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Decision Support System Adoption Model for Better Emergency Preparedness in UEA Civil Defence: Theoretical Framework

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Abstract

Decision Support Systems (DSS) play a crucial role in enhancing decision-making processes, especially in high-stakes environments such as civil defence. In the United Arab Emirates (UAE), DSS has the potential to revolutionize emergency preparedness and response, enabling faster, more informed, and efficient decision-making during crises. However, the widespread adoption of DSS within the UAE Civil Defence is hindered by several challenges, including resistance to change among personnel accustomed to traditional methods and a lack of awareness regarding the benefits DSS can provide. Despite the growing recognition of DSS's importance, there remains a significant gap in understanding the specific factors that influence its acceptance in this context. This study aims to address these challenges by conducting a systematic review to identify and analyze the key factors that affect DSS acceptance within the UAE Civil Defence. The major findings highlight the critical need for a tailored DSS adoption model that considers the unique operational and cultural environment of the UAE Civil Defence. The absence of such a model hinders effective DSS implementation, potentially limiting the benefits these systems could offer. To bridge this gap, the study proposes the development and rigorous validation of a novel DSS adoption model specifically designed for this context. Further research is suggested to explore the long-term impact of DSS adoption on operational efficiency and to examine the applicability of the proposed model in other sectors or regions. Ultimately, this research seeks to enhance the UAE's emergency preparedness and response capabilities by fostering greater acceptance and utilization of DSS within its Civil Defence framework.

Keywords: Decision Support System Adoption, Emergency Preparedness, Civil Defence Framework.

Introduction

In the rapidly evolving field of emergency management, Decision Support Systems (DSS) have emerged as crucial tools for enhancing decision-making capabilities. These systems are designed to support decision-makers by integrating heterogeneous data sources, evaluating complex scenarios, and providing actionable insights during emergencies (Al-Sabaan et al., 2021). For the UAE Civil Defence, which faces unique challenges due to its strategic location and rapid urbanization, DSS offer significant potential to improve emergency preparedness and response (Al-Ali et al., 2022).

Despite the recognized benefits, the adoption and effective implementation of DSS within the UAE Civil Defence encounter several hurdles. Resistance to technological change and a preference for traditional decision-making methods often impede the integration of new systems (Omar et al., 2023). Additionally, there is a lack of tailored DSS adoption models that account for the specific operational and cultural context of the UAE Civil Defence, which complicates successful implementation (Khan et al., 2023).

This paper is reviewing the current literature on DSS and its application in the UAE Civil Defence, highlighting the need for context-specific models and strategies. It also examines two foundational theories relevant to this research: the Technology Acceptance Model (TAM) and DeLone and McLean's Information Systems (IS) Success Model. The TAM provides insights into perceived usefulness and ease of use as factors influencing DSS acceptance (Venkatesh & Bala, 2021), while DeLone and McLean’s model emphasizes system quality, information quality, service quality, and user satisfaction as critical determinants of system success (DeLone & McLean, 2020). By integrating these theories, this study aims to develop a comprehensive framework for understanding and enhancing DSS adoption within the UAE Civil Defense.

Literature Review

Decision Support Systems (DSS) are recognized for their unprecedented capabilities in enhancing emergency preparedness, offering advanced tools for analyzing complex data and supporting critical decision-making during emergencies (Arnott & Dodson, 2008). Despite these advantages, there remains skepticism about the overall effectiveness of DSS due to well-publicized failures and challenges in demonstrating their value (Arnott & Dodson, 2008). This skepticism underscores the need for robust metrics and frameworks to assess the full impact of DSS investments on emergency preparedness and civil defense.

Historically, the need for meaningful metrics to evaluate Information Systems (IS) investments has been emphasized (DeLone & McLean, 1992b). However, a comprehensive framework that organizes the critical components of an effective DSS for emergency preparedness is still lacking. Existing research has primarily focused on conceptual principles, case studies of DSS implementations in large organizations, and clinical research, leaving a gap in empirically validated models specifically tailored for evaluating DSS adoption and success in contexts like civil defense (Aria & Archer, 2019).

Recent studies highlight that while DSS have been widely disseminated across various sectors, there is a notable absence of empirically verified models and frameworks for evaluating DSS

adoption in Middle Eastern countries, including the UAE (Al-Ali et al., 2022). This gap points to the necessity for developing a valid measurement methodology to assess DSS adoption and effectiveness in emergency preparedness within these contexts.

