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ABSTRACT

Web technology has enabled an efficient way of providing and exchanging applications for Decision Support Systems (DSS). Online technology has become the foundation for the design of the web based DSS and the operation development center of DSS. The Web-based DSS is a powerful method which can help users to identify data and accessible services as an online service on the Intranet. The Web-based DSS consists of a computerized framework which, through the web browser, provides users with decision support information or resources. The aim is to provide fast and inexpensive access to data, information and expertise available around the world, along with the ability in order to collaborate effectively with remote partners in decision support systems. Speedy processes, improved communication and teamwork, distributed computation, improved group members' efficiency, improved data management and data warehouse management in decision making systems and providing remote control are some targets of the web-based DDS. In this study, recent achievements and application of the Web-based DDS in the different field are reviewed to suggest new ideas in the research filed. As a result, the research filed can be moved forward.

Keywords: Decision Support Systems, Web-Based, Data Network

Mathematics Subject Classification: 90B50, 91B06

Computing Classification System: H.4.2

1. INTRODUCTION

Decision making in today's complex world has become a challenge for managers and organizations. The number of decision indicators, the variety of criteria for quantitative and qualitative decision methods and the need to consider them simultaneously, the importance of the effects and consequences of the decision and factors such as it add to the complexity of decisions. When considering several different ways to achieve a goal, we must consider the interrelationships that exist between them when considering these paths, as the increase or decrease of one factor may affect other factors. Therefore, especially in the last two decades, mathematical methods and computer science have helped them to solve decision problems and have created multi-criteria decision

techniques and techniques and decision support systems. The Web-based DSS is a powerful method which can help users to identify data and accessible services as an online service on the Intranet. There is no doubt that the issue of choice dates back to human history. Therefore, decision-making processes to choose the right alternatives from the available options are an integral part of rational processes in human daily life. Moreover, today, with the explosive development of communication technologies and, consequently, the increasing growth of access to information, and as a result, faced with various options and selection criteria, decision-making processes have become more complex.
The Decision Support System (DSS) provides a range of skills to identify and evaluate decision-making problems in the field of information and management systems. As a DSS technology with its limits and boundaries, it is connected with artificial, specialist and management information systems (Khalil, Dominic, and Hassan 2010). The key aim of a modem DSS is to efficiently gather vast volumes of decision-making meta-data and provide assistance to decision-makers to assess the value of data that can aid in the decision-making process (Adla, SOUBIE, and ZARATE 2006).

The steps for solving a decision problem are as follows 1. Intelligence-defining the issue or chance of happening, 2. Design-Construction of models or DSS or potential alternatives, 3. Selection-Examination of alternative options, 4. Implementation-placing the option into action, 5. Review-Re-Assessment of the Framework (Turban 1988).

When choosing an option from multiple options, decision makers often consider several criteria at the same time. Criteria are sometimes aligned and sometimes reciprocal. Classic models of operations research such as linear programming, integer programming, nonlinear programming, and the like are decision models that perform optimization based on only one criterion. Therefore, these models are classified as one-objective models. The chosen goal of such models is generally the first and most important goal and other goals are forgotten in the shadow of this goal (Cakir and Canbolat 2008).

Web technology has enabled an efficient way of providing and exchanging applications for decision support systems. Online technology has become the foundation for the design of the DSS decision support system and the DSS operation development center. The Web-based DSS consists of a computerized framework which, through the web browser, provides users with decision support information or resources. Architecture of Web-based DSS is shown in the Figure 1 (Alves, da Silva, and Varela 2013).

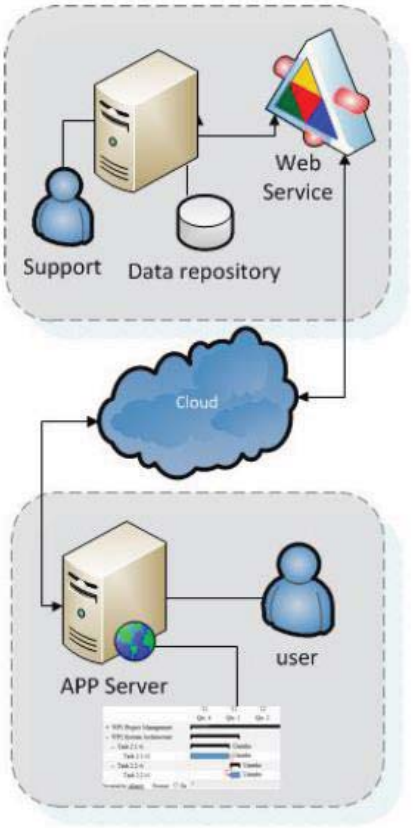

Fig. 1. Architecture of Web-based DSS (Alves, da Silva, and Varela 2013).

