S.J.I.T.N
Saba Journal of
Information Technology
and Networking

REVIEW STUDY

WEB DECISION SUPPORT SYSTEMS: TECHNOLOGIES, MODELS, AND SECURITY

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Abstract

New technologies, especially the world-wide web technologies, have created many opportunities for effective Decision Support Systems. Web- based DSS provides an efficient tool that helps users find information resources available as an online service within an Intranet.

This paper reviews key topics which concentrate on technical issues of Web Decision Support Systems (DSS) research. It highlights the potential results from various papers and researches on Web-Based Decision support system. Our aim is to focus on Web-based Decision Support System definition, architectures and technologies, models and implementations, and Security.

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A decision support system (DSS) is a computer program application that explores and analyzes many sources of related data and presents it so that users can make decisions more easily. The main challenge of Decision Support Systems is to improve the quality of decision-making and the performance of decision makers [1]. The advances in computer technologies have impacted everybody's daily life as computers support and assisted almost every single human activity. Traditional decision support systems (DSS) focus on computerized support decisions with respect to managerial problems [2]. Web-Based DSS take advantage over traditional DSS, where it makes use of widespread Web technologies to distribute the decision making process among a various group of geographically dispersed end- users, many traditional DSS implementations were controlled by localized client/server systems [1]. Researches in the decision sciences have resulted in the development of a variety of Decision Support Systems (DSS) that are useful in solving many decision problems faced by individuals and organizations. It is now possible to access these DSS using the Internet. However, it is often difficult for individuals and organizations to locate specific DSS that could benefit them. Nowadays, the Internet provides access to thousands of gigabytes of information, with more information being added every day [3].

Theoretical Background

The Decision making process starts with the intelligence phase, where, potential problems and/or opportunities are identified and defined. In the design stage, alternative solutions to the problem are developed. In the choice stage, a specific action is chosen. In the implementation stage, action is taken to put the solution into effect. In the monitoring stage, the implementation of the solution is evaluated to determine if the expected results were achieved and it modifies the process.

DSS applications can be composed of the following subsystems [4]: (1) Data Management subsystem: The database management subsystem includes a database, which contains relevant data for the situation and is managed by software called, the database management system (DBMS). The database management subsystem can be interconnected with the corporate data warehouse, a repository for corporate relevant decision-making data. (2) Model Management subsystem: The model base gives decision makers access to a variety of models and assists them in decision making. The model base can include the model base management software (MBMS) that coordinates the use of models in a DSS. (3) Knowledge-based Management subsystem: This subsystem can support any of the other subsystems or act as an independent component. It provides intelligence to augment the decision maker's own. It can be interconnected with the organization's knowledge repository, which is called the organizational knowledge base. (4) User Interface subsystem: it allows users to interact with the DSS to obtain information. The user interface requires two capabilities; the action language that tells the DSS what is required and passes the data to the DSS

and the presentation language that transfers and presents the user's results. The DSS generator acts as a buffer between the user and the other DSS components, interacting with the database, the model base and the user interface.

Literature Review

Tripathi [4] attempted in his paper to highlight the decision support system as a tool for making the better decisions in the organization. The researcher has proposed the study with respect to Birla Corporation Limited. **Tripathi** studied the "Attendance Recording System (ARS)" at Birla Corporation Limited. The main objective of Attendance Recording System is to ensure that the attendance of employees is accurately recorded and reported for computation of payable days, overtime hours, festival allowances, payable assistance etc. This automated system helps managers and employees to save their time and improve their work. By eliminating manual record keepings, it reduces errors, avoiding arguments. The DSS (designed in this study for Attendance Capturing & Recording for Birla Corporation Limited) mainly generates the reports like Daily Attendance, Monthly Attendance, Sick Reports, etc. The top management, by receiving these reports, can analyze and make decisions regarding shifting the priority of the job, also the observance of performance and corrective measures are taken. The author came up with that DSS, developed specifically to help managers to keep control on the staff's work at various levels. The Reports generated are as per the format which will help top

management to make decision concerned with human resources in attendance recording and capturing, which is one of the basic needs of any organization. The Decision Support System is required for managerial report generation specialized tools; software and procedures are used to develop DSS in the organizations.

Valentin, et al. **[5]** presented in their paper an original model of an information system for decision making, which is able to provide reliable management solutions in various fields. They presented some overviews of the proposed decision support system and then exposed three cases where it has been successfully applied: two applications in university management and one in urban planning. Their proposed model has shown that the decision support system allows the decision maker to choose the best alternative out of a set of possible interventions, based on a group of custom-defined criteria. The developed algorithm requires good mathematical abilities from the user, and this can therefore limit the real-life applicability of the proposed decision support system. In order to make it easier for the users to use the DSS and increase the number of potential users, the DSS was implemented online with a user-friendly interface.