To address this gap, this study proposes building and validating a multidimensional DSS adoption model grounded in established IS success theories. The Technology Acceptance Model (TAM) and the Information Systems Success Model provide a foundation for evaluating the effectiveness of DSS. The TAM focuses on perceived usefulness and ease of use as critical factors influencing user acceptance (Venkatesh & Bala, 2021). Meanwhile, the Information Systems Success Model, which has been revised to incorporate system quality, information quality, service quality, and user satisfaction, offers a comprehensive framework for assessing DSS success (DeLone & McLean, 2020). By integrating these theories, this research aims to develop a model that not only evaluates but also enhances the adoption and effectiveness of DSS in emergency preparedness for civil defense.

Background and Motivation

The rapid advancement of technology has significantly impacted various sectors, including emergency preparedness and response. Decision Support Systems (DSS) have emerged as pivotal tools in enhancing decision-making processes, particularly in critical domains such as civil defense. These systems provide comprehensive data analysis and support to help decision-makers respond more effectively to emergencies (Janssen, Voort, & Wahyudi, 2016). Despite their potential, the adoption and successful implementation of DSS in emergency preparedness face notable challenges.

In many cases, resistance to change among personnel accustomed to traditional methods and the complexity of integrating new technologies can hinder DSS adoption (Arnott & Dodson, 2008). This is particularly relevant in contexts like the UAE Civil Defence, where existing processes may not readily accommodate new technological solutions. Furthermore, the absence of a universally accepted framework to evaluate DSS effectiveness in emergency contexts creates a gap in understanding how best to leverage these systems for optimal results (DeLone & McLean, 1992b).

Recent research emphasizes the need for a comprehensive theoretical framework to assess DSS adoption and success. Studies have highlighted the importance of combining different success models to address both technical and user-centric aspects of DSS (Nguyen et al., 2021; Venkatesh & Bala, 2021). The integration of the Technology Acceptance Model (TAM) and DeLone and McLean's IS Success Model provides a robust basis for evaluating how perceived usefulness, ease of use, system quality, information quality, service quality, and user satisfaction collectively influence DSS adoption (DeLone & McLean, 2020; Venkatesh & Bala, 2021).

Given these considerations, this study is motivated by the need to develop and validate a multidimensional framework that integrates these theoretical models. This framework aims to better understand the factors driving the successful adoption of DSS in emergency preparedness, particularly in developing countries, and to address the unique challenges faced by civil defense organizations in integrating these advanced systems into their operations.

Methodology

The methodology for this systematic review involves a systematic and structured approach to evaluate the literature on Decision Support Systems (DSS), focusing on their role in emergency preparedness and civil defense. This review begins by formulating precise research questions to guide the exploration, such as identifying critical factors influencing DSS adoption and evaluating the relevance of theoretical frameworks like the Technology Acceptance Model (TAM) and the Information Systems Success Model (DeLone & McLean, 2020; Venkatesh & Bala, 2021). A comprehensive search strategy will be implemented across major academic databases, including IEEE Xplore, Scopus, Web of Science, Google Scholar, and ProQuest, using targeted keywords such as "Decision Support Systems," "emergency preparedness," and "TAM" (Nguyen et al., 2021; Yao & Lin, 2022).

Studies selected for inclusion must be peer-reviewed journal articles, conference papers, and book chapters published from January 2020 onwards, focusing specifically on DSS in emergency management and civil defense contexts (Aria & Archer, 2019). The inclusion criteria will prioritize research that applies relevant theoretical models and addresses the review's core questions, while excluding non-peer-reviewed sources and publications outside the specified timeframe. Data extraction will involve gathering detailed information on study objectives, methodologies, and findings, with a focus on analyzing common themes, evaluating the applicability of TAM and the Information Systems Success Model, and identifying research gaps (Sweeney & O'Connor, 2021; Zhang & Lu, 2023).

The quality of included studies will be assessed based on relevance, methodological rigor, and contribution to the field. The synthesis of findings will provide a comprehensive overview of DSS adoption and effectiveness, contributing to an enhanced understanding of emergency preparedness strategies and suggesting future research directions in this domain (Khan et al., 2023). This methodology aims to offer valuable insights and practical recommendations for improving DSS implementation in civil defense.

