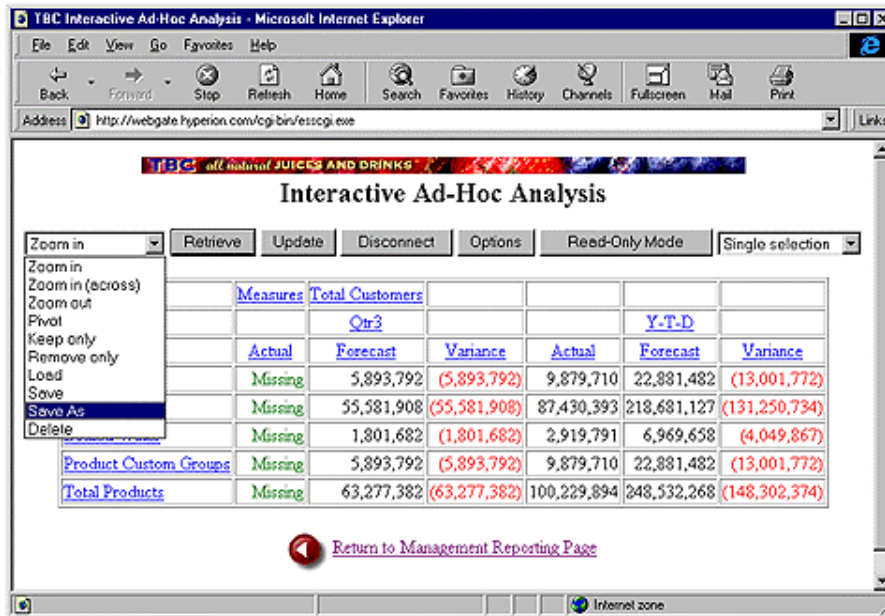


Figure 11.3 – Example of Application built using Hyperion Web Gateway

Examples of Web-Based DSS

Many Web sites have decision support for customers or suppliers. Microsoft Carpoint at URL <http://carpoint.msn.com> demonstrates both Data and Model-Driven DSS. Users can use a Compare feature to make pair-wise comparisons of car models across pre-specified attributes.

A prototype Web-based, Communications-Driven Group DSS called TCB Works was developed by Dennis and Poothari at the University of Georgia. TCBWorks is different from the "typical" discussion-oriented tools available on the Web. It is designed to enable people to interact, discuss issues, and make decisions. It can support both structured discussions and multi-criteria decision making. When a user connected to TCBWorks a login screen requested the user's name and password. Once logged on, the user started with a Project Screen. Figure 11.4 shows a Voting Screen in TCBWorks. GroupSystems and other companies are developing similar Web-Based GDSS.

The screenshot shows a Netscape browser window titled "Netscape - [TCB Works - Voting Screen]". The browser's menu bar includes File, Edit, View, Go, Bookmarks, Options, Directory, and Help. Below the menu bar is a toolbar with icons for Back, Forward, Home, Reload, Stop, Print, Find, and Mail. The main content area is titled "Voting on : Site Selection" and contains a table with the following structure:

Topics	Manufacturing Cost	Access to Transportation	Incentives
1. INSTRUCTIONS - Read Me First	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Glasgow, Scotland	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Atlanta, Georgia, U.S.A.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. Boston, Mass., USA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Taipei, Taiwan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. Hong Kong	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Newark, NJ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Montreal, Quebec, CANADA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Seoul, Korea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Munich, Germany	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Bristol, UK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Sydney, Australia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Santiago, Chile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Mexico City	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

On the left side of the table, there is a vertical column of buttons: Enter, Group, Options, Order, Help, and Exit.

