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Exploring the Landscape of Decision Support Systems: A Comprehensive Review of Implementations and Key Characteristics

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ABSTRACT

In today's complex business landscape, organizations grapple with data overload and dynamic decision environments. This necessitates the implementation of decision support systems (DSS) for effective decision-making. DSSs have become an attractive option for organizations for making decisions in the current digital age of management systems. DSS are used for a variety of reasons across different industries and contexts which also provide individuals, teams and organizations with the tools, information, and insights they need to make informed and effective decisions. The purpose of this study is to review the characteristics of DSS and how it is being used in various areas. The uses of DSS can be divided in multiple sectors such of medical, forest management, education, and business development. This paper will hopefully be a valuable contribution to the ingoing discussion about decision support systems and their impact on sustainable development in organisations.

1. Introduction

Decision support system (DSS) is an information technology-based solution designed to assist in decision making, integrates models, data, and user interfaces. Through the use of interactive interfaces and various analytical tools, DSS empowers users to efficiently examine data, weigh options and make decisions. The value of DSS is found in its capacity to improve decision-making through rapid access to relevant information, simplified scenario analysis and overall higher quality decisions [1,2]. DSS helps with solving difficult problems, improves productivity, improves the accuracy of decisions, and promotes the collaboration of decision makers, among other things. Because of its adaptability, it can be used in a variety of settings, including business, healthcare, and

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academia. This helps professionals understand the difficult process of decision making in a world where data is becoming increasingly important.

Predicting and making choices from the available information on hand, an organization would utilize the use of a computerized program called decision support system (DSS) to analyze and synthesizes vast amounts of given information to assist in decision-making. The concept of DSS began developed in the 1960s and the framework was developed further so that its research and development can exploit any new technology developments and benefit in very large databases, artificial intelligence, human-computer interaction, simulation and optimization, software engineering, telecommunications, and from more basic research on behavioural topics like organizational decision making, planning, behavioral decision theory, and organizational behaviors [3].

Organizations face challenges related to data overload and dynamic decision settings in the intricate commercial landscape of today. This means that in order to make decisions effectively, decision support systems (DSS) must be implemented. The use of DSS can be utilized in any organization such as medical and healthcare, agriculture, industrial or even just a general situation. An example of DSS uses is staff team management where it produces automated pre-selection of candidates that fit best with future team members. Another general use of DSS is using the system to evaluate software products systematically to assist in software selection in an enterprise [4,5]. In a general sense, a decision support system is a major tool that organizations use with its goal to support and enhance its decision-making activities as stated by Bhatt *et al.,* [6].

The purpose of this study is to review the implementations and characteristics of DSS. This work is organized as follows: Section 1 for introduction, Section 2 presents literature review and Section 3 for the methodology. Meanwhile, Section 4 discusses DSS implementations, DSS characteristics for Section 5, and finally the conclusion will be included in Section 6.

2. Literature Review

DSS models may include knowledge-based, analytic hierarchy process, system dynamic, multi-criteria decision analysis, Bayesian network, fuzzy logic, neural network, Markov, regression and simulation models and four DSS approaches had been which are the data-driven, model-driven, knowledge-driven and document-driven approaches. As to implement DSS, a general guideline should be used such as those given by Keen *et al.,* [7] and Power and Daniel [8]. They stated that to develop a DSS, the developers must first get to know the in and out of the current system used by the organization first so they can properly design the dialogues, commands, processes, define the users and programs its logic and data management. Aside from that, the developers must build the DSS architecture that is flexible for future development or update, reduce the fixed costs of programming and the time to respond to users, data management needs to have quick processing time and assure that the DSS is user friendly to the users.

According to Galipalli *et al.,* [9], an efficient DSS would be able to diagnose decisions once a task plan is sent to the system, able to identify, must make a decision to purchase or develop the anticipated DSS when any task is feasible, rapidly prototype the DSS and developers must design architects that support company objectives and provided being beneficial to business. They have to make certain to aim for suitable planning and development methods to ensure it reaches the business targets and profits the customer.

Developing and designing a DSS also comes with its challenges. As stated by Ferretti *et al.,* [10], there are challenges and meta-choices in designing and applying multi-criteria spatial decision support systems where designing the decision process that they don’t know who should participate

and how to deal with limited availability of spatial data for the criteria. Building a clinical DSS presented by Sittig *et al.,* [11] also have a problem with the human-computer interface, prioritization, and filter recommendations to the user, creating architecture for sharing executable modules and services, creating internet-accessible clinical decision support repositories, and even mining large clinical databases. In general, building a DSS with specific features requires more improvement and prototyping. The uses of DSS can be divided in multiple sectors such as medical, forest management, education, and business development.

3. Methodology

Articles review for the decision support system characteristics and implementations were carried out using two online databases namely Google Scholar and Scopus. There are three main processes in the systematic searching strategies namely identifying, assessment, and qualification as illustrated in Figure 1.