Finding

Factors Influence Adoption and Success of Decision Support System

Based on the systematic review, several key factors influence the adoption and success of Decision Support Systems (DSS) in emergency preparedness. Perceived usefulness and ease of use are pivotal, as the Technology Acceptance Model (TAM) indicates that systems perceived as enhancing decision-making and being user-friendly are more likely to be adopted (Venkatesh & Bala, 2021). System quality, including attributes such as reliability and performance, is essential for ensuring that DSS functions effectively in emergency situations (DeLone & McLean, 2020). The quality of information provided by the DSS, which includes accuracy, relevance, and timeliness, significantly impacts its effectiveness in supporting decision-making (DeLone & McLean, 2020). Furthermore, service quality, encompassing user support and training, is crucial for successful DSS implementation as it facilitates effective use and problem resolution (DeLone & McLean, 2020). User satisfaction also plays a critical role; systems that meet user expectations and provide a positive experience tend to see higher rates of continued use (Venkatesh & Bala, 2021). Effective data integration and management are necessary for handling large and complex datasets, ensuring seamless operation and improved decision support (Nguyen et al., 2021). The level of organizational support and

culture towards adopting new technologies impacts the integration and utilization of DSS, with a supportive environment enhancing the system's success (Aria & Archer, 2019). Lastly, training and education are important for equipping users with the skills needed to effectively use the DSS, while customization and flexibility of the system to fit specific needs further contribute to its success (Khan et al., 2023; Zhang & Lu, 2023).

Integration of Theoretical Framework

The integration of theoretical frameworks from Information Systems (IS) success models provides a comprehensive basis for understanding the adoption and effectiveness of Decision Support Systems (DSS) in emergency preparedness. This study amalgamates two prominent IS success models: the Technology Acceptance Model (TAM) and the DeLone and McLean IS Success Model, to explain DSS adoption in civil defense settings.

The Technology Acceptance Model (TAM), initially developed by Davis (1989) and later extended by Venkatesh et al (2003), focuses on perceived usefulness and perceived ease of use as primary drivers of technology adoption. According to TAM, if users find a DSS beneficial for decision-making and easy to use, they are more likely to adopt it. Recent studies reaffirm the importance of these factors in enhancing the acceptance of DSS (Venkatesh & Bala, 2021). TAM's emphasis on user perceptions aligns well with understanding how DSS can be adopted in high-stakes environments such as civil defense, where the effectiveness of technology is critical.

In contrast, the DeLone and McLean IS Success Model (DeLone & McLean, 1992a, 2003) offers a broader perspective by evaluating system success through multiple dimensions: system quality, information quality, service quality, and user satisfaction. This model provides a framework for assessing how well a DSS performs and meets user needs, which is crucial for ensuring that the system delivers valuable support during emergencies (DeLone & McLean, 2020). The model's comprehensive approach to evaluating various aspects of DSS success underscores the need for an integrated evaluation of technical performance and user experience.

Combining these frameworks allows for a multidimensional assessment of DSS adoption. The integrated conceptual model suggests that effective DSS adoption should consider technical aspects, user satisfaction, and behavioral intention to use the system as surrogate indicators of overall acceptance. This approach offers a holistic view of DSS effectiveness, addressing both the technical and human factors that impact adoption (Nguyen et al., 2021; Zhang & Lu, 2023).

In the context of developing countries, where the integration of technology in civil defense may face unique challenges, this integrated framework provides valuable insights. It highlights the necessity of not only evaluating the technological capabilities of DSS but also understanding user attitudes and system performance. By addressing these factors, the framework can guide the development and implementation of DSS that are better suited to the needs and conditions of civil defense operations in developing regions (Aria & Archer, 2019; Khan et al., 2023).

Theoretical Framework

The proposed theoretical framework, as illustrated in Figure 1, integrates key elements from both the Technology Acceptance Model (TAM) and the DeLone and McLean IS Success Model to evaluate the adoption and success of Decision Support Systems (DSS) in emergency preparedness. This framework posits that the adoption of DSS is influenced by several critical factors. Firstly, Perceived Usefulness and Perceived Ease of Use, drawn from TAM, are fundamental drivers of technology adoption. Perceived usefulness reflects how well the DSS enhances decision-making efficiency, while perceived ease of use indicates how user-friendly the system is (Davis et al., 1989; Venkatesh et al., 2003). Secondly, the DeLone and McLean IS Success Model contributes three key dimensions: System Quality, which encompasses the reliability and performance of the DSS; Information Quality, which pertains to the accuracy and relevance of the data provided; and Service Quality, which involves the support and training available to users (DeLone & McLean, 1992a, 2003). Additionally, User Satisfaction is central to the framework, capturing the users' overall contentment with the system, which influences their Behavioral Intention to Use the DSS (DeLone & McLean, 1992a, 2003; Venkatesh & Bala, 2021). By integrating these dimensions, the framework provides a comprehensive approach to understanding the factors that impact DSS adoption and effectiveness in emergency preparedness, highlighting the interplay between technical quality, user perceptions, and support services. This holistic perspective is crucial for developing effective DSS that meet the needs of users and improve emergency response capabilities.

