ASSESSING READINESS FACTORS FOR INTEGRATING ARTIFICIAL INTELLIGENCE IN UAE DISASTER RESPONSE MANAGEMENT

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ABSTRACT

Objective: This study aims to uncover the readiness factors for AI integration by the National Emergency Crisis and Disasters Management Authority (NCEMA) in the UAE.

Research Method: The study employed a quantitative research methodology to gather data from 317 personnel employed by the National Emergency Crisis and Disasters Management Authority (NCEMA) in the UAE, using stratified random sampling to distribute the questionnaire.

Findings: The findings of this study emphasize the critical need for aligning the integration of AI in the UAE's disaster response system with international standards and best practices. By prioritizing fairness, accountability, human oversight, ethical clarity, and transparency, the UAE can ensure that AI-driven disaster response efforts are both effective and trustworthy. A robust policy and regulatory framework are essential to enhance readiness for AI integration. Key considerations include ensuring data privacy and security, establishing tailored AI-specific policies, securing government support, complying with international regulations, and upholding ethical guidelines. These measures will contribute to the development of AI systems that are secure, ethically sound, and highly effective in disaster response. Furthermore, strengthening the UAE's technological infrastructure is vital for successful AI integration. Access to computational power, availability of AI tools, seamless communication platforms, and reliable data analysis capabilities will collectively enhance AI-driven disaster response efforts. Government support and incentives also play a crucial role in fostering AI readiness. Investments in research and development, financial grants, tax incentives, and strategic partnerships will create a robust ecosystem for AI implementation, ultimately improving national disaster resilience.

Originality: This study aims to address the key readiness factors for AI integration in the UAE's disaster preparedness and response capabilities. By leveraging AI as a transformative tool, the UAE can mitigate risks, improve response efficiency, and safeguard communities against future disasters. This research aims to offer significant insights assessing readiness factors for integrating Artificial Intelligence in UAE Disaster Response Management.

Keywords: Readiness Factors; National Emergency Crisis and Disasters Management Authority (NCEMA), AI in Disaster Management

1. INTRODUCTION

Disasters have significantly impacted the UAE's growth potential, leading to annual economic losses estimated at $314 billion, primarily affecting urban infrastructure (UNDRR, 2022). Over the past decade, more than 1.5 billion people, including vulnerable groups such as children, women, youth, and marginalized communities, have been adversely affected by disasters in the UAE. The costs related to climate change-induced losses are even more substantial. The UAE's geographical location, bordered by Saudi Arabia, Oman, Iran, and Qatar, makes it vulnerable to natural and man-made disasters, including floods, storms, and earthquakes. Recent regional developments have increased the likelihood of such occurrences, emphasizing

the urgent need for a robust disaster preparedness and management framework (Alshamsi, 2022).

Despite advancements in disaster resilience, the UAE still lacks an advanced, technology-driven disaster management system. The absence of a comprehensive legal framework and reliance on conventional approaches have hindered the country's ability to assess and predict disaster frequency, severity, and locations using modern technologies. As the UAE continues rapid urbanization, particularly in the energy and infrastructure sectors, disaster risks increase, necessitating urgent technological interventions (Alhashmi & Mahmood, 2022). Without strategic improvements, the UAE's progress toward Sustainable Development Goals (SDGs) and its aspirations to be a global leader in smart cities could be compromised.

To strengthen disaster management, the UAE government established the National Emergency, Crises and Disaster Management Authority (NCEMA) in 2007, introducing a standardized disaster management framework (Charles, 2007; Alshamsi, 2022). In 2013, the National Response Framework (NRF) was created to clarify emergency response strategies (NCEMA, 2012; Alteneiji, Ahmed & Saboor, 2021). However, these initiatives have yet to fully integrate advanced technological tools, such as Artificial Intelligence (AI), which could revolutionize disaster preparedness and response.

Research underscores the need for AI-driven transformation in the UAE's disaster response management (Alshamsi, 2022). Emerging technologies such as aerial robotics, big data analytics, modern communication tools, and social media have demonstrated their effectiveness in emergency management (Yu, Yang, & Li, 2018; Munawar et al., 2021). Additionally, studies indicate that AI applications, such as predictive analytics and real-time disaster monitoring, significantly enhance response efficiency. AI tools deployed during flood incidents in Australia, for instance, improved real-time disaster assessment and victim response (Munawar et al., 2022). Similarly, citizen-led disaster responses via social media have proven to be valuable assets in emergency situations (Smith et al., 2018).