The purpose of their approach is to offer a set of tools to the decision makers by leaving the computational part to the server. It allows users to concentrate on planning issues rather than having to understand the formulae that lie behind the algorithm. The results of this paper; which are obtained using the proposed information system in

the three cases presented in the paper, show its high flexibility and the usefulness of information systems for management.

Yao [2] viewed Web-based Support Systems (WSS) as a multidisciplinary research area that focuses on supporting human activities in specific domains or fields based on computer science, information technology, and Web technology. His paper presented the fundamental issues of WSS, a framework of WSS, and research on WSS. He also presented preliminary studies on two examples of WSS, Web-based research support systems (WRSS) and Web-based information retrieval support systems (WIRSS). **Yao** concluded his paper that emerging interdisciplinary study of Web-based support systems is motivated by the challenges and opportunities of the Web. He indicated that the research of Web based support systems is a natural growth and extension of existing research. The evolution of the application dimension is the extension of decision support systems to computerized support systems. With the emergence of Web technology and Web intelligence, various Web-based support systems are extended from a single machine to a single user computerized support system. Finally he showed that there are four types of existing research, namely, WSS for specific domains, Web-based applications, techniques that are related to WSS and design, and the development of WSS that can be classified as WSS research.

Shim et al. [6] discussed the evolution of DSS technologies and issues related to DSS definition, application, and impact. They presented four

powerful decision support tools, including data warehouses, OLAP, data mining, and Web-based DSS.

Issues in the field of collaborative support systems and virtual teams are presented. The authors also described the state of the art of optimization-based decision support and active decision support for the next millennium. Finally, some implications for the future of the field are discussed. They arrived to the fact that a standard Web browser can be used as the user interface/dialog, that means that companies can introduce new DSS technologies at their sites at a relatively low cost when compared to client-based DSS. Only a little user training is required with Web browser user interface at implementation of DSS technology

Chien-Chih [7] due to the rapid advancement of electronic commerce and web technologies in recent years, the concepts and applications of decision support systems have been extended a lot. One quickly emerging research topic is the consumer-oriented decision support system that provides functional supports to consumers for efficiently and effectively making personalized decisions. **Chien-Chih** presented an integrated framework for developing web based consumer-oriented intelligent decision support systems to facilitate all phases of consumer decision-making process in business-to-consumer e-services applications. His paper resulted that through using the consumer-oriented intelligent decision support system (CIDSS), all phases of the consumer decision-making process can be supported, and in addition, serving consumers with great satisfaction

may eventually lead to continuing consumer relationships as well as add values and assets to the entire value chain. He argued that major application functional modules involved in the system framework include consumer and personalized management, navigation and search, evaluation and selection, planning and design, community and collaboration management, auction and negotiation, transactions and payments, quality and feedback control, as well as communications and information distributions.

Rosso et al. **[1]** discussed the DSS Capabilities Deliverable over Web. Web-based DSS can deliver a huge number of decision support platforms. Among these are Data-Driven DSS, Model-Driven DSS, Optimization DSS, Communication-Driven DSS and Knowledge-Driven DSS. The two most common of these are Data-Driven and Model-Driven. Data-Driven DSS refer to a DSS system that allows the access to and manipulation of data. Their report has sought to outline the usability of the Web and the unique enabling technologies that power the Internet. They reported that, there are many benefits of web-delivered DSS tools, like reduced costs, universally accepted communications infrastructures and ease of use. That has established Web-Based DSS as the preferred platform for the delivery of information to facilitate effective decision-making. In the same time they reported that security is still an important concern.

Okleshen et al. **[8]** their paper highlights the potential of Customer Decision Support Systems (CDSS) to assist students in education-related decision making. These resources can be employed by faculty to effectively advice students more on various elements of college life. In the same time students can use them to participate more actively in their own learning and improve their academic experience. The authors also summarize consumer decision support systems (CDSS), concepts and benefits. Students can make use of these websites to support their education-related decision making. The authors discuss the potential benefits and drawbacks such resources create from a student perspective and conclude with directions for future research.

The benefits of CDSS that provide insights into consumer choice processes, increase customer loyalty, and reduce marketing costs. In addition, if the faculty recommends such systems to students, it is more likely they will generate greater student satisfaction and confidence with the advising experience (i.e., service encounter) and the decisions that ensue. On the other hand, their disadvantages include high costs, slow inquiry response time, and the difficulties posed by mediated learning formats, as well as ethical issues. They ended their paper is to illustrate the potentially valuable role of customer decision support systems may perform in assisting students with education-related decision making. Professors and personnel at all institutional levels can use these resources to advise students within all areas of college life, while students can refer to them individually when facing specific challenges.