Figure 11.4 – TCBWorks Voting Screen


Retirement and Investment planning is facilitated at a number of Web sites. Also, many 401 K plans are supported by Web sites. Plan participants and sponsors do the work of entering data, transferring investments and researching investments. Model-Driven DSS can show how an investment may grow over time and Suggestion DSS

provide advice. Some sites with DSS include Fidelity Investment's <http://www.401k.com>, Principal Financial group at <http://www.principal.com>, and American Express at <http://www.americanexpress.com>. The Fidelity "Retirement Planning Calculator" is a Model-Driven DSS that helps a person decide how much to invest for retirement each month. Principal Financial has an "Investor Profile Quiz" that is a Knowledge-Driven DSS.

Netscape Decision Guides are good examples of Model-Driven and Knowledge-Driven DSS. One can find more than 25 Decision Guides at URL <http://home.netscape.com/decisionguides>. Topics of guides include choosing pets, bikes and business schools.

Stockfinder at <http://stockpoint.com> has a Data-Driven DSS that helps investors identify stocks based on criteria like price, earnings and type of industry. Stockpoint also has an Investment Profile Knowledge-Driven DSS (see Figure 11.5). A user answers a short questionnaire about income constraints, personal financial goals and risk tolerance. The DSS processes the responses and provides a list of possible investments that match the person's personal goals and budget constraints. A number of Investment web sites provide their users with DSS capabilities. Document-Driven DSS provide company information from many sources, charting software lets users manipulate financial comparisons of large time series databases, and search and agent software that alert users to news, stock prices and changes in stock prices.

Location: <http://www.stockpoint.com/topnav/pages/profile.asp>



Time Horizon - This is the most important criteria for determining the appropriate type of investment vehicle. Investors with years ahead of them can afford to be more aggressive, strive for higher returns and ride out market volatility. Investors that need their money in a few years need to be more concerned with safety of principal.

1. In approximately how many years do you expect to need the money you are investing?

- Less than 1 year
- Between 1 and 3 years
- Between 3 and 10 years
- More than 10 years

Figure 11.5 – Stockpoint.com Investment Profile Knowledge-Driven DSS

Companies with Web-Based DSS

Many companies have implemented Web-Based DSS. For example, NDC Health Information Services has a Web-enabled prescription data warehouse that it markets to pharmaceutical manufacturers. Universities are also making data available to stakeholders at Web sites. A number of DSS software companies provide case

studies of successful Data-Driven DSS implementations at their Web sites. All of the Vendors are reporting favorable results from Web-Based DSS.

According to Arborsoft and Hyperion materials, Bell Canada implemented a Web-Based DSS. A Bell Canada spokesperson said, "... the cost of deploying traditional client/server OLAP software makes it prohibitively expensive to enable the entire enterprise for OLAP ... The Web dramatically alters the cost dynamics of delivering applications to users." He notes, "All users need are a Web browser and a laptop computer. There's almost no training required, very low client costs and zero infrastructure costs. The internet acts as a free wide area network."

Bell Canada installed the Essbase Web Gateway. Arborsoft says, "hundreds of business, operation and sales managers will be able to compose their own interactive queries right from their Web browser rather than accessing static data reports prepared by financial analysts. They can navigate, analyze and even update their sales forecasts without the need for proprietary client software."

John Deere is using Information Discovery to harvest accurate sales forecasts. Their system is web-browser based and it allows users to instantly access historical data and forecast for the future. The system has allowed John Deere to better forecast tractor sales for different times of the year because the Data Mining system allows more of John Deere's data to be used. This lowers Deere's inventory and marketing costs and allows Deere to better plan sales.

In January 1998, Information Advantage announced that EDS had chosen DecisionSuite and WebOLAP(tm) to support implementation of the EDS knowledge management strategy. "EDS is rolling out DecisionSuite to several hundred users performing on-line analyses on a 50 GB database. 1998 deployment could scale up to 9000 knowledge worker desktops." Larry Ford, president and CEO of Information Advantage said in the press release, "The Web enables multinational organizations, like EDS, to provide applications that deliver content to the end-user without the traditional, costly barriers of installation, training and maintenance."

Hannaford Brothers Grocery chain developed a DSS using Microstrategy's DSS Web. At Hannaford, DSS Web provides store managers with access to the same data warehouse application relied upon by corporate decision makers. Utilizing DSS Web, managers receive detailed sales, cost, inventory, and budget reports and use this information to make decisions at the store level.

