Article

An Informed Decision Support Framework from Strategic Perspective in Health Sector

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Abstract: Decision makers have to work on resolving multiple forms of problems within their organizations. The problems can be structured, semi-structured, or unstructured. Handling these issues requires intensive time dedication and resource allocation. Looking at the perspective of strategic decision making in Saudi Arabia, current operations are lacking in various sectors. This indulges an immediate need to introduce proper systems and highlight the loopholes that would allow the leaders make informed decisions aided by a support system. For this reason, the researchers set out to work on two research questions. The first question focused on how decision makers ensured accuracy of the decisions they are making. It would allow to identify why such system is important that should also guarantee consistency and accuracy. The second question asked about the proper process that would govern and control the outcome of decision. Considering the above questions, this research aimed at identifying the ideal framework, and whether the proposal developed would fit into the Saudi organizations. A case study in health sector has been reviewed containing various models across the world. Following this, interviews with five decision makers in their organization were conducted to perform the qualitative research. The researcher identified that most organizations lacked systems to ensure their decisions were accurate. The research also concluded that the tools and elements presented in the proposed informed decision framework would fit into most Saudi organizations to eliminate the identified problem, and especially due to the inclusion of the non-digital sources of information as part to the decision process. Furthermore, the analysis was conducted and discussion was determined stating validations of the study.

Keywords: decision support, framework, stakeholders, information systems, analysis

1. Introduction

The Organizational decision-making is an integral part of a successful and efficient organization. It requires effective management, analysis, and communication in order to generate the most appropriate solution [1]. Poor decisions can lead to wasted time, resources, and financial loss, which all have the potential to negatively impact an organization's performance. For this reason, decision support frameworks and systems (DSS) have been developed to help managers effectively make decisions and maintain control over their strategic initiatives [2]. The purpose of this research is to propose an informed decision-support framework that could be adopted by Saudi organizations in order to facilitate better decision-making processes. On the other hand, the results and the proposed framework can be adopted by further research in order to build a comprehensive decision support system. The primary objectives of this study are twofold: firstly, it seeks to review

the concept, background, and history of building an effective decision making and the DSS with other relevant studies in the area; secondly, it aims to interview relevant stakeholders within Saudi organization with regard to their views on decision-making processes as well as assessing their current needs and expectations from the decision support frameworks. In addition, the research intends to analyze the results from the interview in order to create a new informed decision support framework specifically tailored for Saudi Arabian organizations that address the strategic decision-making process. Lastly, the study focuses on developing a comprehensive implementation process for utilizing the framework so that effective decisions can be made consistently throughout all stages of an organization's development.

In life people have to make decisions based on choices available to them. The outcome of a decision is a factor of multiple influences, which control the outcomes. An individual's role is mainly about reacting to outcomes, either positively or negatively. Whenever a person or a company makes acts in a particular way, a decision precedes the action. Making a right or a wrong decision may mean the difference between realizing profitability or loss making for an entity in a competitive market. Therefore, decisions are critical in the overall performance of an individual or an organization. Organizations are facing complex decision-making processes with increasing pressure to perform efficiently and competitively. In such a scenario, there is a need for an informed decision support framework that can provide organizations with data-driven decisions that take into account both internal and external factors of the business [3]. Moreover, the framework should consider various aspects like political and economic factors, customer preferences digital and non-digital sources, thereby enabling organizations to have an integrated approach toward decision-making. The framework enables organizations to leverage technological advances to help guide and facilitate decision-making processes. According to [4] the need for such a system arises from the complex nature of the decision-making process, which requires both accurate data collection and sophisticated analytical capabilities to optimize outcomes.

Since making the right decisions plays a fundamental role in organizational management, methods and techniques that promote decision making have been receiving significant attention in the recent years. Such approaches are classified as approaches of decision support and the systems designed for this reason are categorized as decision support systems (DSS). The continually expanding development of computer systems and the internet have transformed decision support systems into shared resources across organizations. They are not just single user tools, but rather multiple-user resources [5]. The concept of decision support systems entails their representation of relatively new thinking approaches that use computers for administrative purposes. Such computer-based systems are designed with the aim of improving productivity and increasing efficiency. They support the decision-makers and policy developers in long-term planning. Such systems are flexible and interact with multiple users with expansive efficiency.

In recent years, Saudi Arabia has experienced unprecedented economic and technological progress. They have developed vastly in the past few decades to the level where its organizations are competing in similar levels with other major global organizations. For instance, as of May 2022, Saudi Aramco became the largest and most valuable company in the world by market capitalization [6]. As a result of these developments, the organizations in the country must also develop means of enabling the decision-making processes of their leaders. When running such massive organizations, a wide range of data come into play when making decisions. It may be challenging to compile such data as an individual or a group of people making up the top leadership team in an entity. Consequently, it is critical for Saudi organization to keep up with the transformations within its sector, and develop systems and frameworks that promote decision-making effectiveness and processes. Therefore, to stay competitive in the rapidly changing global economy, many organizations in the country are focusing on improving their decision-making process [7].

 doi:10.20944/preprints202305.0135.v1

1.1 Motivations and Contributions

The aim of this research is to develop an informed decision support framework for the Saudi Arabian organizations, taking the case of health sector. In addition, the research should answer two fundamental questions which are: How the decision makers ensure the accuracy of the decision that has been chosen? and What is the proper process that assure the accuracy of the decision? However, the objectives of this research are to:

- To review the decision support system framework history, concept, and case studies in the related area
- To make interviews with relevant stakeholders.
- To analyze the interviewees response of the interview.
- Develop an informed decision support framework to oversee and tackle strategic decisions for the decision maker in Saudi Organization.
- Visualize the findings and trends using flow diagram for decision making process.

2. Related Work

The history around the decision support framework as well as DSS framework is discussed, and the different cases and examples discussed in previous researches mainly focusing in the countries of Gulf including Saudi Arabia.

Decision Support Systems (DSSs) or frameworks have evolved over the years from simple model-oriented systems to the current advanced multi-function entities. In the early days, in the 1960s, it was expensive to construct a large-scale information system. However, new systems, such as, the IBM System 360 came up and were powered by powerful mainframe systems [8].It became practical and feasible to develop management information systems (MIS) for large organizations. These systems focused on offering the management structured reports, periodically [8]. At the time, the main focus was on the accounting and transaction systems. As technologies developed, additional systems developed with a specific focus on assisting management in decision making processes. The management decision system (MDS) was developed between 1966 and 1967 by Scott Morton, and it used computers and analytical models [8]. Later in 1971, the Scott Morton and Gory Keen coined the term Decision Support System (DSS) as cited in their 1978 book, "Decision support systems: An organizational perspective" [9]. As such, DSS refers to an interactive software system, which provides information derived from models and data in a way that it enables decision makers to solve decision problems more effectively [9]. Consequently, it is a framework or a system, which assists the decision maker, but it does not replace them. The applications of DSS are extensive and they include both structured, semi-structured, and unstructured processes. The development and utilization of DSS frameworks was to enable decision makers consider more aspects and options in the decision-making process and prevent tunnel vision [9].

While the early researches in the field contributed massively to the current systems and operations, the last few decades have led to huge developments in the field. Since the 2000s, there have been various major changes in the DSS theory and practice. Some of the developments include the incorporation of Business Intelligence (BI) and Business Analytics (BA) concepts in DSS [10]. The concepts focus on different aspects of using computer systems to gain information analyze it. As computers became increasingly powerful, companies integrated them into their daily operations, and they could capture massive amount of data, which could be analyzed further to guide decision-makers in their endeavors.

The DSS industry has transformed over the years resulting in the development of an advanced decision theory. In 2002, Daniel Kahneman received the Nobel Prize for the decision-making theory, which he developed together with Amos Tversky. The theory is

based on a set of theories that explain the cognitive processes of how humans make decisions, with a specific focus on the system failures [10]. It was one of the main transformations that resulted in DSS taking a scholarly and research perspective. Theoretical contributions in the field have led to the collection of data and continued analysis to ensure information gathered answers numerous questions and allows further developments within the field.