The Web-enabled DSS is shown in the Figure 2.

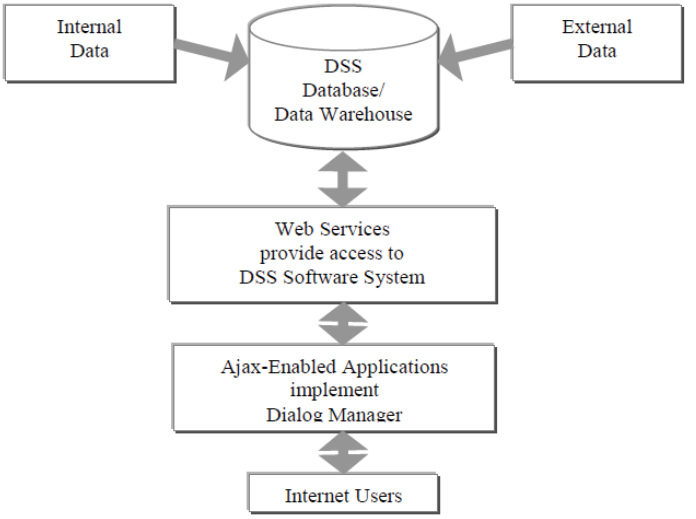

Fig. 2. Web-enabled DSS (Boreisha and Myronovych 2008).

Application of the Secure Socket Layer in the Network and Web Security is investigated by Dastres and Soori (Dastres and Soori 2020b) to increase the security measures in the web of data. The impact of meltdown hole on various processors and operating systems are studied by Dastres and Soori (Dastres and Soori 2020a) in order to increase security of CPU manufacture by preventing the capturing data on computer or smartphones by attackers. A review in recent development of network threat and security measures is presented by Dastres and Soori (Dastres and Soori 2021b) to classify the presented research works and suggest some future research trends. Advanced image processing systems is reviewed by Dastres and Soori (Dastres and Soori 2021a) to introduce new techniques in the image processing systems.

Web-based DSS uses a thin-client" web browser such as Netscape Navigator or Internet Explorer that accesses the Global Internet or a company intranet to provide decision support information or decision support resources for a manager or business analyst. A network with a TCP/IP protocol connects the computer server hosting the DSS program to the user's computer. Web-based means that Web applications are used to execute the whole program; Web-enabled means that key aspects of an application, such as a database, exist on a legacy infrastructure, but the application can be accessed and viewed in a browser from a Web-based component.

2. LITERATURE REVIEW

Natural resources and their management are fundamentally complex due to the dynamic equilibrium and interactions among coexisting biotic agents and their abiotic environments within an ecosystem. For research on complex ecosystems, computer models have long been used, providing the basis for an integrated system approach to management planning and implementation guidance (Mohtar and Zhai 2007). Ghobadi and Kaboli (Ghobadi and Kaboli 2020) presented application of the web based DDS to the flood management systems in order to minimize the flood damage in the natural disasters. To use form the knowledge of different scientist around the word, application of the web-based DDS in the soil and water assessment is investigated by McDonald et al. (McDonald et al. 2019). To decrease the damage level of flood in natural disasters, application of web-based DDS in forecasting the flood is presented by Wang and Cheng (Wang and Cheng 2007). To manage the large international rivers in the risk of flood damages, application of the web based DDS is presented by Salewicz and Nakayama (Salewicz and Nakayama 2004).