Despite these global advancements, there is a significant gap in AI adoption within the UAE's disaster response sector. Studies by Alshamsi (2022), Yu, Yang, and Li (2018), and Munawar et al. (2021) emphasize the role of AI technologies like robotics and big data in improving disaster response efficiency. However, UAE-based research specifically addressing AI integration in disaster management remains scarce. While AI readiness has been examined in sectors such as energy (Pathirage & Al-Khaili, 2016) and healthcare (Alhashmi et al., 2019), its potential in disaster response remains largely unexplored.

This study aims to assess the UAE's readiness to integrate AI into disaster response management, identifying technological, organizational, and policy-related barriers to adoption. Existing studies have explored AI applications in related fields, such as disaster-response robotics (Al Hmoudi, 2020), AI-driven diagnostics in radiology (Abuzaid et al., 2020), and AI's role in business operations (Chang, 2020; Solaimani et al., 2020). However, research on AI-driven disaster response frameworks in the UAE remains limited. By addressing this gap, this study seeks to provide actionable insights into AI's potential to enhance disaster resilience and response efficiency in the UAE.

2. DISASTER MANAGEMENT

Disaster management is a critical field that encompasses various strategies to mitigate the impact of disasters, respond effectively, and facilitate recovery. Previous studies highlight the importance of technological advancement in this domain. For example, the Fukushima nuclear disaster showcased both the potential and limitations of using robots in search and rescue operations, prompting further development of robotic systems for disaster management (Jangid & Sharma, 2016). Similarly, studies have shown the positive role of social media and AI tools in

enhancing communication, coordination, and response during disasters (Smith et al., 2018; Munawar et al., 2022). Building on these findings, the current study focuses on the integration of AI in disaster management within the UAE, specifically through the efforts of the National Emergency Crisis and Disasters Management Authority (NCEMA). The need to deepen the understanding of AI's role in disaster response at an organizational level is still crucial, offering insights into how AI can enhance disaster response capabilities in the UAE (Al Hmoudi, 2020).

Generally, disaster management involves systematic approaches to avoid hazards and control the effects of disasters through innovative ideas, technologies, and activities. Effective disaster management requires a strategic combination of preparedness, response, recovery, and mitigation efforts to minimize harm and ensure efficient logistics in planning, supply, transportation, delivery, tracking, and storage (Alhashmi & Mahmood, 2022; Shah et al., 2018). Researchers emphasize the need for a process-oriented approach to disaster management, incorporating norms, values, and systematic operations to reduce vulnerabilities and enhance disaster response capabilities (Cuthbertson et al., 2019; Delavar & Sadrykia, 2020; Oksuz & Satoglu, 2019; Sharma et al., 2021).

2.1 APPROACHES TO DISASTER RESPONSE

Disaster response is a crucial aspect of the broader disaster management field, encompassing actions taken before, during, and after an incident. It involves various components, including warning/evacuation, search and rescue, immediate relief, damage assessment, continuous support, and urgent infrastructure restoration or construction (Wikipedia, 2022; Sharma et al., 2021). The primary objective is to provide immediate assistance to preserve lives, improve health, and boost morale. Effective disaster response mitigates the loss of life, reduces suffering, and protects property. It requires a coordinated effort among multiple stakeholders, including government agencies, NGOs, first responders, and the local community. Key aspects of disaster response include the rapid deployment of emergency response teams and resources, such as search and rescue teams, medical teams, and essential supplies like food, water, and shelter. Pre-established emergency management plans and protocols, outlining roles, responsibilities, communication strategies, and resource allocation, guide these efforts. The importance of such plans was highlighted during the Fukushima nuclear disaster, where robots and technology played a significant role in search and rescue operations.

Furthermore, large-scale disasters, such as earthquakes or typhoons, cause extensive property and infrastructure destruction, hindering emergency response efforts in densely populated urban areas. Roads and highways may be flooded or blocked by debris, while bridges, rail tracks, and essential services like electricity, water, and telecommunications infrastructure may be damaged (Twigg & Mosel, 2017). Sharma, Parkash, and Joshi (2016) identified several challenges in disaster response, including overwhelming needs, panic situations, casualties, injuries, a constantly changing environment, limited supervisory resources, and issues with storing, sorting, and allocating excessive relief materials. The effectiveness of disaster response depends on various factors, including the nature, location, and severity of the disaster, whether it can be managed locally or requires external support, and the timeframe of the response.