2.1 Decision support frameworks concept

The decision-making process requires the integration of multiple conflicting and non-measurable dimensions. As a result, one of the emerging and commonly adopted aspect of DSS is the multi-criteria decision analysis (MCDA), and it addresses an alternative to dealing with complex decision-making issues, which include multiple, diverse, and conflicting goals [11]. There are DSS tools developed to support the approaches used in MCDA to facilitate decision-making processes using data via models for the resolution of semi-structured and unstructured problems. The tools allow a decision maker to map out all possible alternatives to a decision. To allow such analysis, computer-based modelling has been the main area of focus in DSS research [11]. As discussed in the background section, it has been in place and followed the development of computers. Since mid-1970s, computer-based modelling started appearing, and it used web technologies and modelling software [12]. In the beginning, they were not as sophisticated as the tools available today [11]. The applications of the computer-based models have been used in multiple industries including agriculture, climate change, food, medicine, and supply chain, among others. Cloud storage and access to information through multiple devices globally made web-based technologies emerge as the newest trends within the computer-based modelling arena [11]. DSS requires the use of computerized information systems, which include expert systems (ES) and MCDA, and their role is to support decision-makers to use data, models, and technologies during their decision-making processes. As such, it has led to the use of data-driven DSS, which is mainly focused on data interpretation. Expert systems (ES) are also referred to as knowledge-based systems (KBSs) are rule-based software programs focusing on a specific problem domain. They have incorporated the use of the web where databases are used in the storage and processing of data. When a user accesses data through a web-based DSS, access is done through a central server system, and in recent years, this has been done through web browsers. The integration of previously complex IT concepts into user friendly models have made it easier to incorporate DSS into the workplace [11].

Based on these concepts, the DSS it is evident that the different generations have emerged due to demand from organizations and departments to have the right tools and techniques to support complex decision-making processes. In most cases, such decisions are marred with risks and uncertainties, which requires the integration of human intelligence, IT, and software to interact with each other for the overall benefits of the entity. These DSS frameworks are distinguished from other IT systems through their integration of technology and operations research within a decision-makers' competence structure [13]. Furthermore, it also leads to an increasing number of alternatives and the possibilities of selecting the optimal alternatives from among a set of tested options, which offers rapid sensitivity analysis and response. Since it involves the incorporation of computer systems, it can provide support for successive and interconnected decision series. Therefore, throughout all the decision-making stages, sufficient support is accorded to the decision maker. It also improves the overall business understanding for the decision makers, which also involves visualizing relationships thus visualizing a comprehensive business image. Business operatives can also make rapid responses to unexpected situations as they can access forms and variables with ease. Business managers are also prepared with capacity to perform necessary analysis for a particular purpose, which also provides them with a variety of technical means and approaches for the preparation of analysis for specific business needs [13]. It also prepares businesses with improved communication and oversight

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capacities, and the communication channels are also well documented, which concludes in increased consistency of planning and standardized accounting procedures [13]. It also means that companies can make better decisions, improve teamwork, and use available data efficiently. Finally, it also saves time and costs as decisions made using these models are thought, and highly reliable. Therefore, an organization can have an advantage over its competition by incorporating DSS in its processes.

Understanding these concepts also requires appreciation of the aims and principles that most of these DSS frameworks possess. Since DSS enables problem resolutions to various problems, and quick responses to unexpected situations, organizations manage to operate efficiently in the dynamic work environments. These decision-support capabilities allow the resolution of unstructured and semi-structured issues, which improves the management's expertise and knowledge on matters. Therefore, as illustrated by multiple researchers, DSS should be used in organizations' decision support systems to promote assistance to the management in dealing with complex and semi-structured problems. It should also help them in making decisions rather than altering them. finally, it should be a source of effectiveness and efficiency during the decision-making process.

2.2 Benefits and the need of decision support framework in Saudi Arabia

The increasing globalization and technological advancements of the 21st century have caused businesses in Saudi Arabia to evolve in order to remain competitive. As such, decision support frameworks have become increasingly relevant in helping organizations and decision makers to gain insight into their decision-making process and optimize operations [2]. An information system designed to support decision-making by collecting, organizing, and presenting data in a meaningful way. It provides decision makers with a clear view of the decision-making process, enabling them to make more informed decisions quickly and accurately. It can help organizations identify areas of potential improvement by providing key insights into costs and performance through interactive data visualization tools.

Throughout the literature review process and analysis of the conceptual framework, the literature here identified two main gaps, which are motivated proceeding with the current research, and eventual development of an ideal decision support framework for use in Saudi Arabian organizations.

2.3 Factors that affect the development of decision support framework

There are several factors that can impact the development of a proper decision support framework. These factors can include the culture and values of the organization, how hard it is to make decisions, the quality and availability of data, and the skills and knowledge of the team that is in charge of putting the framework into place among others [14] [15] .

One of the major elements that can affect the development of a proper DSS framework is the team skills and knowledge. Setting up a new system requires the team to have the necessary skills and knowledge to understand its importance and how to use it [16] [17] [14] [18] [15]. Decision making in an organization is a team job as the person making the final decision requires the input of others within the team and at different levels within the organization. Consequently, it is critical for the organization to have individuals with the necessary team skills to operate the framework efficiently. In addition to the skills needed, the technical requirements of the project also affect its success. An extensively technical system may be challenging to implement and might also require intensive training for the users [19] [20].

A competent framework's ability to be developed might also be impacted by other significant factors, like the quality and availability of data. DSS rely on data to make decisions, Therefore the effectiveness of the system can be significantly impacted by the correctness and dependability of the data used by DSS [11] [21] [22] [15]. Organizations need

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to ensure that they have access to high-quality data that is relevant to the decisions being made and that they have systems in place to regularly review and update the data used by DSS [22]. Therefore, successful implementation also requires the organization to invest in data collection and management systems, which guarantee quality. Another critical factor is the complexity of the decision-making process which can impact the development of a proper support framework. According to [23] states that, DSS work best when used to support relatively simple and structured decision-making processes. When the DSS framework developed is complex with multiple connecting points, it might be impossible to operate for employees and potential users [16] [23] [20]. When designing a framework, it is critical that it be made as simple as possible, and also involve the users during the process to ensure they understand how it will integrate into their way of operating. The framework should be made in a way that it improves service delivery and decision-making and not making operations challenging for the users [23].

Another element relates to the cost-benefit analysis of the decision made. The financial element of such a project as per the decision made determines its potential to implement and sustain in an organization. When developed for a specific organization, the system needs to have positive cost-benefit analysis [9] [19] [20]. In addition to all the factors, the leadership support is also required [13] [16]. Most DSS frameworks are meant for use by the leaders to inform their decision-making processes. Therefore, when the leaders support the implementation, there is potential for the successful implementation of the project.

According to [14]Organizations with a strong culture of data-driven decision-making may be more likely to adopt and effectively implement DSS [14]. On the other hand, organizations with more traditional or reactive approach to decision-making may be less receptive to have the decision support framework or may struggle to effectively integrate the system into their decision-making processes. It is important for organizations to consider their culture and values when developing the decision support framework and to ensure that the framework is aligned with these values and is able to effectively support the organization's decision-making processes [14].

Finally, the time is an essential factor in the framework implementation [16]. The framework or the system require to be a timely nature to allow analysis of the data and allow decision-makers to get solutions. in addition, when the system saves time, it is easily integrated into the organization [16]. Ultimately, these factors are critical in the ultimate implementation and it may not be easy to work with them in isolation. A system must support or align to most, if not all these factors.

Table 1: Summary of the factors that affect the development of decision support framework

Factor Name	Definition	Source
Team skills and knowledge	Skills and knowledge developed towards the use of the new framework.	[16] [17] [14] [18] [15]
Quality of Data Available	The value added by available data and its reliability	[11] [21] [22] [15]
Complexity	The complication of the decision-making process	[16] [23] [20]
Cost-benefit analysis	The decision made needs to compare with the benefits it gives	[9] [19] [20]
Leadership Support	Leadership understanding and support of the whole process	[13] [16]
Communication	Interrelationship among the parties involved	[16] [24] [25]

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Technical requirements	Systems and installations needed for the system to operate	[19] [20]
Organizational data- driven culture and values	The way of doing things within the organization	[14]
Time	Adequate factor analysis time	[16]

2.4 *Decision support framework case studies*

Informed decision support frameworks are designed to assist individuals or organizations in making informed decisions by providing relevant information, analysis, and recommendations. These frameworks can be applied in a wide range of contexts, including healthcare, finance, education and technology. Below are several case studies of informed decision support frameworks from around the world. Understanding these applications is critical in identifying the gap, which is needed for further research in Saudi Arabia.

The United Kingdom Environmental Observation Funder (UK-EOF) is an organization that has set up its decision support framework with the intent of improving the decision-making processes with the public sector, and especially in environmental management. Its overall purpose and benefit are outlined in Figure 1 [26].