The optimal management of construction as well as demotion waste in the construction engineering is obtained using the web-based DDS system in the study of Banias et al. (Banias et al. 2011) to decrease the environmental pollution in the waste management system. To decrease the waste materials in production process application of the web-based DDS systems is developed by Chen (Chen 2009). To provide an accurate plan of waste material management systems in the environmental care process, the developed web-based DDS systems is presented by et al. Sugumaran (Sugumaran, Meyer, and Davis 2004). To decrease environmental pollution due to the waste lube oils, application of the web-based DDS systems is developed by Repoussis et al. (Repoussis et al. 2009).

To obtain the solution of multiple objective problems such as wireless sensor networks of production systems, advanced web based DDS is presented by Kirilov et al. (Kirilov, Guliashki, and Staykov 2019). To select the best material supplier in the manufacturing systems, advanced web based DDS is presented by Utomo and Pratikto (Utomo and Pratikto 2020).

In order to help with integrated pest management, crop nutrition, and other forms of knowledge transfer, web based DSS are commonly used. It is therefore desirable to develop highly portable and especially web-based DSSs that can easily be adapted to new environments in view of the globalization of agriculture (Kuflik et al. 2007). Application of web-based DDS in the food and agriculture products is presented by Molitor et al. (Molitor et al. 2016) in order to increase add value in food production process. A web-based decision support system to estimate extended withdrawal intervals is presented by Gehring et al. (Gehring et al. 2004) to prevent drug residues in food of animal origin that are potentially harmful to consumers. A web-based decision support system to enhance IPM programs in Washington tree fruit is presented by Jones et al. (Jones et al. 2010) to increase added values in food production process. To manage the water resources in the Irrigation of agriculture process, application of the web based DDS is presented by Li et al. (Li et al. 2018). Development of a prototype web-based decision support system for watershed management systems by utilizing cloud computing technology is presented by Zhang et al. (Zhang, Chen, and Yao 2015) to increase efficiency in process of watershed management systems. The Main interface of developed DSS in watershed management systems in the study is shown in the Figure 3 (Zhang, Chen, and Yao 2015).

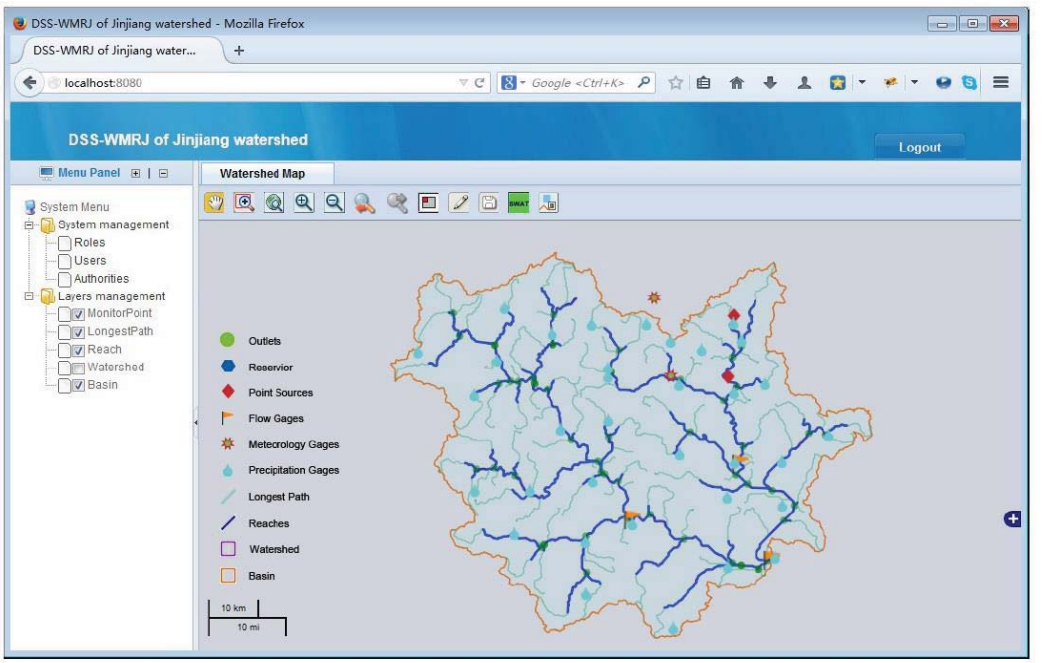

Fig. 3. The Main interface of developed DSS in watershed management systems (Zhang, Chen, and Yao 2015).