According to a MicroStrategy case study, Societe Generale USA chose a multi-tier architecture that enabled the support of both client server and Web computing. MicroStrategy software enabled Societe Generale USA to provide support for executive and power users, running on either PCs or UNIX workstations and provided a web browser interface.

Advantages and Disadvantages of Web-Based DSS

Web-Based DSS have reduced technological barriers and made it easier and less costly to make decision-relevant information available to managers and staff users in geographically distributed locations. Because of the World-Wide Web infrastructure, Enterprise-Wide DSS can now be implemented in geographically dispersed

companies and to geographically dispersed stakeholders including suppliers and customers at a relatively low cost. Using Web-Based DSS, organizations can provide DSS capability to managers over an intranet, to customers and suppliers over an extranet or to any stakeholder over the global Internet.

The Web has increased access to DSS and it should increase the use of a well-designed DSS in a company. Using a Web infrastructure for building DSS improves the rapid dissemination of "best practices" analysis and decision making frameworks and it should promote more consistent decision making on repetitive decision tasks across a geographically distributed organization. The Web also provides a way to manage a company's knowledge repository and to bring knowledge resources into the decision making process. One can hope that Web-Based delivery of DSS capabilities will promote and encourage ongoing improvements in decision making processes.

Also, the Web can reduce some of the problems associated with the competing "thick client" enterprise-wide DSS design where special software needs to be installed on a manager's computer. Web-Based DSS should reduce IT management and support costs and end user training costs.

With many Web-Based DSS and OLAP products, managers with a browser and access to a Web-Based DSS have the same type of ad-hoc reporting and interactive data analysis capability as that provided by "thick client" on-line analytical processing (OLAP) tools. Web technology is and will continue to change the way organizations deliver all types of documents and data.

What are the potential problems with Web-Based DSS? First, user expectations may be unrealistic, especially in terms of how much information they want to be able to access from the Web. Second, there may be technical implementation problems especially in terms of peak demand and load problems. Third, it is costly to train decision support content providers and to provide them with tools and technical assistance. Fourth, the continuing "browser wars" between Microsoft and Netscape are also a potential problem. Fifth, Web-Based DSS create additional security concerns. Finally, using the Web for decision support may result in the accumulation of obsolete materials, especially management reports and documents.

Conclusions about Web-Based and Inter-Organizational DSS

The World-Wide Web has created a major opportunity to deliver more quantitative and qualitative information to decision-makers. A Web architecture and networks permit Information Systems professionals to centralize and control information and yet easily distribute it in a timely manner to managers who need it. Also, intranets are providing many opportunities for securely delivering information from data warehouses and external databases to a manager's desktop in a format that permits and encourages frequent use and follow-on analysis.

The Web has not resolved all problems associated with building, developing and delivering Enterprise-Wide DSS and many questions about Web-Based DSS remain controversial. The following questions are still being debated, but I'll share my opinions. Can a Web-Based DSS provide a company with a competitive advantage? **SOMETIMES**, especially in knowledge-oriented businesses. Does a Web-Based DSS have significant cost advantages compared to other competing DSS

technologies? **USUALLY**, especially in large-scale implementations where companies have multiple sites. Will a Web-Based DSS speed application deployment and increase access to both structured and unstructured data? **YES**, in most situations.

Will a Web-Based DSS improve decision-making? **PERHAPS**, I'm an optimist. Will Web-Based DSS provide a broader knowledge base for decision-making? **YES**, in most cases once the "knowledge" is on-line. Does Web access increase the value of a data warehouse? **YES**, if the data is meaningfully displayed and drill-down is available to decision makers.

Does a Web-Based DSS provide timely, user-friendly and secure distribution of business information? **YES**, if a good development product is selected and if the implementation is successful. Can a Web-Based Decision Support System be managed and maintained? **YES**, the tools for managing the Web server and Web content are maturing. Will information on a Company Web site expand in an uncontrolled manner? **NO**, not if a person manages the knowledge base. Will managers be able to locate what they need when they need it? **PROBABLY**, staff need to organize information in meaningful ways and search engines need to be available for unexpected information queries.