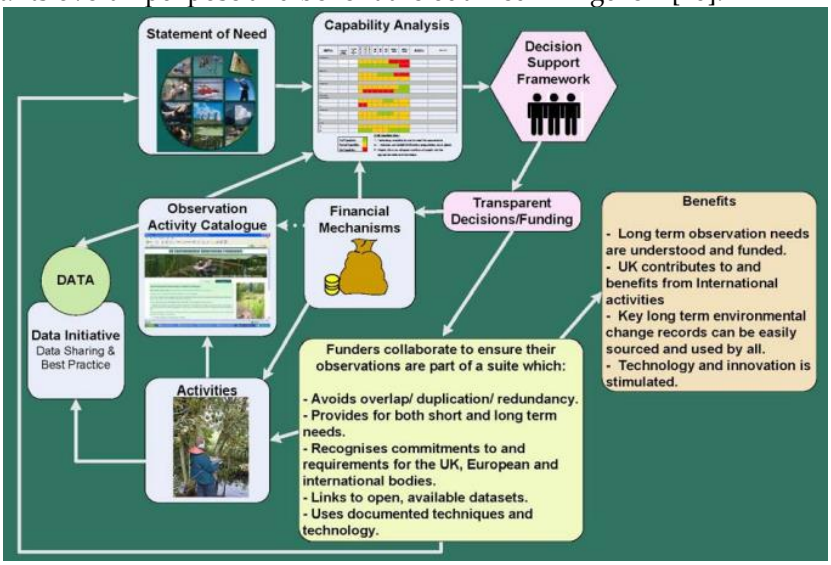

Figure 1: Benefits and purpose of the uk-eof decision support framework. source: environment research funders' forum UK- Environmental Observation Framework

The decision support framework for the UK- EOF shown in Figure 2 is a process that captures and summarizes the key evidence needed to make a decision based on a set of common criteria or issues. The process involves input from a variety of organizations and is coordinated by a central support body, such as the UK-EOF secretariat. The process has six stages, including proposal initiation, evidence gathering, discussion forum, outputs formulated, decision made, and observation activity catalogue modification [26].

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The framework begins with proposal initiation, where the proposing organization or funder assigns a member of the organization to lead the proposal. The next stage is evidence gathering, where the proposing organization or funder provides the required supporting activity description and completed draft activity scorecard, which is then circulated to external organizations for comment and scoring. The central support body then gathers the evidence, sets up a discussion forum, and provides a summary of informed responses for the proposing organization to use in making a decision. The discussion forum is the next stage, where a summary scorecard is produced using the evidence gathered. The outputs are then formulated, and the proposing organization or funder makes a decision based on the informed advice provided by the central support body and supporting organizations. The final stage is the observation activity catalogue modification, where the funder is encouraged to make any necessary changes [26].

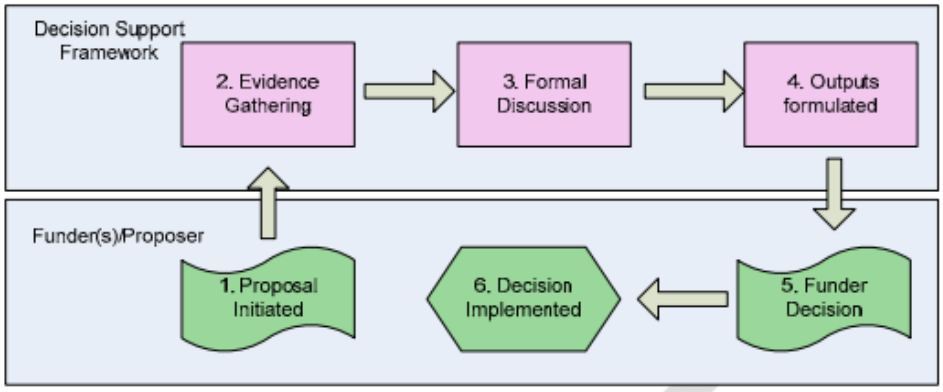

Figure 2: UK-EOF decision support framework source: environment research funders' forum uk- environmental observation framework

Marušák et al. [19] discussed a DSS approach implemented in the Czech Republic as presented in Figure 3. The system was named *optimal*, and its logical structure was based on the need of its application, which was within the forest management sector. It involved making the necessary data inputs, which included the forest stand map and forest inventory data at the start before adding information on the systems requirements, and it gave the potential harvest units [19]. It was noted as a powerful system for harvest scheduling. The authors also added that the system allowed forest managers to change the parameters and create various scenarios within a matter of minutes to find the best solutions based on specific needs [19].

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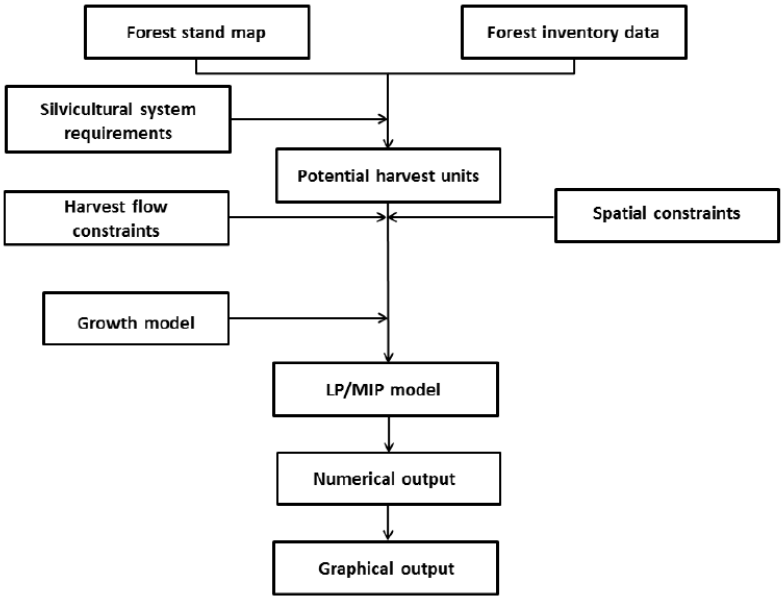

Figure 3: Optimal framework. Source: R. Marušák, J. Kašpar, and P. Vopěnka, "Decision Support Systems (DSS) optimal—A case study from the Czech Republic," Forests, vol. 6, no. 1, pp. 163-182, 2015.

Another case of the informed decision framework, the decision support framework shown in Figure 4 for improving Evidence-Informed Decision-Making (EIDM) in health service management is a comprehensive framework that takes into account all the relevant factors that influence the practice of EIDM in different types of organizations [27]. This framework is designed to provide guidance on the strategies that need to be developed and evaluated to improve EIDM in health service management. The framework is based on an understanding of the various factors that interact to influence EIDM and the relationships between these factors [27].

The framework takes into consideration all factors relevant to the various types of organizations that play a significant role in influencing EIDM. These organizations include government departments, healthcare organizations, professional and training organizations, and university and research institutions. Within each type of organization, there are various factors that affect the practice of EIDM, but it is clear that the factors relevant to each type of organization are interrelated. Therefore, to best influence the practice of EIDM amongst health services managers, changes should be introduced within the three types of organizations as detailed in the framework [27].

The framework suggests that changes should be specific and relevant to the local context, making evidence more easily understood and interpreted by managers for immediate use. This focus on promoting and rewarding the use of evidence, as well as improving the relevance of evidence, ensures that managers are making informed decisions based on the most current and relevant information available. Additionally, the framework takes into account the interrelated nature of factors relevant to each type of organization, highlighting the need for a holistic approach to improving EIDM in health service management [27].

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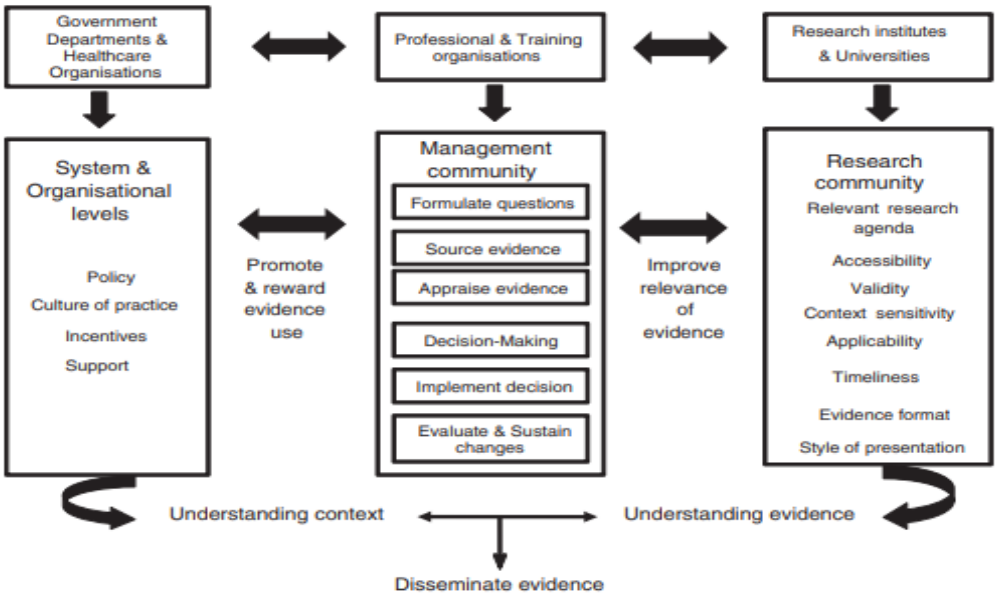

Figure 4: Framework for improving the use of evidence in managerial decision making. Source:Z. Liang, P.F. Howard, S. G. Leggat and G. Murphy,"A framework to improve evidence-informed,"Australian Health Review, vol. 36, no.1, p. 284–289, 2012.