In recent years, disaster response has become increasingly complicated due to technological advancements, climate change, and the rising intensity of natural disasters and extremist attacks (Berchtold et al., 2020). Effective logistical operations are crucial in mitigating the impact of disasters, as they can significantly influence the severity of the event (Berkoune et al., 2012; Talarico et al., 2015). Disasters often prompt self-organizing efforts from volunteers and individuals within and beyond affected areas, mobilizing before established organizations can respond (Twigg & Mosel, 2017). Modern technology, including Artificial Intelligence (AI), is increasingly

integrated into disaster response, aiding in early warning systems, data analysis, resource allocation, and decision support. Studies like Munawar et al. (2022) have shown the positive impact of AI tools in specific disaster situations, such as floods. Additionally, social media and technology enhance communication and coordination among stakeholders during disaster response efforts, as demonstrated by Smith et al. (2018). Moreover, disaster response requires the timely delivery of a vast array of resources, including food, water, medication, and shelters. Effective planning, administration, and monitoring are critical to ensure these demands are met (Oksuz & Satoglu, 2019). Given the unpredictable and dynamic nature of disaster environments, response agencies must be able to detect and verify data and decisions, allowing them to adapt or modify their plans as new information arises (Ramchurn et al., 2016). Additionally, the competencies of human responders must be addressed to ensure all tasks are completed safely and efficiently.

Key disaster response tasks include situation assessment (Endsley, 1995; Berchtold et al., 2020), decision-making (Groenendaal et al., 2013; Berchtold et al., 2020), coordination, command and control (Waring et al., 2018; Berchtold et al., 2020), logistics (Balcik & Beamon, 2008; Berchtold et al., 2020), and communication with the public (Wendling, Radisch & Jacobzone, 2013; Berchtold et al., 2020). These tasks must be executed effectively to ensure a comprehensive and efficient disaster response. Hence, disaster response is a dynamic field that continues to evolve with technological advancements and changing disaster risks. It involves the organized efforts of multiple stakeholders and the use of technology, including AI, to address immediate needs, save lives, and facilitate recovery. By learning from previous disaster response efforts and integrating technology, disaster management practices can be refined and enhanced, contributing to the overall resilience of communities and regions, particularly in areas prone to disasters like the United Arab Emirates (UAE).

2.2 DISASTER RESPONSE IN THE UAE

The United Arab Emirates (UAE) has made significant advancements in disaster response planning and mitigation efforts, recognizing the importance of preparedness due to its susceptibility to various natural and man-made disasters. Central to these efforts is the National Crisis and Emergency Management Authority (NCEMA), which coordinates disaster management by formulating policies, conducting risk assessments, and collaborating with stakeholders (NCEMA, 2012). A study by Al Hmoudi (2020) used primary data from a questionnaire to investigate the use of robots for disaster warning and response in the UAE. The respondents, randomly selected from Abu Dhabi Emirate Police, Emirates Fire & Rescue Authority, and the National Emergency, Crisis, and Disaster Management Authority, totalled 24 participants. The study found an inadequate understanding and usage of robots for disaster response. It highlighted a lack of awareness regarding the benefits of robotics among search and rescue (SAR) teams, emergency organizations, and the general public. The study concluded that for the UAE to benefit from robotic technology, issues such as insufficient knowledge, inadequate resources, lack of criteria and legal frameworks, and unclear duties and responsibilities need to be addressed. The study also recommended further research into the types of robots used in the UAE, their applications, efficacy, and associated challenges.

Over the past twenty years, the UAE's understanding of its potential vulnerabilities has evolved. Consequently, the National Emergency Crisis and Disaster Management Authority (NCEMA) was established in 2007 to monitor, regulate, and organize national disaster response efforts. Governed by the Supreme Council of National Security, NCEMA oversees all aspects of disaster management, including preparedness, response, recovery, and mitigation (Almarzouqi, 2017). Additionally, Alblooshi and Bin Yahya (2021) found a significant positive relationship between the geographic information system (GIS) and disaster management in the UAE, highlighting GIS's critical role in successful disaster response and management.

To enhance disaster mitigation, the UAE has invested heavily in infrastructure resilience. This includes implementing stringent building codes and guidelines to ensure structures can withstand natural disasters such as earthquakes and floods (UAE General Civil Aviation Authority, 2019). Additionally, the UAE has adopted advanced technologies, including Artificial Intelligence (AI), for improving disaster response. AI-driven early warning systems and predictive analytics help monitor weather patterns, identify hazards, and issue timely warnings, allowing for swift reaction and impact minimization.

Moreover, international collaboration and knowledge sharing are key components of the UAE's disaster management strategy. By participating in regional and global forums, the UAE exchanges best practices and experiences with other nations, enhancing its capacity to respond to large-scale or cross-border disasters effectively (NCEMA, 2012). In summary, the UAE's progress in disaster response and mitigation is marked by robust government coordination, infrastructure resilience, the integration of advanced technologies, and international collaboration. These efforts have equipped the UAE to better address the unique disaster challenges it faces in the region.