Does a Web-Based DSS help mobile managers, sales staff and customer support staff? **YES**, information access and analysis is much easier and more widely available. Does a Web-Based, Inter-Organizational DSS help customers and suppliers? **YES**, customers and suppliers can make better choices. Are Web-Based agents and alerts useful and practical? **YES**, if you understand what they are and how to use them. An alert or agent can help a busy manager stay informed about more key performance indicators.

The Web makes it possible to deploy a global Enterprise-Wide DSS. Will Web-Based DSS facilitate corporate growth? Improve productivity? and Improve profitability? **YES**, appropriately designed DSS can impact the corporate bottom-line.

Along with the Web-Based opportunities for building innovative DSS come new challenges. Managers must choose which Web technologies to use and decide how to deploy these new technologies. Also, managers must learn how to use Web and Internet technologies to really gain a competitive advantage. This means that to implement Web-Based and Inter-Organizational DSS we need to develop appropriate strategies and organizational structures, redesign business processes, integrate the technologies and associated information into decision-making processes, evaluate costs and benefits, and manage new types of business relationships.

The Web is the platform of choice and the new frontier for innovative Decision Support Systems. All of the Web DSS development environments have strengths and weaknesses, but the capabilities are increasing rapidly and the Web DSS user interfaces are impressive compared to those of only a few years ago. The concept of a Web portal provides a means to implement the different generic DSS into more complete management support systems than any built in mainframe or client/server environments. Decision Support Systems built using Web technologies will take on a new importance as accessible and useful tools for improving business decisions.

Audit Questions

1. Does your firm have an Intranet? An Extranet?
2. Has your firm deployed any Web-Based DSS?
3. What group is responsible for Web technologies? MIS? Public Relations?
4. What are your firm's plans for Web-Based DSS?
5. Have you used any Web-Based DSS?

Questions for Review

1. What are definitions of key terms? What is a Web-Based DSS?
2. What is an example of a Web-Based DSS?
3. What is a Common Gateway Interface script? What is JavaScript?
4. What factors have led to the increase in Inter-Organizational systems?
5. What issues should managers consider when deciding if their company should build a Web-Based DSS?
6. What benefits does a Web-Based DSS provide a company?
7. What is an inter-organizational DSS?
8. What are the potential problems with Web-Based DSS?

Questions for Further Discussion

1. What vendors have the "best" Web-Based DSS products?
2. What are the effects of an Inter-Organizational DSS on consumers?
3. What problem(s) are companies trying to solve by implementing an Intranet?
4. How can Web-Based DSS and an Intranet be used to assist in organization and management tasks?
5. What role should managers play in developing Web-Based DSS?
6. Should managers be "content" providers for Web-Based DSS?
7. How do Web-Based DSS extend "information reach" and "information range"?

JavaScript Decision Aid Exercise



You have been asked to evaluate a Data Mart project. The initial cost of the Data Mart is \$50,000 with indirect costs of \$25,000. In year 2 of the project analysts estimate direct benefits of only \$5,000, but indirect benefits of \$10,000. In years 2 and 3 the project will involve \$10,000 each year direct and indirect costs. The benefits of the projects won't really start to be realized until year 3 when \$10,000 in direct benefits and \$20,000 in indirect benefits will result. Additional indirect benefits will result in year 4 (\$20,000), year 5 (\$20,000), year 6 (\$20,000), and year 7 (\$10,000). What is your evaluation of this proposed project? What is your recommendation? Use the JavaScript decision aids at DSSResources.COM. They can be found at <http://dssresources.com/decisionaids/>. You may want to try the following decision aids:

- Cost/Benefit Analysis (shown in Figure 11.6)
- DSS Project Evaluator
- Multi-Factor Evaluator

Location: <http://dssresources.com/decisionaids/cbanalysis.html>

Cost/Benefit Analysis

This Cost/Benefit Analysis Decision Aid is based on a common financial decision model for evaluating projects or proposals. Enter annual costs and benefits and then click **Calculate**. The results are then displayed. Use this decision support tool to test different sets of assumptions and to see results change. Check an [example problem](#).