Another model framework was applied in the University of Babylon to assist in the procurement decisions as highlighted in [17]. Their proposed a framework based on data collection from interview and consequent analysis, as well as, review of literature review. It is applicable in both simple and complex decision probabilities to assist in the provision of accurate results for each criteria as highlighted in Figure 5 [17].

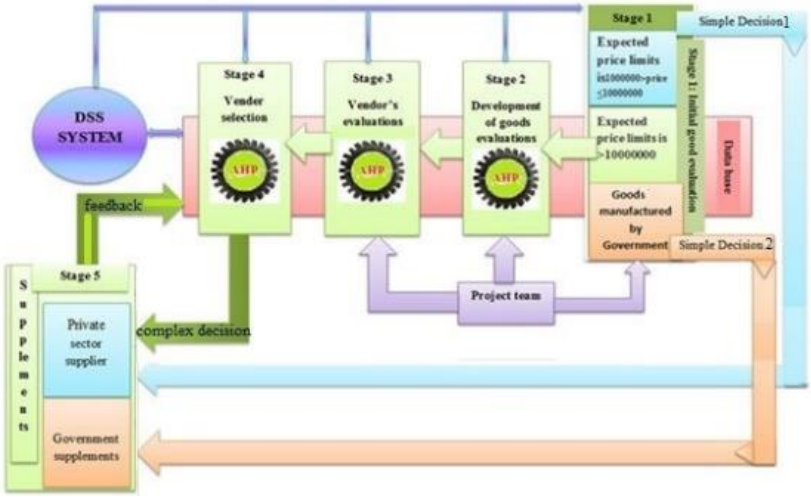

Figure 5: UOB DSS procurement framework. Source: Abid, Rahman Nahi, Suraya Bt Miskon, and Syed Norris Hikmi. Decision Support System Framework for Procurement Decisions in University of Babylon

The framework has five constructs with each of them passing through five unique stages. It starts with the initial goods evaluation in stage one followed by development of goods evaluation in stage two [17]. Stage three requires vendor bids evaluation followed by vendor selection in stage four, and finally the supplements in stage five [17].

One of the models applied in a different setting was developed by Van Delden [9].The model as presented in Figure 6 incorporates three different elements, which are the design, development, and implementation. (a) represents the relationship between the main parties that are involved in the development process to enable the functionality of the Decision support framework. Each party has their responsibility within the process

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expressed. It also identifies all the communication blocks that could have the potential to prevent the development. (b) describes the development process, which is presented as an iterative process as opposed to a waterfall. Finally, (c) places the tasks in their respective order as necessitated in the development process, and it also focuses on iterative processes that arise throughout the framework.

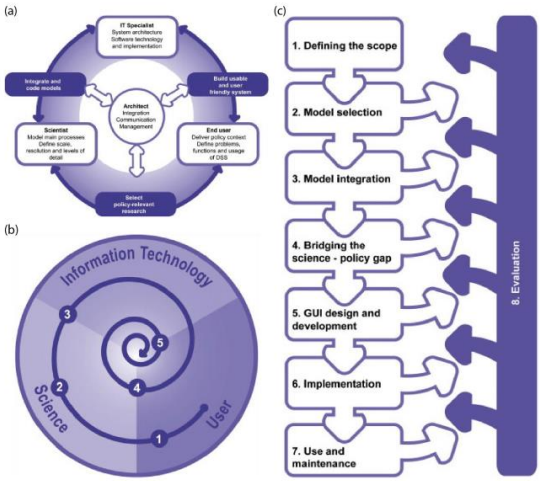

Figure 6. Decision support system framework development by Van Delen 2011, source: "Literature review on decision support systems for optimizing long-term natural hazard mitigation policy and project portfolios," University of Adelaide, Report, (2014.009)., 2014.

Di Mateo [18] proposed a decision support model for the management of cultural heritage. Their proposed framework aimed at supporting organizations and companies with interest in cultural heritage and museum management to assist in the adoption of scientific policies and criteria in their plans and management of daily operations [18]. Figure 7 is a depiction of their proposed framework.

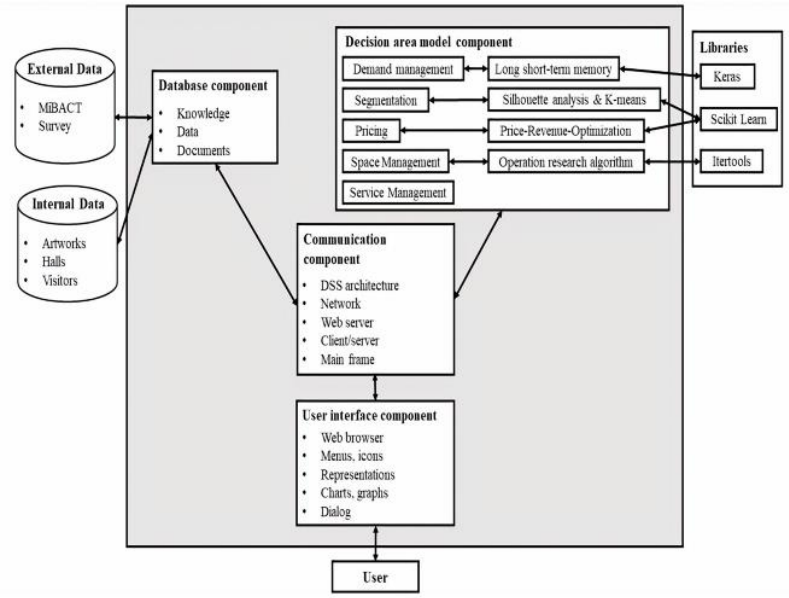

Figure 7. DSS framework for cultural heritage. Source: Di Matteo E, Roma P, Zafonte S, Panniello U, Abbate L. Development of a Decision Support System Framework for Cultural Heritage Management

Another decision support framework applied within the clinic sector is the multi-agent clinical decision support system which uses Case-Based Reasoning (CBR) [28]. The Clinical Decision Support System CDSS is created as an approach towards the improvement of medical decisions by focusing on clinical knowledge, patient information, and

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related medical information [28]. The approach integrates CBR into CDSS through a connection of the search agent to the decision agent. As highlighted in Figure 8, there is a combination of both CBR and CDSS to develop the ideal tool.

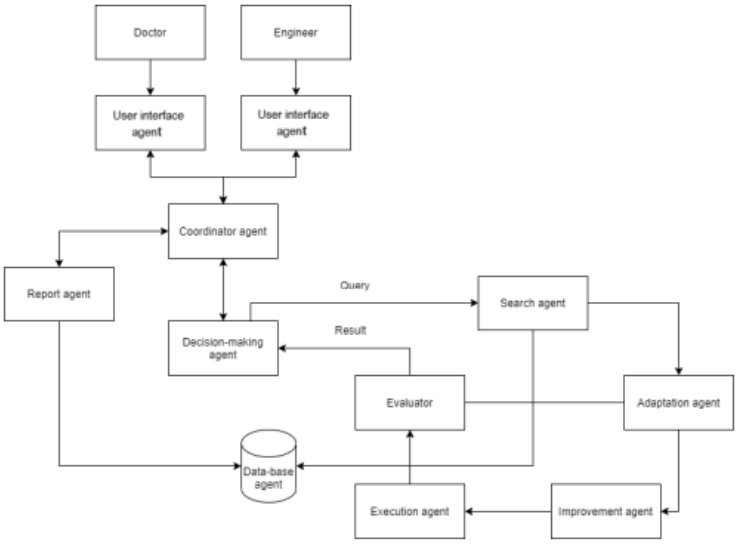

Figure 8. Architecture of multi-agent CDSS using CBR. Source: Mykola, Korablyov,; Axak, Natalia; Fomichov, , Oleksandr; Volodymyr, Hnidenko, Multi-agent Clinical Decision Support System using Case-Based Reasoning.

The process of combining CBR into CDSS requires connecting the search agent to the decision agent. The search agent allows finding the cases that are the most similar to the problem. An adaptation agent follows and they determine the differences between the selected cases and the current problem. If it is proven necessary, they set the necessary rules, which makes it possible to apply old solutions to the new problem [28]. An enhancement agent adapts checks and criticizes the results and the execution agent applies the refined solution. In the end, an evaluator is responsible for storing the results into a database and the result is shard with the decision agent [28].