Application of the Web-based DDS in the weather forecasting of the agriculture process is investigated by Soyemi et al. (Soyemi and Adesi 2018) to increase productivity in harvesting process. The risk level for long production of rice is analyzed by using the web-based DDS in the presented study of Mukhlash et al. (Mukhlash, Maulidiyah, and Setiyono 2017) to provide developed DDS in the food production process. Development of a web-based decision support system for crop managers is presented by Fernandez and Trolingerto (Fernandez and Trolinger 2007) to increase productivity in farming industries.

Application of the web-based DDS systems in the quality control of water systems in the cities is presented by Booth et al. (Booth et al. 2011) to increase quality level of water for people in the cities. To decrease the risk of water pollution in private wells of houses, an advanced web-based DDS systems is presented by Lan et al. (Lan et al. 2020). Development of a web-based decision support system for supporting integrated water resources management by using an artificial neural network (ANN) is presented by Zeng et al. (Zeng et al. 2012) to provide efficient allocation of water resources among different regions of Daegu city, South Korea. Developed DSS for water resources management of Daegu city is shown in the figure 4 (Zeng et al. 2012).

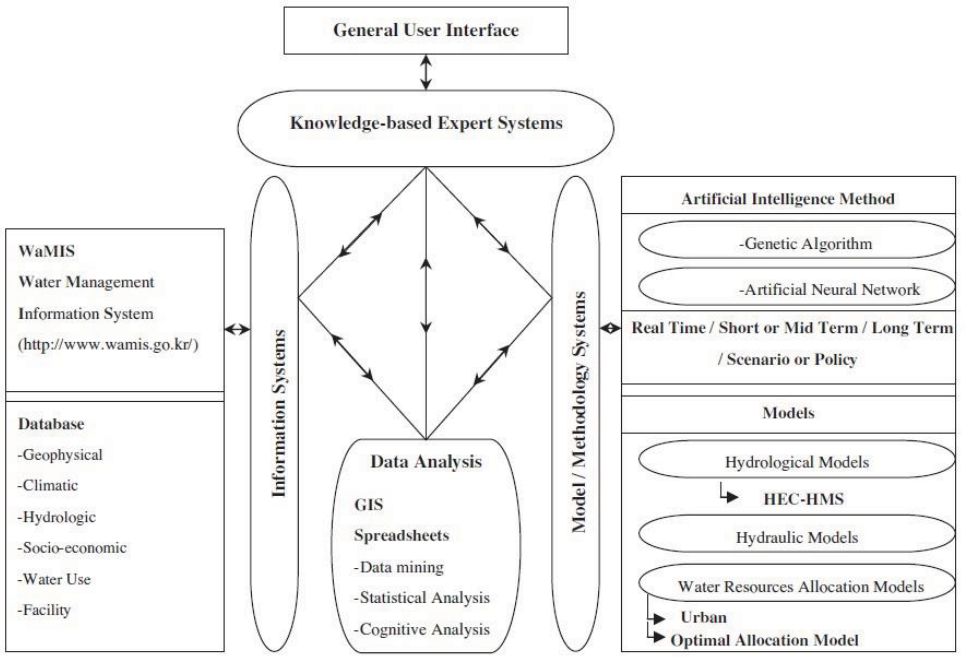

Fig. 4. Developed DSS for water resources management of Daegu city (Zeng et al. 2012).

An architecture for coastal water quality prediction and alert system by integrating different platforms and services to achieve scalability, provisioning of resources in real time, simplified deployment and management of resources and applications is presented by Kumar et al. (Kumar et al. 2020).

To increase the effects of network systems in the quality of online educational systems, application of the web-based DDS in efficiency enhancement of online teaching system is presented by Feghali et al. (Feghali, Zbib, and Hallal 2011). Application of the web based DDS in the educational systems and academic precreation is presented by Siddiqui et al.(Siddiqui, Raza, and Tariq 2018) to develop the online educational systems. Application of the Web-based decision support system using ELECTRE III for ranking of British universities is presented by Giannoulis and Ishizaka (Giannoulis and Ishizaka 2010) to illustrate and develop the process of ranking universities. Web-based public decision support tool for integrated planning and management in aquaculture is investigated by Gangnery et al. (Gangnery et al. 2020) to identify aquaculture issues and key data and help aquaculture planning in four countries.