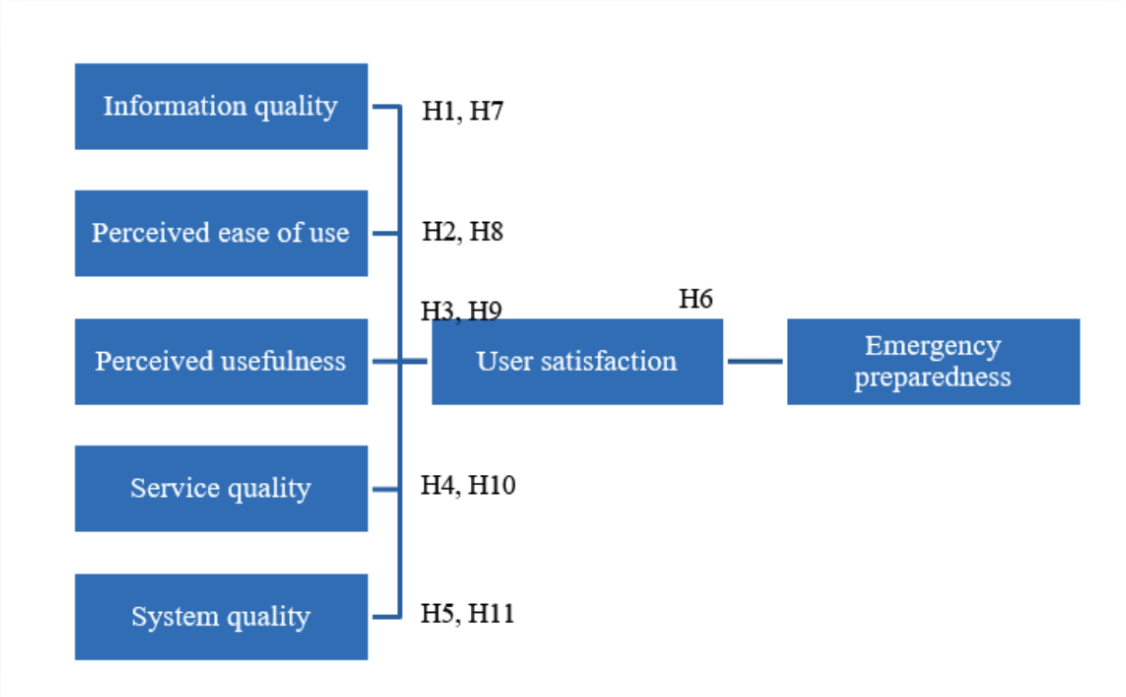

Figure 1: Theoretical Framework

Conclusion and Future work

In conclusion, the integration of the Technology Acceptance Model (TAM) and the DeLone and McLean IS Success Model provides a comprehensive framework for evaluating the adoption and success of Decision Support Systems (DSS) in emergency preparedness. This study underscores the importance of understanding both technical and user-centric factors that influence DSS effectiveness. Key factors such as perceived usefulness, perceived ease of use, system quality, information quality, service quality, and user satisfaction are crucial for enhancing the adoption and performance of DSS in civil defense settings. By addressing these dimensions, the proposed framework offers valuable insights into how DSS can be optimized to improve emergency response and preparedness.

Despite the progress made, several areas warrant further exploration. Future research should focus on empirical validation of the proposed framework in diverse emergency preparedness contexts to ensure its robustness and applicability. Additionally, exploring the impact of emerging technologies such as artificial intelligence and machine learning on DSS effectiveness could provide further insights into enhancing system capabilities (Khan, Lee, & Hong, 2023). It is also important to investigate the role of organizational culture and change management strategies in overcoming resistance to new technologies, particularly in developing countries where such challenges may be more pronounced (Nguyen, Reddy, & Kim, 2021). Furthermore, longitudinal studies could assess the long-term impacts of DSS adoption on emergency preparedness outcomes, providing a deeper understanding of the sustained benefits and areas for improvement.

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