Finally, the application in the field of clinical medicine was explored by [20] in Saudi Arabia and shown in Figure 9. They explored the application and experience of Clinical Decision Support System (CDSS) and its effectiveness within the healthcare sector in Saudi Arabia [20].To be successful, the system required three main areas of focus: input content, integrity of CDSS, and output advice. The input content had to be right, reliable, and updated. For the system to express the right level of integrity, it needed to integrate with Health Information System, clinical workflow, and adopt mechanisms of alerts. Finally, the output advises needed to be simple, speedy, and with references [20]. The CDSS alerts were both active and passive, and they had three main levels, which included critical, moderate, and least important. In KSA, it was implemented as part of the Evidence-Based Medicine for the improvement of patient safety. It offers clinicians with the necessary knowledge of the specific patients or diseases which facilitate taking the decision.

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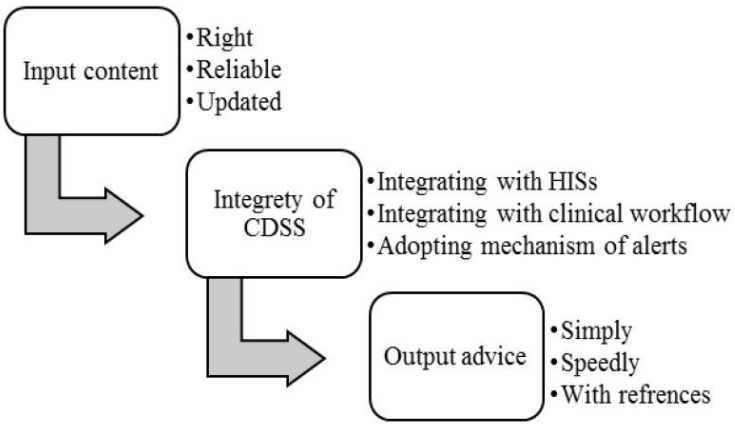

Figure 9. Requirements of CDSS success . Source: Alqahtani, Sahar S, Alshahri, Sabah, Almaleh, Ahood, Nadeem, Farrukh. IJ Information Technology and Computer Science

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Table 2: Summary of the decision support framework presented

Framework Name	Specialty	Country	Source
Environmental Observation Framework (EOF)	Environmental Management in Public Sector	United Kingdom	UK-EOF [26]
Optimal	Forest Management	Czech Republic	Marušák et al. [19]
Evidence-informed decision-making in health service management framework	Health Service Management	Australia	Liang et al. [27]
UOB DSS procurement framework	University setting	Iraq	Abid et al. [17]
Decision Support System Development Framework	Natural Hazard Mitigation	Australia	Newman et al. [9]
DSS framework for cultural heritage	Cultural Heritage Management	Italy	Di Mateo et al. [18]
Multi-agent Clinical Decision Support System using Case-Based Reasoning	Clinical sector	Ukraine	Korablyova et al. [28]
Clinical Decision Support System (CDSS)	Clinical sector	Saudi Arabia	Alqahtani et al. [20]

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3. Proposed Framework

One of the main gaps indicated that most models focused on specific sectors, such as health, forestry, education, etc for specific organizations, which reduces their application in other settings. Additionally, the literature did not find any clearly published framework that would generally can be applied to the decision-making processes for leaders and decision makers in Saudi organizations and serve a business decision. In addition, the need of a comprehensive process of the decision making which this research intended to conduct. Therefore, the research aimed and worked with the data collected to formulate and identify an ideal that would apply in the Saudi organizations to foster decision making. Although there are multiple frameworks for improving the informing and the quality of the decision making, there is a lack of comprehensive overview of the factors that impact the decision quality and accuracy. As mentioned in the factors previously that one of the key factors are related to the quality of data availability. Therefore, and to answer the research question, of how the decision makers assure the decision accuracy with covering all the aspects. Including the non-digital sources and the data management authority which have an impact on the decision beside the digital sources are should be taking into account in the proposed framework. Moreover, to ensure the effectiveness of the framework, a defined set of decision criteria must be applied to the decision's issue.

The proposed Informed Decision Support Framework (IDSF) for the Saudi organization that taking health sector as example shown in Figure 10 outlines a comprehensive process for tackling strategic decisions at the operational, managerial, and strategic levels. The (IDSF), comprising an Informed decision support (IDS) committee, will be responsible for overseeing and implementing the framework.

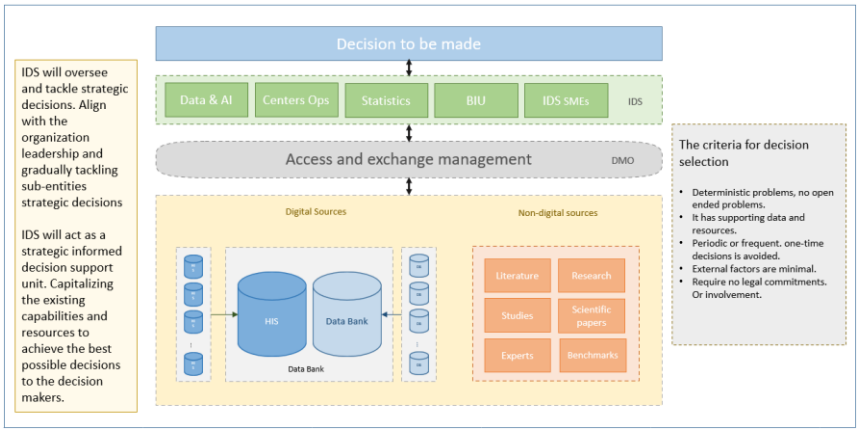

Figure 10: the proposed Informed Decision Support Framework (IDSF)

A notable aspect of the framework is the ability to focus on structured, semi-structured, and unstructured decisions. Structured decisions are those that are repetitive and routine, and for which a definite procedure can be followed. Semi-structured decisions involve a mix of clear-cut answers provided by accepted procedures and the need for judgment, evaluation, and insights. Unstructured decisions are those that require the decision maker to provide judgment, evaluation, and insights into the problem definition. By addressing all three types of decisions, the framework aims to provide a comprehensive approach to informed decision making.

The framework also outlines a set of criteria for selecting decisions for consideration in order to make sure of the decision accuracy and efficiency, including the need for supporting data and resources, the frequency of the decision, and the minimal impact of external factors. This helps to ensure that the IDS committee is able to focus on those decisions that are most suitable for informed decision making.

There are several components of the framework, which include Data & AI, which refer to the data and AI responsible for data storage and retrieval. The second component

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is the centers operation , which is responsible for the monitoring all the health centers and the services provide and their performance. The Business Intelligence Unit (BIU) is another component, which is specific for the health cases and events. They have vital information and they avail information related to the statistics and IDS SME. As represented in the figures above, the criteria about the framework involves deterministic problems and no open-ended problems. Therefore, it means that there are no decisions to resolve general issues. It was critical to ensure that the framework could access the necessary supporting data and resources. Furthermore, any periodic or frequent one-time decisions must also be avoided. The external factors should also be minimal and focus on issues has the least legal commitments or involvement.

The process flow of the framework shown in Figure 11 is thorough, starting with the receipt of a problem or question from the leadership and proceeding through stages including problem definition, data requisition and approval, data acquisition, scenario/research implementation, and dissemination. Each stage is subject to review and approval by the IDS committee and relevant execution teams, ensuring that the process is well-coordinated and that decisions are thoroughly researched and evaluated which is answered the research question of how to assure the decision accuracy through a proper process.

