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A Systematic Review of Decision Support Systems and Future Development Techniques

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Abstract

A DSS is an information system that develops and evaluates various alternatives to support decision-making by selecting the best option. The objective of this paper is to shed the lights on the characteristics of Decision Support Systems (DSS), also highlights the future opportunities for decision support systems four technologies were addressed: cloud computing, artificial intelligence, Internet of things (IoT), and big data and their role in the next generation of DSS. In addition to current challenges that face decision support systems. We conducted a literature review to have a clear and solid understanding. After the review we concluded that information quality and uncertainty were found to be the common challenges of DSS, most decision support systems (DSS) were produced as standalone systems, followed by web-based DSS and last as mobile application with only 4%. Medicine is the most frequent field to be addressed by researchers, followed by business, and finally education with only 7%. This review provides solutions to software developers about future demand. The review will also help educational providers with clear view about the most likely future techniques of development and demand for IT professionals in different domains. Meanwhile, providing feedback allows us to model and assess the impact of research and demand on IT for the industry, and supply market for DSS.

Key words: Decision support systems, DSS, IoT-Based DSS, cloud-based DSS

Introduction

Choosing an option among several possibilities is referred to as decision-making. A choice offers the decision-maker two or more alternatives to evaluate. DSSs are resources that assist management in making choices. They consist of a computer for data analysis and modeling, along with various functions. DSSs are not especially effective for ordering but also for selecting the best options [1]. To determine the optimal choice, the decision-maker must pick one of the existing alternatives or create a new solution [2].

In a business context, numerous choices exist for making decisions, and the decision-maker is able to select while considering the possible outcomes of their choice. Digital decision support systems and decision information systems are alternative terms that have been utilized to describe decision support systems [3].

In such administrative environments, the use of modern technology to aid decision-making has generally focused on two factors: excessive information and limited time. Management requires that decision makers obtain, generate, and utilize information through different channels, based on the type and quality of information received [4]. The exchange of information among key participants has progressed to a new stage, indicating enhanced data accessibility while maintaining the confidentiality of management data. The choice regarding the information system, which determines how businesses react to information or how information is controlled by businesses, is vital for the successful development of the economy and industry. The business customizes the information system, not the reverse, despite significant changes in how information is presented concerning decision-making, management functions, and economic development. The advantage of information adaptability is that it can help recognize trends in decision-making, providing participants with an extra advantage over each other in the market [5].

There are several techniques and methods for Decision support systems and we have discussed in this paper about, traditional DSS, IoT-Based DSS, and cloud-based DSS.

To develop a comprehensive summary for investigating the design and implementation of

decision systems in these areas, our primary aim is to examine the existing and cutting-edge literature related to decision support systems (DSS) across information systems, management, organizational behavior, and decision support systems.

Methodology

The literature review includes **researching articles, scientific journals, and google search repository about decision support systems, and analyzing the selected articles and papers, in addition to evaluating, and summarizing scholarly literature** to understand what happened among the scientific community.

The Importance of Decision Support Systems

An information system is a system that can gather data automatically or manually, store and process data, and—most importantly—transform data into information that is useful[6]. The information that is produced can take many different forms, but its main goal is to make decision-making easier in order to guarantee the long-term viability of a business.

The writers discussed the value of decision-making processes in both the public and private sectors, examining how they help in problem-solving and community service [7]. Good decision support systems should be utilized to discover uncertain decisions, find alternatives, assess options, and make decisions by creating and considering their own reasoning models about the available options. [8]. The authors in [9] shed lights on the significance of management information systems (MIS) in making administrative decision. MIS is counted as an element of a common organizational plan [10]–[12]. Another study proved the strong association between accounting information and managerial decision making [13]. Authors investigated the power of sustainability assurance (SA) on managerial decisions, in terms of sustainability and effectiveness [14]. A qualitative study addressed the advantage of personal experience for making better decision [8]. MIS gives information with high quality, accurate, relevant, timely, [15] added reliability. Authors in [10] proposed that quality is the most desirable character of any effective system to support decision makers.

Future Trends

The following section illustrates the future opportunities for decision information systems developments starting with big data analytics, Cloud-Based Decision Support System, Intelligent Decision Support Systems, and IoT-Based Decision Support Systems.