3.1 Identifying

Identifying is the process of searching synonyms, related terms, and variations of the main keyword for example “decision support system” and “DSS”. Articles are identified using the Publish or Perish application that can list out articles based on the keywords and search term that was input when you choose a search database. When choosing Google Scholar as a search, it resulted in 1000 articles, and it was then changed to use Scopus as it only results in 200 articles instead.

3.2 Assessment

All articles were screened using the sorting function of the respective database based on the criteria of being published in the range year 2020 and 2022. When using these criteria on Publish or Perish in the Google Scholar database, it remains as 1000 articles but only articles from year ranges. Because the Scopus database will only return 200 articles only, it was advised we search using individual years instead of setting the range. In the Scopus database, 600 articles were returned for the 200 articles for each year. In total, 1600 articles were returned in Publish or Perish.

3.3 Qualification

The title and abstract of the articles were manually examined in this process. Because we are searching for the characteristics and implementations of DSS, there is a drastic number of articles that can be excluded as it does not include the component that we wanted. In the end, the qualified articles that can be used from the Google Scholar database are only five articles while in Scopus there are 10 eligible articles.

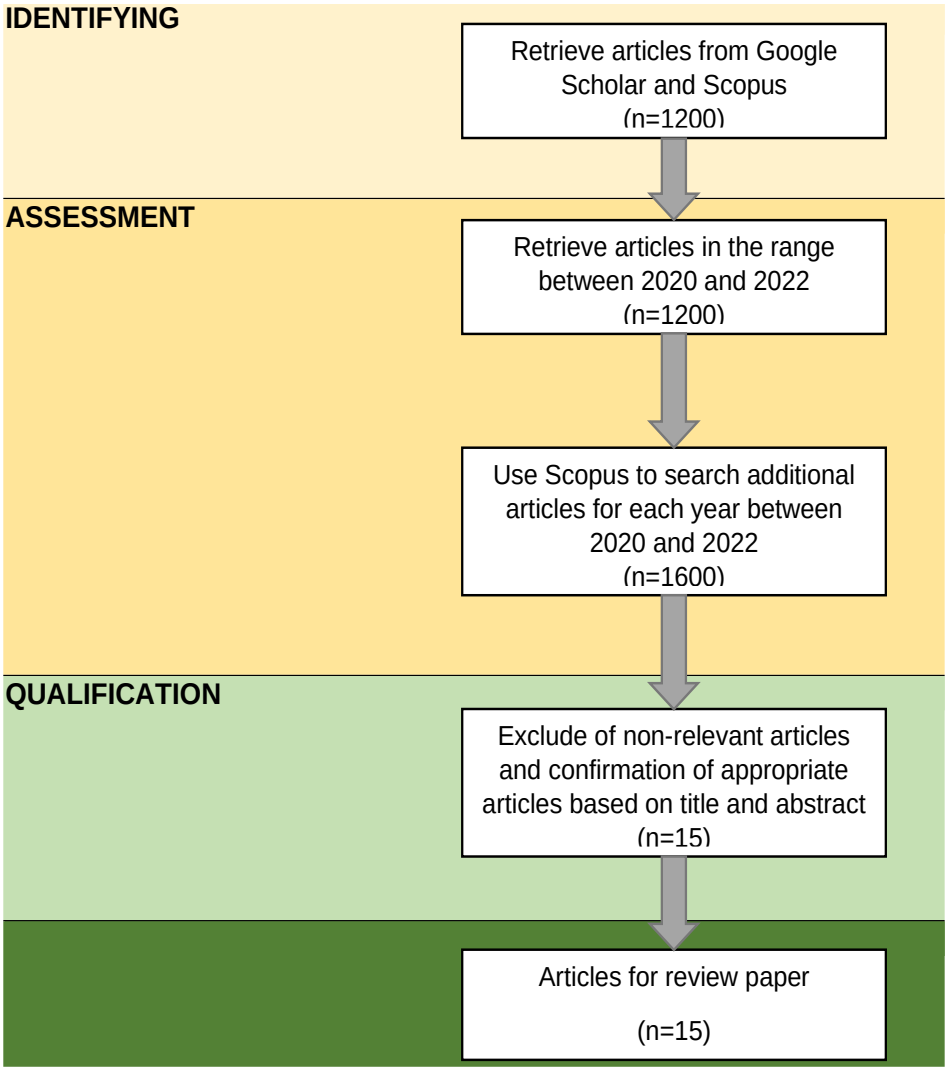

Fig. 1. Research methodology

4. Implementations

Implementation of DSS can be in any sector. Refer to Table 1 for the implementations of DSS. It includes in the educational sectors, agriculture, and environment, medical as well as in the business sector.