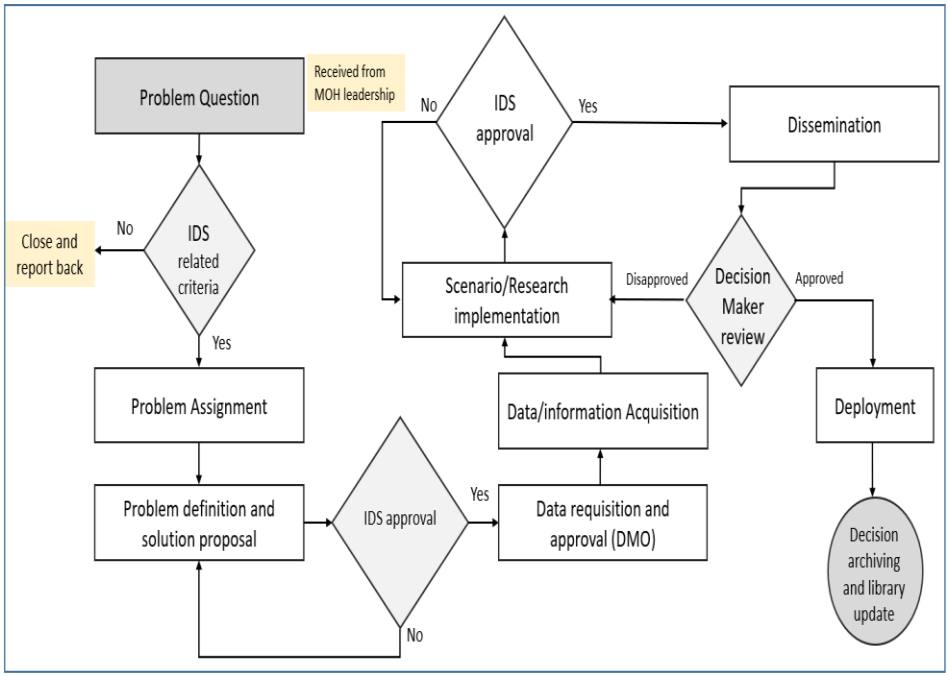

Figure 11: the process flow of the Informed Decision Support Framework

Overall, the IDSF proposed for the health sector appears to be a comprehensive and well-structured approach to informed decision making. By addressing a range of decision types and utilizing a thorough process flow, the framework aims to ensure that the organization is able to make informed and accurate decisions that drive better outcomes.

4. Methodology

There is also an extensive coverage of the data collection tool used. The aim of the study was to develop an informed decision support framework for Saudi Arabian organizations. As the organizational gets complex and there is an increase in data available to decision makers, there is an inherent need to make sure that the leaders have sufficient tools to make informed decisions based on the information available to them. Therefore,

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the research here has adopted a multi-faceted research approach. For this study, the research opted a qualitative research approach [29]. The research has explored into an intensive literature review as they presented on the literature review, which included relevant case studies from across the world, and interviews with different decision makers in the Saudi organization which will be introduced in this section.

4.1 Data collection

The data will be gathered utilizing a qualitative methodology by conducting interviews with decision makers due to the study's experimental character and the limited time available. The decision to use the qualitative methodology and interviews to collect data was informed by the elements of the study requirements, and time limitations relating to data collection. Furthermore, the merits of qualitative research over quantitative were also part of the reasoning for the choice. Quantitative research approaches are designed for the collection of numerical data, which can be applied in the measurement of variables [32]. Usually, the quantitative data is structured and statistical and the results obtained are objective and conclusive. Furthermore, the approach uses the grounded theory, which depends on systematic analysis of the collected data [32]. Furthermore, the quantitative research approach provides the necessary support when they need to draw general conclusions from their research and predict potential outcomes. To power this study approach for data collections, researchers tend to choose for surveys [32]. These tools are considered flexible, cost effective, and they allow to collect data from an extensive sample size.

However, the research focused on the organizations in Saudi Arabia, which required the inclusion of Saudi organizational decision makers. Consequently, the idea was to identify whether the targeted organization had the ideal informed framework to allow informed decision making or what they felt was necessary towards the development of an ideal tool to assist them in the decision-making process. Ultimately, there were five participants who were mainly decision makers in the organization. The aim was to get responses from all levels of leaders, including both top level and low-level managers. The decision to select five participants was informed by the findings of Crewell who recommended 5 to 25 participants and Boyd (2001) who recommended 2 to 10 participants provided that the study had thematic redundancy [34].

The interviews focused on two main sections. The first section was an introduction to the study and it collected data about the participant. The second section focused on answering the seven interview questions and getting responses to the overall research aim.

4.2 Interview role and sample

An interview with a few of decision-makers in the health sector will be conducted to get their responses to the questions that prepared.

The role of the interviewer may summaries as following [35]:

1- Getting ready for the interview.
2- Find respondents and solicit their cooperation.
3- Address any misunderstandings or worries.
4- Watch the level of the answer's clarity.
5- Document the answers to start the analysis phase.

5. Results and Analysis

Here, the research presents the results based on the data collected. It informs the way forward on the development of an informed decision framework to support decision making in the Saudi organization. There were five interviewees who responded to seven semi-structured interview questions. All the five interviewees were leaders in five different departments in the organization. Their personal details and names of their organizations are left out from the report to ensure confidentiality.

When analyzing the data, the researcher searched for data familiarity, which meant reading the responses and understanding the data offered, impressions, and meaning to get all the necessary data from the myriad of information offered [33]. Also, Through the analysis, the key questions that needed to be answered were identified. Furthermore, a

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focused on answering each of the seven interview questions and comparing the results to literature findings. Coding and indexing data during the analysis process also proved critical as it enabled to group the information based on various common elements including ideas, behaviors, concepts, phases, and interactions, among others [36]. Coding also made it possible to manage the information, and get the required answers from the bulk of information offered by the interviewees. Therefore, Table 3 has been used to summarize and facilitate the analysis phase. The interviews were had five participants, and the interviewer took between 30 minutes and an hour to complete with each participant. There were seven questions, and each of the participants had a unique take on the responses given their experience and organizational set up. Different sectors within the organization were represented, which could be seen as a representative sample to handle the concept of IDSF within Saudi Arabian organizations.

5.1 Interviews Answers analysis

A. Question one

The first question asked the interviewees, who were decision makers in the organization, about their thoughts regarding the present decision-making processes within their organization. It also required them to express whether they could guarantee the veracity of the decisions. All the interviewees shared their opinions based on what they had experienced within their organizations. For the most part, all the departments represented had some form of a decision-making process, but the differences emerged when describing how it worked, and how veracity could be guaranteed. According to P1, their organization was hierarchical, and the decision-making process required different individuals to participate based on their levels of authority. They also highlighted the importance of the type of decision needed, urgency, or the overall strategy affected.

"*As a decision-maker, I am part of the process, and I play my role based on the type of decision being made. While in some cases, and especially when strategy is involved, the decision is largely top-down, there are others where the team at the bottom present options for validation. Therefore, it depends on the type of decision being made, and the reason and urgency involved*."

A similar stance was taken by P2 who also indicated that strategic decisions were made by the top leaders in their organization. P3 stated:

"*necessary to identify the authority of the individuals who can work on the decision-making process. Finally, the decision-makers have to seek for the relevant information, data and resources that they intend to use during the process*."

Therefore, all the participants understood what the question required of them, and they shared their opinions based on the operations within their sectors. They also highlighted the need for improvements to ensure validity of the solutions offered during decision making processes.

B. Question Two

The second question investigated into the issues of systems within the organization and what should be used when dealing with decision making. All the respondents had views and opinions regarding potential systems for use, whether they were within their sectors, or they understood their importance based on industry understanding. P3 stated that the BIU, data and statistics sources were critical for the organization when making decisions. Data and statistics were also selected by P1 who stated:

"*In my opinion data and statistics allow even a perform unfamiliar with an issue to make a conclusive and informed decision*."

P5 highlighted two important elements: which included an internal system within an organization dedicated to support decision making. They also mentioned the importance of Centers Operation from which all relevant health information can be accessed to inform the basis of decision making for an entity.

He said:

"*Firstly, an organization's internal system that supports decision making…Secondly,* Centers Operation *which has the access to all the relevant health information within the organization.*"

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C. Question three

The third question asked the interviewees about the decision criteria that should be taken into account prior to starting the decision-making process. P4 stated that there was a need to understand the type of decision that was required, and in the event that it was a strategic decision for the organization, an informed alternative was necessary. It would be powered by getting the necessary data and exploring potential impact. P3 stated:

"*the initial process requires defining the problem and identify how it impacts on the organization*."

For most of the responses, the interviewees highlighted the importance of defining the problem to understand the level of authority required to resolve it and allow the organization to find the necessary resources to support the process. P1 also raised an essential concept by adding that it was necessary to assess the impact that the problem or ultimate decision would have on the organization, which would inform the level of authority that the decision maker required.

"*one needs to identify the actual problem. It means that the problem is defined and each of its relevant elements presented. At this stage, the identified problem is classified in line with its impact within the organization*."

D. Question Four

The fourth question requested the interviewees to state the sources that had the biggest impact on decisions. While the sources of the ultimate information to make the decision could be diverse, P1 stated:

"*There could be multiple sources, but one of the determinants is the actual problem. Once it is analyzed, one can find the most ideal approach to handle it and find a solution*."

One of the sources that they highlighted as important was industry data from which the organization could benchmark what its peers were doing. Internal sources of information, both digital and non-digital were selected as critical in the decision-making process by P2. Their argument was that most organizations had a many of data about their historical performance and the results of different actions, which they had not taken into perspective when implementing selected decisions. P3 had an extensive list of the vital information that their organization required and the sources that they found essential in the process. He said:

" *Customer surveys, market research, financials, and the related reports, opinions of experts in the field, such as consultants, lawyers, and financial advisors…data from external sources, such as government regulatory agencies*."