Big Data Analytics

Many developments have been made in the field of gathering massive amounts of data, or "Big Data," in recent years. By providing copious amounts of data to the prescriptive and predictive models [16]. Big data can assist evidence-based policy - making and be used to identify trends that were previously unidentified. Big data can assist public sector administrators in making better decisions [17]. Big data may impact how knowledge is currently used within organizations, as well as making decision, policy formulation, incentive structures, capabilities, and many other processes that currently shape public policy [18]. The accessibility of information sources was a primary restriction to choice back frameworks. Be that as it may, with the made strides expository strategies for enormous information sources unused openings have risen that can conceivably improve how choice producers analyze their issue and arrive at choices utilizing data frameworks [19].

IBM Application in Big Data

Watson is an IBM item empowered with AI innovations to drive commerce choices. Agreeing to IBM 99% of companies detailed that Watson decreased their costs by utilizing virtual operator innovation and 70% of worldwide keeping money teach utilize Watson [20]. Big Data contains a high visibility into progressed examination frameworks by presenting its Watson stage, which empowers gatherings of people to associate with it in common dialect. Watson makes a difference organizations anticipate future results, robotize complex forms, and optimize directors and employees' time.

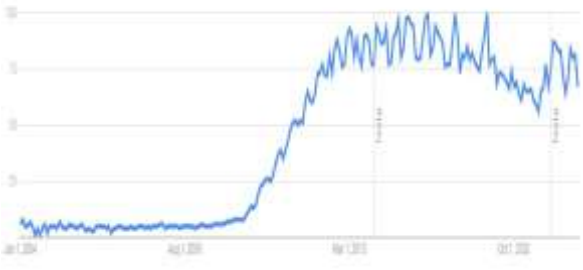

Figure 1. Big data trend from 2004 to 2022.

The figure above shows the trend of big data as a term used in google search engine from 2004 until 31/12/2022. The trend emerged from 2011.

Cloud-Based Decision Support System

A cloud decision support system could be a sort of DSS that works on cloud computing innovation to store and handle information and data. Cloud based DSSs are used to improve the capacity of organizations to create the correct and educated choices by progressing the quality of information and analyzing it way better and speedier. Cloud computing innovation permits clients to get to computer assets, programs, and information through the Web. Cloud choice bolster frameworks give the capacity to store expansive sums of information, analyze it utilizing machine learning and manufactured insights strategies, and show comes about rapidly and successfully. Cloud decision support frameworks are adaptable and versatile, as clients can increment or diminish the sum of information and assets utilized concurring to their needs. This innovation moreover permits get to information and analytics from anyplace and at any time, which increments the effectiveness of the decision-making prepare. The cloud decision support framework can be utilized in different areas such as trade, promoting, generation, finance, health care, education, etc., and it is considered one of the most recent innovations utilized within the field of decision support.

Cloud computing has become a developing field due to its low cost and versatility highlights energize numerous organizations and people to exchange their information to the cloud. It makes a difference people and ventures to get to cloud computing assets to meet their computing needs. Cloud computing gives adaptability to get to the information regardless of time and area [21].

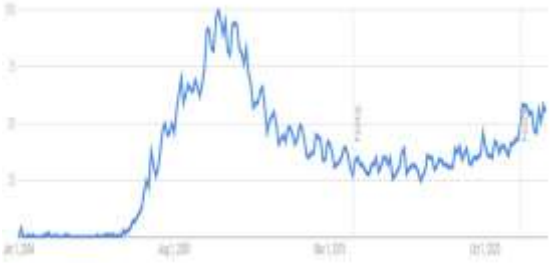

Figure 2. The trend of cloud computing from 2004 to 2022.

The figure above shows the trend of cloud computing as a term used in Google search engine from 2004 until 31/12/2022. The figure shows an increase in the term between 2009 and 2015.

Intelligent Decision Support Systems

Intelligent Decision Support Systems (IDSS) is one of the cutting edge advances within the field of choice bolster, and it depends on the utilize of savvy innovations such as fake insights, machine learning, enormous information examination, mechanical technology, profound learning, and others. IDSSs point to analyze information and turn it into profitable data and bits of knowledge that can be valuable in decision-making forms. These frameworks regularly analyze information related to execution markers, deals, costs, generation, clients, etc., and give mindful suggestions that help clients make the proper and fitting choices. IDSSs give numerous preferences, counting:

Superior and speedier information investigation, mindful proposals, improving work proficiency, increment exactness and unwavering quality, progressing organizational forms to encourage communication and participation between representatives.