Discount Rate %  

	Direct Costs	Indirect Costs	Direct Benefits	Indirect Benefits
Year 1	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>
Year 2	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>
Year 3	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>
Year 4	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>
Year 5	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>

Figure 11.6 - Cost/Benefit Analysis

JavaScript DSS Programming Exercise

Develop a simple Web-Based DSS that converts from Fahrenheit temperatures to Centigrade temperatures. The formula for converting from Fahrenheit to Centigrade is $\text{Centigrade Temperature} = 5/9 (\text{Fahrenheit Temperature} - 32)$. Use form tags to create input and output fields. Then, write the JavaScript program and include it on your web page. Title the page “Temperature Converter”. In the head of the HTML page, include this JavaScript code.

```
<script language="JavaScript">
function convert() {
var f = eval(document.form.fahrenheit.value);
var c = 5/9*(f-32);
document.form.centigrade.value=c;
}
</script>
```

JavaScript is very sensitive to returns and formatting. Be careful that you include all of the code. Create the form in the body of your HTML page and include a heading for the temperature converter. Use the following code. If you change variable names, make sure they correspond to the names in the JavaScript program.

```
<form method="post" name="form">
Fahrenheit Temperature: <input type="text" name="fahrenheit" size="5"><p>
Centigrade Temperature: <input type="text" name="centigrade" size="5"><p>
<input type="button" onClick="convert()" value="Submit">
</form>
```

OnClick calls the function convert(). The parentheses tell JavaScript that you are calling the function. We use the document object model in the function to read the data and to output it.

The HTML page should look something like Figure 11.7:

Temperature Converter

Fahrenheit Temperature:

Centigrade Temperature:

Figure 11.7 – Screen Shot of Temperature Converter

Examples of Web-Based DSS

AlphaBlox at URL <http://www.alphablox.com/>. Check screens of the product AlphaBlox Enlighten.

Comshare at URL <http://www.comshare.com/>. Check for Web-Based products.

Cow Culling Decision Support System at the University of Arizona, URL <http://ag.arizona.edu/AREC/cull/culling.html>.

DSSResources.COM Decision Aids at <http://dssresources.com/decisionaids/>.

InterNetivity, Inc. has a product called dbProbe 4.11 and a product called databeacon. dbProbe is a cross-platform, corporate-wide tool written in Java for sales analysis, statistical analysis, financial analysis, inventory analysis, or any other application, such as a data warehouse, that requires multidimensional data analysis. Check the examples of Small Appliance Sales PageCube and Billing Analysis at http://internetivity.com/Demos_Downloads/demos_downloads_generic.html.

Microsoft Carpoint at URL <http://carpoint.msn.com>.

Netscape Decision Guides at URL <http://home.netscape.com/decisionguides>.

Stockfinder at <http://stockpoint.com> has a number of DSS.

WATERSHEDSS (WATER, Soil, and Hydro- Environmental Decision Support System) at URL <http://h2osparc.wq.ncsu.edu/>, is used to help watershed managers and land treatment personnel identify their water quality problems and select appropriate best management practices.

SimScope: An Inter-Organizational, Web-Based DSS

Artesyn Technologies (www.artesyn.com) has a series of virtual design tools intended to provide both existing and prospective customers of its power supply products with pre-sales technical support.