P5 selected the organizations within the industry that they found critical in the process, and according to them, all the statistics and data collected through customer surveys, BIU and Centers Operation were vital sources for their organization.

E. Question Five

The fifth question asked about the effectiveness of the decision-making process when using digital and non-digital sources. According to the respondents, there was evidence of the fact that they understood how the world was moving away from analogue or non-digital formats to digital formats. Accordingly, a combination of the two sources was selected as the most effective option by most participants. P4 highlighted the importance of considering to use non-digital sources since, according to them, digital sources were often inaccurate.

"*A business must utilize both digital and non-digital data sources. The digital sources, however, are not always accurate. In order to help the decision-making process, it is crucial to take into account non-digital sources*."

P5 stated that the use of digital sources gave the decision maker access to a wide range of information, and the process of retrieving non-digital materials was times-taking, which could delay the decision-making process.

He said:

"*When coupled with the swiftness of digital technology and authenticity of non-digital materials, a decision-maker has access to some of the most critical information tools necessary*."

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F. Question Six

Question six asked about the importance of DMO in the decision decision-making process. P3 stated that they were critical as tools of controlling the decision-making process.

"Limiting access to information, data and potential actions enable organizations control the decision-making process."

Additionally, they ensured that sensitive data within the organization necessary for the decision-making process was only accessible to authorized parties. P5 stated that DMOs were necessary to ensure that individuals only made the necessary input according to their level of authority in the sense that if a person was only required to save information, they could not retrieve it and edit without getting the proper authority. P4 stated that DMO served two main purposes and said:

"It's the central unit to guide the decision-making process to the right information, it gives a clear indication of the information's precise source and assure the right access to the data."

Therefore, the importance of DMO was evidently understood by all the participants, and they highlighted the need for every organization to have such a system within its processes.

G. Question seven

Finally, the last question asked the interviewees to state whether they believed that the addition of Centers Operation, BIU, Statistics, Data, and IDS would improve the decision-making process accuracy. For the most part, all these tools were thought to be important due to their impact on access to data and statistics, which would increase their impact on decision accuracy. According to P3:

"data and statistics form the backbone of any decision."

P4 highlighted the importance of aligning these sources to ensure that the organization prevented duplicity. Finally, P5 stated that the tools improved the process, and they were well planned and could be easily audited. They also ensured that the decision-making process presented the required relevance to the organization.

"An accurate decision-making process is one that is well planned, and easily audited. When multiple tools are added and they interact with ease, it becomes an ideal tool to promote the framework and its operations."

Finally, Table 3depicts the interview questions as well as the interviewees' responses to each question.

Table 3: a summary of each participant response for all interview questions

Interview analysis table					
Question#	P1	P2	P3	P4	P5
Q1: As a decision-maker, what do you think of the organization's present decision-making process? And how can you guarantee the veracity of the decision?	X	X	X	X	X
Q2: Considering that you interact with a variety of systems within the company, what do you think of the systems should be taken into consideration when making decisions?	X	X	X	X	X
Q3: What do you think about the decision criteria that should to be taken into account before getting started the process of decision-making?	X	X	X	X	X
Q4: What are the sources that could have the biggest impact on the decision?	X	X	X	X	X
Q5: How effective is the decision-making process when using digital and non-digital sources?	X	X	X	X	X
Q6: How crucial is the DMO's presence in the decision-making process?	X	X	X	X	X
Q7: Do you believe adding (Centers operation, BIU, Statistics, Data, and IDS) will improve the decision-making process' accuracy?	X	X	X	X	X

6. Discussion and Outcomes

The research analyzed the industry problems within Saudi Arabia and found a gap in the decision-making processes within organizations. Fundamentally, there was a lack of systems implemented or implementable by organizations at large to allow their decision makers make decisions from an informed perspective. For this reason, the researcher

 doi:10.20944/preprints202305.0135.v1

interrogated literature and interviewed five decision makers from the health sector regarding the possibility of implementing an informed decision support framework that would improve the processes.

The initial research questions focused on how the decision makers ensured accuracy of the decisions they made, and what proper processes were in place to govern and control the results of the decisions. Therefore, the findings analyzed in the previously were meant to inform whether their proposed framework would be applicable within these organizations, and whether it would improve the accuracy of the existing processes.

One of the issues that became clear from the beginning was that most of the organizations lacked for an informed framework within their entities. In some cases, there were no well-planned processes, which guided the decision makers on areas of focus. As the researcher had found out during the literature review, there was a gap within Saudi organizations in the sense that a model applicable to all organizational decision-making processes was lacking. Furthermore, there was no specific model that could be applied by all decision makers, which necessitated the implementation of the proposed model.

When asked about the tools that would be necessary to incorporate into the system, the participants were vocal regarding the importance of tools aligned to data and statistics. These findings aligned to an element that most of the models analyzed during the case study presented. For instance, Liang [27] had source of evidence as part of their model, and so did Di Matteo [18] who incorporated both external and internal data as part of their database component.

Another element that came up as critical for the framework was the concept of time, which some of the results indicated that it was critical based on the decision that needed to be made. Essentially, when a decision was needed swiftly, the sources of data that could be used would be mainly digital give their ease of retrieval and analysis. Similar views had been raised by Almalki [16] as they highlighted the challenges of the implementing information systems. The organizational structure was also a critical issue shared in the results as it determined how the decisions were made. Even in organizations that lacked clear systems, they still followed the levels of authority, which governed their entity. It was in agreement with the findings of Al Shobaki and Abu-Naser [25] who stated that the levels of authority were critical in the development of effective informed decision support frameworks.

The decision makers interviewed in the process were in support of the elements and tools presented in the proposed framework. They agreed that they would be compatible to their organization, and they would improve the accuracy of the decisions. Furthermore, they would develop a formal process that would guide all the decisions within their sectors.

The paper presented critical elements within the proposed framework, which resolved some of the gaps identified during the literature review. The use of foreign non-digital sources has been largely left out by other models, including what has been described in Figure 1, 4 and 7, which fail to recognize or mention them.

Contrary to the options presented in these frameworks, the proposed framework has an option to use both digital and non-digital sources, which the interviewees also supported as being a critical source of information for their organizations during the decision-making process. Furthermore, several cases have been found of some form of decision framework in Saudi Arabia, they were not applicable to all organizations. Therefore, the proposed framework also resolved this problem by presenting a model that can be easily replicated and adapted to any organization. Therefore, through the proposed model, the paper resolved major gap issues identified during the literature review process.

However, the findings supported most of the views that have been raised when identifying the research problem. There was a general agreement that Saudi Arabia lacked a general IDS framework that could apply in all organizations. In addition, the researcher concluded that the introduction of the proposed framework would be welcome for the organizations, and it was also necessary as a tool for improving the accuracy of decisions.

 doi:10.20944/preprints202305.0135.v1

Additionally, sources of data and statistics came up as essential elements of the framework, and they would strengthen the authority of the decisions.

Therefore, the implementation of the proposed framework for all entities within Saudi Arabia is recommended to assist in their decision-making frameworks. It is also recommended that they adjust its processes and elements to fit into their structure and organizational processes. In addition, the automation of the scenarios to be adapted and enhanced through a digitalized DSS framework.

Table 4: A summary of the components discussed

Findings Analysis Table				
Component	**Literature finding**	**Research finding**	**Similarity**	**Differneces**
Process and Accuracy	*the decision framework and DSS requires data to ensure accuracy and reliability of the processes [11][21][22][15]. Therefore, the quality of data is critical in the process and accuracy.*	*Data make up a significant part in ensuring the effectiveness of a decision-making system*	*Data is critical in guaranteeing the effectiveness of the process, and the accuracy of decisions made.*	*The only differences emerge from the inclusion of specific elements and tools into the system, which guarantee the accuracy and process in addition to data, such as IDS and NHCC*
Internal & external data	Data is a critical component in the decision-making process [13][9][18][27]	data falls into various categories based on its application in the decision process and format. It can be digital nor non-digital.	the importance of data in the framework is highlighted in both cases.	In the literature review non-digital sources are not expressively defined and explained in relation to their importance.
Non-digital sources	*The literature review did not capture signficant information on the use of non-digital sources*	*The findings highlighted the importance of non-digital sources due to their authenticity and availability in*	*None*	*Literature review did not include the component as part of materials discussed.*
Statistics	*Statistics also make up essential information sources in the decision-making process.[10]*	*Statistics are vital, which necessitates the inclusion of both internal and external sources.*	*The identification of the importance of statistics in decision-making is evident in both the study and reviewed literature.*	*The literature does not expound on the importance of including both internal and external statistics from both digital and non-digital sources.*
Data management and autherity	*The literature did not include DMO*	*DMO is explained as critical in the decision-making process of any organization as it presents the levels of authority and limits access to critical information to authorised personnel only.*	*None*	*Current research expounds on the importance of DMO, which is an apparent gap in literature.*
Decision Criteria	*The decision criteria is essential in the proces of decision making as evidenced in the frameworks, such as the MCDA that presents its vitalness in complex problems [11].*	*The decision criteria is fundamental in decision making processes of any organization.*	*The importance of the decision criteria*	*Greater emphasis and description is shared in the current research than literature.*
Applicability	*The frameworks are only appliacable in their specific fields*	*The proposed framework can apply in any organaization*	*all models focus on enhancing decision making*	*Unlike other frameworks, the proposed model can be used in all organizations in any part of the world.*