Creators coordinates information science procedures into choice bolster framework to maximize quality and value[22]–[27]. Artificial intelligence (AI) algorithms can assist decision-makers to take faster and more accurate decisions [17], [28].

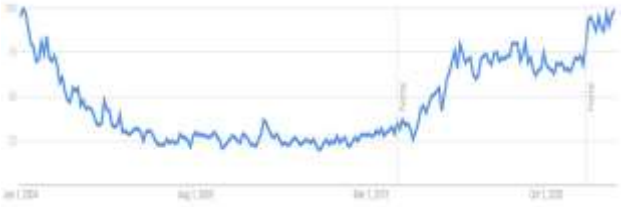

Figure 3. The trend of artificial intelligence from 2004 to 2022.

The figure above shows the trend of artificial intelligence (AI) as a term used in google search engine from 2004 until 31/12/2022. The trend shows a decrease from 2006 to 2015. But, it began to emerge a again in the last five years.

IoT-Based Decision Support Systems

The use of the Internet of Things (IoT) is quickly becoming an essential part of decision support systems. IoT pledges new approaches in different business areas through effective data analytics tools and improved decision support systems. Despite this, IoT implementations are susceptible to different security risks across multiple levels of the connectivity and communications infrastructure [29].

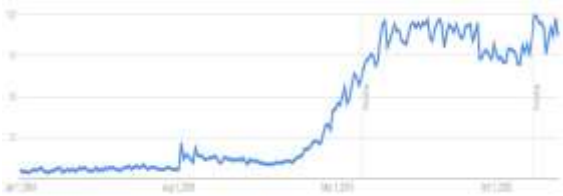

Figure 4. The trend of internet of things (IoT) from 2004 to 2022.

The figure above shows the trend of internet of things (IoT) as a term used in google search engine from 2004 until 31/12/2022. It is the newest term among the four, the trend arises recently in the last five years.

Challenges of Decision Support Systems

The focus is on decision-making under conditions pressure time, information overload, uncertainty, in an organizational context, while the decision-maker is empowered to make a variety of decisions. To make decisions while considering the consequences of bad choices [4]. The decision is consciously taken among a several of options [30]. Authors discussed how to keep the privacy of data over cloud environment [21]. It was a real challenge, especially with the growing demand for privacy in the coming years. On the other hand, study [31] taking into consideration information overload as a challenge for decision making [31] added information overload.

Table 1: illustrates the frequency of decision support systems challenges.

Reference	Information Overload	Selection Bias	Quality	Uncertainty	Complexity
[31] 2019	✓				
[32] 2019		✓			
[4] 2020	✓			✓	✓
[33] 2019			✓		
[16] 2019			✓		
[34] 2020		✓			
[7] 2017				✓	
[35] 2014			✓		
[36] 2020				✓	
[37] 2017		✓			
[38] 2018				✓	
[22] 2019			✓		
[38] 2018				✓	
[39] 2020				✓	
[40] 2019					✓
[41] 2020			✓		
[42] 2020					✓
[43] 2018			✓		
[44] 2020					✓

From Table 1 above we observed that quality and uncertainty were the most frequent attributes that addressed by the research community.

Table 2: shows the classification of DSS product.

DSS Product	Reference
System	[3],[39],[40],[45],[44],[27],[46],[28],[17],[42],[43],[24],[47],[48],[49],[50],[51],[52],[53],[54],[55],[56],[57],[58],[59],[60],[61],[62],[63],[26]
Web-Based	[64],[65],[66],[29],[23],[24],[19],[67],[68],[45],[69],[70],[71]
Mobile Application	[72],[73]

According to the table above, most decision support systems (DSS) were implemented as systems, followed by web-based DSS and last as mobile application.