4.1 Education

DSS analyses and synthesizes vast amounts of data to assist in decision-making so it can be useful in an education department. According to Dinkel *et al.,* [12], DSS assist in efficiently scheduling faculty and assigning subject without causing any constraint. An integrated approach to the educational DSS design has been demonstrated which includes administrative and planning features as well as statistical analysis of students' performance and program assessment features [13,14]. The implementations of DSS in the education department bring positive outcomes. Facilitating DSS allow the different decision-making participants to reach a common understanding efficiently and effectively [15]. According to Yu *et al.,* [16], education-based DSS allows finding a good research topic very crucial for a researcher as soon as possible by using a novel system that is proposed to help a user quickly find a research topic based on paper recommendation.

4.2 Environment

One way a DSS was implemented in helping the environment was by getting the system to do forest management. Forest management is the process of planning and implementing practices for the protection and use of forests to meet specific environmental, economic, social, and cultural objectives. DSS in forest management has enabled more-effective analysis of the options for and implications of alternative management approaches for all components of forest ecosystems [17,18]. An example of DSS application in forest management is to protect forests for sustained yield of water resources. Aside from managing a forest water resource, DSS implementation assists in assessing biomass availability for renewable energy production and mapping potential bushfire hazards.

4.3 Agriculture

Agriculture is the art and science of cultivating the soil, growing crops, and raising livestock implementing DSS in agriculture improve and assists with producing better quality products as well as improving how to manage their farm. DSS can be used to manage irrigation control with in-field data feedback and real-time monitoring of irrigation operations [19]. Crop growth can be monitored and estimated growth rate as well as improving crop productivity and efficient use of fertilizers by implementing DSS in the field [20,21]. Aside from crops, DSS can also be used to monitor livestock such as a dairy farm by using precision farming technology to develop in-depth precision farming data and decision-making [22].

4.4 Medical

The integration of DSS into the computerized record in a medical environment provides up-to-date medical knowledge and evidence-based guidance to the physician at the point of care. As reimbursement is increasingly tied to process and clinical outcomes, clinical decision support system (CDSS) will be integral to future medical practice. DSS is essential in improving effectiveness and factors that influence good healthcare [23].

4.5 Business

In a company, business processes and related decisions are the main elements of its operation. When DSS is implemented in business operations, the company will benefit from more informed decisions and more consistent outcomes as decision-makers and knowledge workers have access to an increasingly accurate and up-to-date trusted source of information [24]. Generally, DSS in the business industry incredibly help improve the company as DSS assist in task autonomy and microcomputer training in a company [25,26].

Table 1
Implementations of DSS

References	Field
[12-16]	Education
[17,18]	Environment
[19-22]	Agriculture
[23]	Medical
[24-26]	Business

5. Key Characteristics

For this section, we will be comparing the authors' supported characteristics in their research or book. In general, a DSS's main functions include identifying problems, evaluating these alternatives, and selecting the best alternative. The assessment of how articles were obtained can be seen in the methodology in Figure 1. In total, we reviewed 15 research articles and 10 books relating to DSS's characteristics. The comparison of supported characteristics is shown in Table 2. The percentage is where we calculate the percentage of authors who agree with the characteristic by f/25×100 where f is the number from frequency.

Table 2
DSS characteristics

Characteristics	References	Frequency	Percentage
Assist decisions	[27-51]	25	100%
Assist activities interacting with each other	[27-33,35-37,39-42,47,48,50,51]	18	72%
Repeat and Constant	[28,34,35,41]	4	16%
Use multiple components	[27,30-35,38-42,45-47,49,50]	18	72%
Use External/Internal Data	[27-37,41-48]	19	76%
Analyse scenarios and goal	[29,32,35-39,41,42,44-51]	17	68%
Provide alternatives solution and optimise	[29,34-38,44,45,48,49,51]	11	44%

6. Conclusions

A decision support system (DSS) is a computerized system that gathers and analyses data, synthesizing it to produce comprehensive information reports. This review paper is to analyse how DSS is implemented in an industry as well as what are their characteristics. This paper discussed the implementations of DSS for sustainable development in an organisation. In order for companies to succeed, it is crucial that they integrate decision support systems into their plans. These systems can be crucial in the quest of sustainable development. The implementation of the DSS model in an organization needs to consider the scope and purpose of the system. A well-thought-out plan allows organizations to develop the model that best suits their specific needs. The area of implementation for DSS includes education, environment, and agriculture, medical and business.

While the searching for the DSS characteristic resulted in different opinions of what DSS characteristic is. There is a collective acknowledgement that it assists users' decisions in their task and there is sizeable agreement that DSS use internal and external data using multiple components in their system. It is hoped that this will be used as a basis for organisations to make more informed decisions as well as understand the differences between the available models and approaches when it comes to the implementation and use of DSS in their organisations. Furthermore, this paper will hopefully be a valuable contribution to the ingoing discussion about decision support systems and their impact on sustainable development in organisations as stated in sustainable development goals (SDGs) by United Nations (UN).

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