To increase quality of health system in the hospitals, the developed web-based DDS systems is presented by Fortney et al. (Fortney et al. 2010). To increase effects of medical care in the hospitals, a web based clinical decision support systems is presented by Graber and Mathew (Graber and Mathew 2008). Challenges involved in establishing a web-based clinical decision support tool in community health centers is investigated by Gold et al. (Gold et al. 2020) to improve quality of the health care services in hospitals.

A multi-agent framework for a web-based decision support system applied to manufacturing system is presented by Imène and Noria (Imène and Noria 2009) to manage resources in process of part production. Designing an integrated AHP based decision support system for supplier selection in automotive industry is presented by Dweiri et al. (Dweiri et al. 2016) to manage and improve the quality of automotive industry supplier selection. Fuzzy AHP-based decision support system for selecting ERP systems in textile industry by using balanced scorecard is presented by Cebeci (Cebeci 2009) to compare and develop the enterprise resource planning system in production processes.

A web based decision support system for individuals' urban travel alternatives is investigated by Ocalir-Akunal (Ocalir-Akunal 2016) to manage the traffic problems for public transport riders and car users in smart cities. A Smart Decision Support System based on the evolution of the Analytical Hierarchical Process model for Smart City is presented by Bartolozzi et al. (Bartolozzi et al. 2015) to provide an advanced web based DDS system in the decision process of smart cities. Smart DSS block architecture is shown in the figure 5 (Bartolozzi et al. 2015).

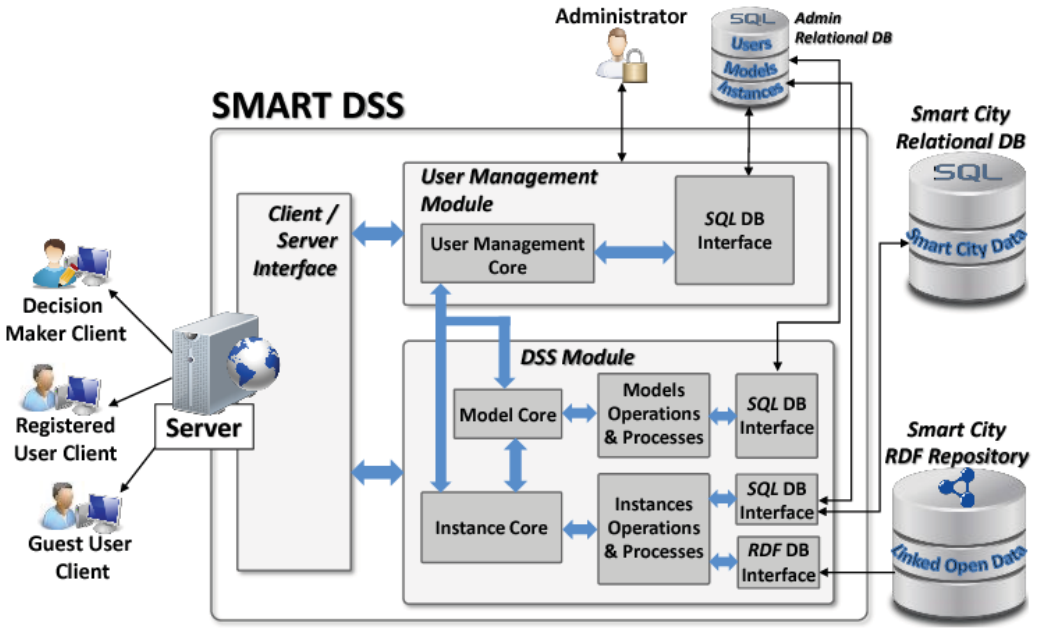

Fig. 5. Smart DSS block architecture (Bartolozzi et al. 2015).