Gregg et al. [3] inducted in their paper that the explosion of information on the World Wide Web

(WWW) and on corporate Intranets has made it increasingly important to have methods of organizing and understanding the available content. Their paper focuses on verifying a metadata model designed for distributing decision support systems (DSS) over the Web.

Metadata is one method that is being used to facilitate both, the location of specific Web content and the assessment of its quality. It is the information about the structure and content of a data resource and it allows businesses and consumers to locate appropriate resources and judge their power.

Web-based Decision Support System Definition

Decision Support Systems can be defined as computer technology solutions that can be used to support complex decision making and problem solving [9]. A DSS is defined as a system that "assists management decision making by combining complicated analytical models and tools, and user-friendly software into a single powerful system that can support semi-structured or unstructured decision making"[8]. One of the most significant advancements of Web-Based DSS, in contrast to traditional DSS implementations, is the ability of ordinary customers and "casual users" to make use of information generated by these tools [1].

Some of the most significant weaknesses of traditional DSS systems include the high cost involved in the implementation and maintenance, and a dependence "on expensive IS resources for wide-spread use." Web-Based DSS goes a long way in eliminating these concerns.

Global access to Internet resources, the well-known and user- friendly browser interface, and the relatively low costs involved in implementation make Web-Based DSS a step closer to the ideal of paperless e-business management [1]. Web-based systems are regarded as "platforms of choice" for delivering decision support while taking into account many technical, economic and social considerations [9].

Architectures and technologies

Beginning in the early 1990s, four powerful tools emerged for building DSS. The first new tool for decision support was the data warehouse. The two new tools that emerged following the introduction of data warehouses were On-Line Analytical Processing (OLAP) and Data Mining. The fourth new tool set is the technology associated with the World Wide Web [6].

A Web-based DSS uses the Web as a portal to the underlying DSS. It lets users access and make use of the underlying DSS through the Web [9]. Web technologies have provided a new media for sharing information about decision support and a new means of delivering decision support capabilities. For DSS developer, the big leap forward is to use the "web as computer" [10]. A number of enabling technologies have evolved in just the last ten years. That facilitated the distribution of DSS services over the Web. Among these is the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of Internet standards [1].

Models and implementations

As decision making moves from an individual activity toward a group activity, many organizations are creating ''virtual teams'' of geographically distributed knowledge workers to collaborate on a variety of workplace tasks [6]. Distributed implementation of the underlying DSS is important for a Web-based DSS and presents a challenge, which needs the combination of a DSS with distributed computing technology [9]. E-commerce makes use of the decision support system. It plays an important role on its application. The benefits of using a decision support system in e-commerce adoption includes improved customer service, better inventory control, and lower marketing and distribution costs, reduced cycle time, increased market reach, and reduced operation costs [11]. Metadata Model is the description of the structure of the database in database environment. It is used to describe the structure of the files, the type and storage format of the data, and the constraints on the data. Metadata are used in the Web environment to identify the content and quality of Web pages. The Open DSS protocol metadata model currently includes functional attributes related to the problem domain of the DSS, the solution options, the inputs, the outputs, and the assumptions made. The Open DSS metadata model also includes metadata on the resources required to execute the DSS. Information on the hardware requirements (e.g., computing platform), software requirements (e.g., operating system or application needs), and any specific user skills required to use the DSS are all included. Finally, the metadata model contains all other information necessary to purchase and download the DSS. This includes information on the DSS's cost, its references, related DSS, and source/author information [3].

Security

There are three main security items to keep in mind when selecting a Web tool that permits access to crucial data: First, it should be compatible with your existing firewall and encryption layers. Second, it should use caching wisely in a security-conscious manner; and finally, it should manage passwords for optimal safety and convenience [1]. There are at least four systems that perform some or all of the web-based DSS. The four systems are Joint Protection Enterprise Network (JPEN), Joint Warning and Reporting Network (JWARN), Area Security Operations Command and Control (ASOCC), and Protect, Respond, Inform, Secure, and Monitor (PRISM). A description, overview, and summary of each system's capabilities will follow [12].

Conclusion

By reviewing various papers and researches on the Web-based Decision Support Systems, we can conclude that the web is where the DSS action is today. It is obvious and clear that DSS provides valuable information required for making effective and efficient decisions where it cannot be ensued without the information pool such as the Internet. Also World-Wide Web technologies have rapidly transformed the entire design, development and implementation process for all types of

Decision Support Systems. This new environment allows individuals and organizations to make more informed, more collaborative decisions that will help achieve the organization's goals more effectively. The developments in the last decade will guide us in understanding the coming growth of decision support technologies. The implementation environment users are becoming more sophisticated and more demanding, and organizations are becoming more complex. These are some of the future challenges which have to be deeply researched and investigated. Finally the computer science and web technology will not stop at any point, they will both continue to grow up and develop new inventions constantly.

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