6. Conclusions

The informed decision support framework has the potential to dramatically enhance the precision and effectiveness of decision-making in a wide range of industries and organizations. The implementation of DSS across the Gulf region, particularly Saudi Arabia, has not, however, been without obstacles. In the absence of appropriate frameworks in the region, the effectiveness and impact of these systems, as well as the capacity of businesses to make informed and accurate decisions, have been compromised. For future studies, it is needed need to conduct a similar study from a survey perspective to increase the scope that it could reach and compare the findings. In addition, also proposes future studies focused on how the proposed framework could be applied in each of the sectors within Saudi Arabia. Also, a study on how to incorporate the time as a factor that affects the decision-making process is also recommended.

Conflicts of Interest: The authors declare no conflict of interest.

 doi:10.20944/preprints202305.0135.v1

References

1. Zong, Ke, et al. "Or-based intelligent decision support system for e-commerce." Journal of Theoretical and Applied Electronic Commerce Research 16.4 (2021): 1150-1164.
2. Aversa, P., Cabantous, L. and Haefliger, S., 2018. When decision support systems fail: Insights for strategic information systems from Formula 1. The Journal of Strategic Information Systems, 27(3), pp.221-236.
3. Gupta, S., Modgil, S., Bhattacharyya, S. and Bose, I., 2022. Artificial intelligence for decision support systems in the field of operations research: review and future scope of research. Annals of Operations Research, pp.1-60.
4. Martins, D., Assis, R., Coelho, R. and Almeida, F., 2019. Decision support system for business ideas competitions. Journal of Information Systems Engineering and Management, 4(3), p.em0093.
5. H. Allaoui, Y. Guo, and J. Sarkis. "Decision support for collaboration planning in sustainable supply chains," Journal of Cleaner Production, vol. 229, pp. 761-774, 2019.
6. Zhavoronkova, V. Zhavoronkov, and N. Khoroshchak. "Trends in the development of transnational business in the context of globalization and the pandemic (COVID-19)," Science. Business. Society, vol. 7, no. 1, pp. 15-20, 2022.
7. Farshidi, S., Jansen, S., De Jong, R. and Brinkkemper, S., 2018, July. A decision support system for cloud service provider selection problem in software producing organizations. In 2018 IEEE 20th Conference on Business Informatics (CBI) (Vol. 1, pp. 139-148). IEEE.
8. D. J. Power, "A brief history of decision support systems," DSSResources, http://DSSResources.COM/history/dsshistory.html, version 2.8, 2003.
9. J. P. Newman, H. R. Maier, H. van Delden, A. C. Zecchin, G. C. Dandy, G. Riddell, and C. Newland, "Literature review on decision support systems for optimising long-term natural hazard mitigation policy and project portfolios," The University of Adelaide, Report, 2014.
10. D. Arnott and G. Pervan, "A critical analysis of decision support systems research revisited: The rise of design science," Journal of Information Technology, vol, 29, pp. 269-293, 2014.
11. G. Talari, E. Cummins, C. McNamara, and J. O'Brien, "State of the art review of Big Data and web-based Decision Support Systems (DSS) for food safety risk assessment with respect to climate change," Trends in Food Science & Technology, vol. 126, pp. 192-204, 2022.
12. D. J. Power and S. Kaparthi "Building Web-based decision support systems," Studies in Informatics and Control, vol. 11, no. 4, pp. 291-302, 2002.
13. M. J. Al Shobaki, "The strategy and its impact on the use of decision support systems in Palestinian universities," International Journal of Academic Management Science Research (IJAMSR), vol. 5, no. 6, pp. 70-86, 2021.
14. M. W. L. Moreira, C. J. Rodriques, V. Korotaev, J. Al-Muhtadi and N. Kumar, "A Comprehensive Review on Smart Decision Support Systems for Health Care," IEEE Systems Journal, vol. 13, no. 3, pp. 3536-3545, 2019.
15. F. Alharbi, A. Atkins and C. Stanier, "Strategic Framework for Cloud Computing Decision-Making in Healthcare Sector," The Seventh International Conference on eHealth, Telemedicine, and Social Medicine, vol. 1, pp. 138-144, 2018.
16. Almalki, S. Al-fleit, and A. Zafar, "Challenges in implementation of information system strategies in Saudi business environment: A case study of a bank," International Journal of Computer Trends and Technology, vol. 43, no. 1, pp. 56-64, 2017.
17. R. N. Abid, S. B. Miskon, and S. N. Hikmi, "Decision Support System Framework for Procurement Decisions in University of Babylon," Journal of Information Systems Research and Innovation, vol. 5, pp. 54-62, 2013.
18. E. Di Matteo, P. Roma, S. Zafonte, U. Panniello, and L. Abbate, "Development of a Decision Support System Framework for Cultural Heritage Management," Sustainability, vol. 13, no. 13, 7070, 2021.
19. R. Marušák, J. Kašpar, and P. Vopěnka, "Decision Support Systems (DSS) optimal—A case study from the Czech Republic," Forests, vol. 6, no. 1, pp. 163-182, 2015.
20. S. S. Alqahtani, S. Alshahri, A. I. Almaleh, and F. Nadeem, "The implementation of clinical decision support system: A case study in Saudi Arabia," IJ Information Technology and Computer Science, vol. 8, pp.23-30, 2016.
21. H. J. Marvin, E. M. Janssen, Y. Bouzembrak, P. J. Hendriksen, and M. Staats, "Big data in food safety: An overview," Critical Reviews in Food Science and Nutrition, vol. 57, no. 11, pp. 2286-2295, 2017.
22. A. S. Musaad, Z. Zuo, Z. A. Siyal, G. S. Muhammad, S. A. Shah and Y. A. Solangi, "An Integrated Multi-Criteria Decision Support Framework for the Selection of Suppliers in Small and Medium Enterprises based on Green Innovation Ability," Processes, vol. 8, no. 4, p. 418, 2020.
23. D. M. Barakah and S. S. Alwakeel, "Impact of CPOE on physicians and dentists' work performance at King Saud Medical Complex Hospital: A case study," In Proceedings of the World Congress on Engineering and Computer Science, vol. 1, pp. 20-22, 2009.
24. M. J., Al Shobaki and S. S. Abu-Naser, "Decision support systems and its role in developing the universities strategic management: Islamic university in Gaza as a case study," International Journal of Advanced Research and Development, vol. 1, no. 10., pp. 33-47, 2016.

 doi:10.20944/preprints202305.0135.v1

25. K-EOF. Decision support framework concepts and tools: A step towards transparent, evidence based decision making in the UK public sector.
26. Z. Liang, P. F. Howard, S. G. Leggat, and G. Murphy, "A framework to improve evidence-informed decision-making in health service management," Australian Health Review, 36(3), 284-289, 2012
27. M. Korablyov, N. Axak, O. Fomichov, and V. Hnidenko, V. "Multi-agent Clinical Decision Support System using Case-Based Reasoning," In COLINS (pp. 1466-1476), 2021.
28. S. Dawadi, S. Shrestha, and R. A. Giri, "Mixed-methods research: A discussion on its types, challenges, and criticisms," Online Submission, vol. 2, no. 2, pp. 25-36, 2021.
29. S. Jamshed, "Qualitative research method-interviewing and observation," Journal of Basic and Clinical Pharmacy, vol. 5, no. 4, 87-88, 2014.
30. J. Woiceshyn and U. Daellenbach, "Evaluating inductive vs deductive research in management studies: Implications for authors, editors, and reviewers," Qualitative Research in Organizations and Management: An International Journal, vol. 13, no. 2, pp. 183-195, 2018
31. J. F. Gubrium, J. A. Holstein, A. B. Marvasti, and K. D. McKinney, eds. The SAGE handbook of interview research: The complexity of the craft, Sage Publications, 2012
32. Bhattacherjee, A., 2012. Social science research: Principles, methods, and practices.
33. R. Sobh, and C. Perry, "Research design and data analysis in realism research," European Journal of marketing, vol. 40, no. 11/12, pp. 1194-1209, 2006.