Applications of web based DSS as a business enhancement strategy is investigated by Subsorn and Singh (Subsorn and Singh 2007) in order to provide a valuable business enhancement tool. A web-based DSS framework for business environments is presented in the figure 6 (Subsorn and Singh 2007). Web-Based Decision Support for E-Business Strategies is reviewed by Wang et al. (Wang, Mora, and Raisinghani 2015) to support e-business managers during the business strategy making process in a comprehensive, integrated, and continuous manner.

Integrating web-based data mining tools with business models for knowledge management is presented by Heinrichs and Lim (Heinrichs and Lim 2003) to enhance the quality and efficiency of business environments management systems.

The applications of web and network systems in the DDS are recently expanded and developed in order to provide an accurate selection between different options for the problems. As a result, a lot of research works are recently published in the different journals as well as conferences to provide effective method of web-based DDS systems in the different applications. In the table 1, a summary of recent achievements in the published papers is presented.

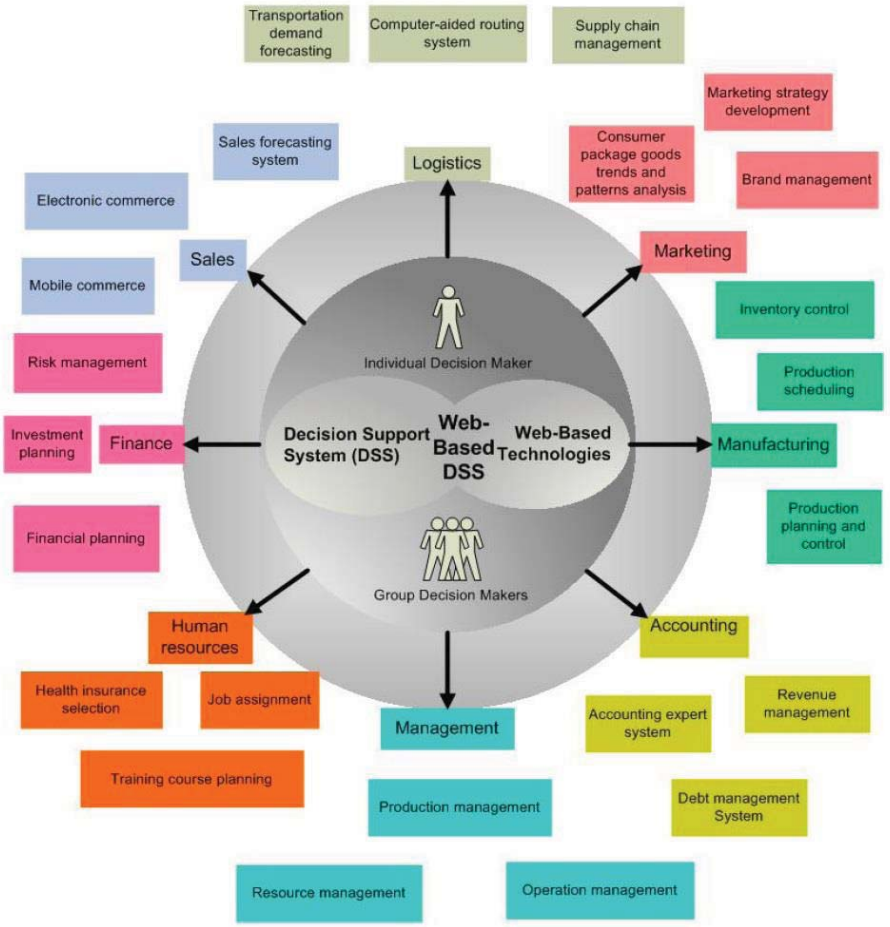

Fig. 6. A web-based DSS framework for business environments (Subsorn and Singh 2007).

No.	Applications	Papers	Definitions
1	Flood management systems	[5]	To minimize the flood damage in the natural disasters, advanced web based DDS is presented.
2		(Wang and Cheng 2007)	To decrease the damage level of flood in natural disasters, application of web-based DDS in forecasting the flood is presented.
3		(Salewicz and Nakayama 2004)	To manage the large international rivers in the risk of flood damages, application of the web based DDS is presented.
4	Waste materials management	(Banias et al. 2011)	The optimal management of construction as well as demotion waste in the construction engineering is obtained.
5		(Chen 2009)	To decrease the waste materials in production process application of the web-based DDS systems is developed.