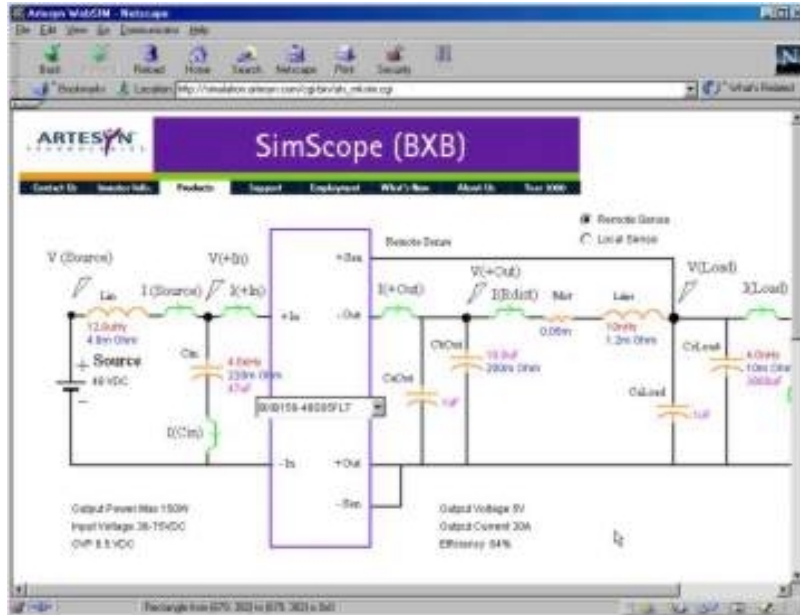


Figure 11.8 - Screen Shot of SimScope

SimScope is the first simulation tool in Artesyn's Virtual PowerLab strategy. SimScope was developed to provide design engineers with a substantially higher level of technical support than was previously available. A number of observers believe that by offering a convenient tool configured for Artesyn's power supply products the company is increasing the likelihood of gaining and retaining customers.

Web-Based design tools presents several issues that must be evaluated by power supply vendors, customers and design engineers. For example, Web-Based simulation tools can influence a power supply vendor's costs of acquiring customers and providing technical support, and the tools can differentiate a vendor's products, giving the company a competitive advantage. Products such as SimScope may also increase the efficiency of OEM product testing during the design stage.

Industry observers expect that the development of Web-Based test simulations will prompt power supply vendors to reevaluate their existing customer-based sales and marketing strategies.

Questions:

1. Who is the target user of SimScope?
2. What type of Web-Based DSS is SimScope?
3. Can Web-Based DSS provide Artesyn a competitive advantage?

References

- Abrams, Marc.(editor), *World Wide Web - Beyond the Basics*, Prentice Hall, 1998.
- Applegate, L., F. W. McFarlan and J. L. McKenney. *Corporate Information Systems Management*. Chicago: Irwin, 1996.
- Gates, Bill with Nathan Myhrvold. *The Road Ahead*. Penguin USA, November 1996.
- Girishankar, S. "On Site with Deere & Co: Of Web And Mainframes", **CommunicationsWeek Interactive**, August 1996, URL <http://pubs.cmpnet.com/cw/081996/624impact.htm>.
- Keen, P. G. W. *Shaping the Future: Business Design Through Information Technology*. Boston, MA: Harvard Business School Press, 1991.
- Kirkner, Bill, et al. *Running a Perfect Netscape Site*. Indianapolis, IN: Que, 1996.
- Negrino, Tom, and Dori Smith. *JavaScript for the World Wide Web*. Berkeley, CA: Peachpit Press, 1999.
- Power, D. J. "Web-Based Decision Support Systems", Part I and II. DS*, The On-Line Executive Journal for Data-Intensive Decision Support, August 18 and 25, 1998: Vol. 2, Nos. 33 and 34.
- Power, D. J. "Web-Based and Model-Driven Decision Support Systems: Concepts and Issues". Proceeding of Americas Conference on Information Systems, Long Beach, CA, August 10 - 13, 2000, "Model-Driven and Web-Based Decision Support Systems" Mini Track. (URL <http://dssresources.com/papers/amcis/TT08overview.pdf>)
- Tapscott, D., "How are Internet Technologies changing industries?", **USA TODAY**, 11/17/98 at URL <http://www.usatoday.com/life/cyber/bonus/1198/cb004.htm>.

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