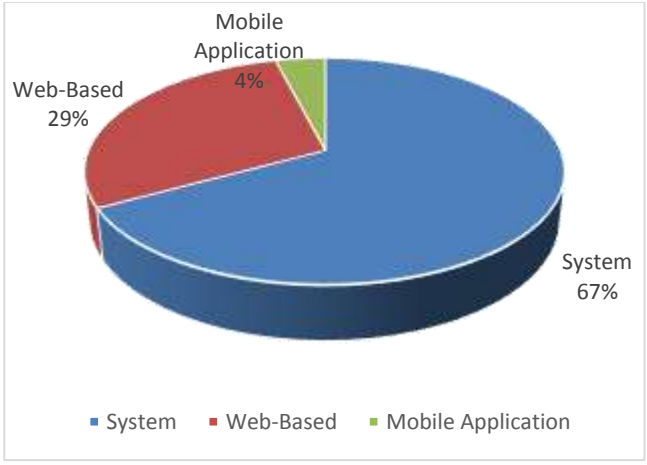

Figure 5: presents the categories of DSS products.

From the figure above, most decision support systems (DSS) were produced as systems, followed by web-based DSS and last as mobile application with only 4%.

Table 3: presents the classification of DSS by fields.

Field	Reference
Education	[47],[50],[67]
Industry	[43],[55],[29],[26],[71]
Medicine	[3],[39],[45],[46],[28],[42],[48],[52],[54],[56],[64],[65],[58],[73],[60],[61],[45],[74]

Business	[40],[44],[72],[51],[53],[59],[24]
Other	[17],[49],[57],[66],[62],[63],[68],[70]

According to the table above medicine was the most field to be addressed by researchers recently, then business, other, Industry, and last education.

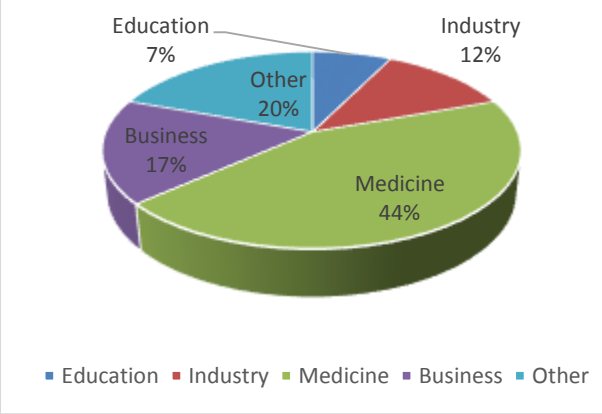

Figure 6: shows the DSS research by fields.

According to figure six above medicine was the most frequent field to be addressed by researchers, followed by business, other, Industry, and last education with only 7%.

Results

After the review and literature analysis the objective of this paper was achieved. We surveyed decision support systems (DSS), also highlights the future opportunities for decision support systems, in addition to current challenges that face decision support systems. We concluded that big data, cloud-based DSS, intelligent decision support systems, and IoT-Based DSS are the popular techniques for DSS development in the coming years. Furthermore, information quality and uncertainty were found to be the common challenges of DSS.

From the figure above, most decision support systems (DSS) were produced as systems, followed by web-based DSS and last as mobile application with only 4%. According to figure six above medicine was the most frequent field to be addressed by researchers, followed by business, iindustry, and lastly education with only 7%.

Recommendation

More comparison with Existing and updated Literature to your findings with existing research in the field. Due the limited sample size working with bigger sample would demonstrates a critical and give comprehensive results.

Subgroup Analysis it is more appropriate to analyze data by subgroups (e.g., based on subdomains, tools, or other factors) to identify any differences or patterns.

More studies are needed in the other domains and fields other than these been addressed by this paper (cloud computing, artificial intelligence, Internet of things (IoT), and big data).

Conclusion

This review can provide solutions to software providers about future demand. They can also give educational institutions ideas on the most likely future directions of development and demand for IT professionals. While, continuous feedback allows us to model the influence of research as well as industry demand on IT production, and supply of DSS. Highlighting, future techniques will allow us to model the influence of industrial demand on IT production, and supply of DSS.

In conclusion, it can be said that the use of decision support systems as a system, mobile application, or web system is continuously increasing in recent years, due to the growth in the volume of available data across different systems and applications, and the need to make correct and appropriate decisions in a short time. The use of decision support systems as a mobile application or web system allows users to access information and produce recommendations at any time and from anywhere, which increases efficiency and productivity in decision-making processes.

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