6		(Sugumaran, Meyer, and Davis 2004)	To provide an accurate plan of waste material management systems in the environmental care process, the developed web-based DDS systems is presented.
7	Production systems	(Kirilov, Guliashki, and Staykov 2019)	To obtain the solution of multiple objective problems such as wireless sensor networks of production systems, advanced web based DDS is presented.
8		(Utomo and Pratikto 2020)	To select the best material supplier in the manufacturing systems, advanced web based DDS is presented.
9	Food and agriculture products	(Molitor et al. 2016)	Application of web-based DDS in the food and agriculture products is presented.
10		(Soyemi and Adesi 2018)	Application of the Web-based DDS in the weather forecasting of the agriculture process is investigated.
11	Quality of health system	(Fortney et al. 2010)	To increase quality of health system in the hospitals, the developed web-based DDS systems is presented.
12		(Graber and Mathew 2008)	To increase effects of medical care in the hospitals, a web based clinical decision support systems is presented.
13	Business Environments	(Subsorn and Singh 2007)	To provide a valuable business enhancement tool, application of the web based decision support systems is developed.
14		(Heinrichs and Lim 2003)	To enhance the quality and efficiency of business environments management systems, a web based decision support systems is presented.

The advantages and benefits of applying the web based DDS to the different issues of engineering problems are as, 1- The Web-based DSS greatly decreases the expense of decision-making, 2- They also eliminated technical and spatial obstacles, 3- They make it easier for enterprises to include their vendors, suppliers and consumers in decision-making, polls, etc, 4- They also greatly enhanced the speed of dissemination of information, 5- They offer an outstanding means of building and maintaining a library of information, 6-As online technologies are used today by almost all they have lowered end-user training costs (Duan, Edwards, and Xu 2005; Pick 2008). The Web as a technology helps to increase the performance, speed and efficiency of specific decisions and has enabled timely, user-friendly and safe circulation of business information despite the cost-benefit effect on web services. It has passed through the geographical boundaries and made it possible to deploy a company-wide DSS of fair results (Bayani 2013).

Due to the demand of advanced technology and network to implement the web-based DDS in the engineering systems, the disadvantages are as, 1-The Web-based DSS is highly related to the technology structures, so upgrading the device too often can be challenging, 2-Obsolete reports can accumulate in the knowledge repository if users do not remove old content, 3-Additional protection as well as network security are required for Web-based DSS, which can be costly (Sugumaran and Sugumaran 2007).

3. CONCLUSION

The decision-making process depends on the availability of sufficient and sufficient information. The more complete, up-to-date and up-to-date this information is, the greater the possibility of making the right decision. Meanwhile, the decision-making role of managers in the field of organizations should not be denied because their decision-making is inevitably closely related to economic, technical, administrative, social, political and cultural issues at the micro and macro levels. Therefore, their role in the decision-making process is much more sensitive and serious. The decision-making process consists of 3 steps:

1- Identifying and understanding the environment
2- Possible modes to respond to the environment
3- Turning it into a solvable problem

The aim is to provide fast and inexpensive access to data, information and expertise available around the world, along with the ability in order to collaborate effectively with remote partners in decision support systems. Speedy processes, improved communication and teamwork, distributed computation, improved group members' efficiency, improved data management and data warehouse management in decision making systems and providing remote control are some targets of the web-based DDS. As a result, by delivering the decision support information to the manager or business analyst around the networks, the manager can select the best solution for the problems to increase efficiency of decision making process. Health care systems, private companies, education system and government services are some applications of the web based DDS in decision making process.

It is clear that DSS offers essential knowledge needed to make accurate and productive decisions where the information pool, such as the Internet, cannot be done without it. Technologies for the World Wide Web which include the entire design and creation, are quickly transformed method for all forms of Decision Support Systems and implementation. This new methodology enables people and organizations to make more competent as well as more collaborative choices which can help to effectively accomplish more of the organization's objectives. Eventually, at no point can computer science and web technologies stop, they will both continue to evolve and continuously introduce new innovations.

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