2.3 UAE'S COMPREHENSIVE APPROACH TO DISASTER RESPONSE AND MITIGATION

The United Arab Emirates (UAE) has demonstrated a strong commitment to disaster response and mitigation through comprehensive plans and strategies, acknowledging the importance of being well-prepared for emergencies due to its geographical location and exposure to various risks (Al Zaabi, 2014). A key aspect of the UAE's disaster response strategy is the focus on early warning systems, utilizing advanced technologies for monitoring and forecasting various types of disasters, including severe weather events and potential industrial incidents, to enable prompt evacuation and preparedness measures (Al Blooshi & Al Nuaimi, 2016). Community engagement and public awareness also play a significant role in the UAE's mitigation efforts. The government actively educates the public about potential risks and necessary emergency steps through drills, informational materials, and communication channels (Al Mulla & Al Neyadi, 2017). Additionally, stringent building codes and standards have been implemented to ensure infrastructure resilience against hazards such as earthquakes and extreme weather events (Al Dhaheri et al., 2018). The UAE leverages technological advancements, including artificial intelligence and data analytics, to enhance its disaster response capabilities, aligning with global best practices (Al Nuaimi et al., 2020). The country has invested in state-of-the-art infrastructure and emergency services, developing advanced crisis management centers equipped with cutting-edge technologies for real-time data collection, analysis, and communication (Al Ameri et al., 2017). International collaboration is another vital component of the UAE's disaster response strategy, involving partnerships with international organizations and neighboring countries to facilitate knowledge exchange and coordinated responses to regional or transnational emergencies (UNISDR, 2018).

The UAE also engages local communities in raising awareness and establishing community-based response mechanisms to strengthen societal resilience (Al Yammahi & Al Awadhi, 2019). Furthermore, the UAE has invested in rigorous safety regulations and preparedness measures across various industrial sectors to prevent disasters through risk assessments, safety protocols, and regular inspections (Al Awadi et al., 2016). The government has developed robust protocols for industrial emergencies, emphasizing rapid response and mitigation strategies to manage potential hazards (Al Marzooqi et al., 2019). Active participation in joint drills and exercises with international counterparts enhances the UAE's interoperability and coordination with other nations, contributing to regional and global resilience (Al Dhaheri et al., 2017). The UAE also plays a significant role in humanitarian assistance, providing aid and support to neighboring countries facing emergencies (UNOCHA, 2017). The UAE addresses climate change-related challenges through investments in renewable energy,

water conservation, and sustainable urban planning, positioning itself as a key player in regional resilience (UAE State of Energy Report, 2019). The country continuously reviews and adapts its disaster response plans to incorporate lessons learned and emerging risks, ensuring a dynamic and evolving disaster management framework (Al Mazrouei et al., 2020). Recognizing the need for a holistic approach, the UAE integrates various sectors into comprehensive disaster response plans, fostering collaboration among diverse stakeholders to enhance national resilience and preparedness (Al Zaabi et al., 2021; Al Awadhi et al., 2022). This interdisciplinary approach ensures an efficient and coordinated effort to address a wide range of emergencies.

2.4 ENHANCED DISASTER PREVENTION READINESS IN THE UAE

The United Arab Emirates (UAE) has made significant strides in disaster response planning and mitigation efforts, recognizing the importance of being well-prepared due to its geographical location and susceptibility to various natural and man-made hazards. Central to these efforts is the National Crisis and Emergency Management Authority (NCEMA), which coordinates disaster management by formulating policies, conducting risk assessments, and collaborating with stakeholders (NCEMA, 2012). To enhance disaster mitigation, the UAE has heavily invested in infrastructure resilience. For example, stringent building codes and guidelines have been implemented to ensure structures can withstand natural disasters such as earthquakes and floods (UAE General Civil Aviation Authority, 2019). Additionally, the UAE has adopted advanced technologies, including Artificial Intelligence (AI), for improving disaster response. AI-driven early warning systems and predictive analytics help monitor weather patterns, identify hazards, and issue timely warnings, allowing for swift reaction and impact minimization.

Moreover, international collaboration and knowledge sharing are key components of the UAE's disaster management strategy. By participating in regional and global forums, the UAE exchanges best practices and experiences with other nations, enhancing its capacity to respond to large-scale or cross-border disasters effectively (NCEMA, 2012). This collaborative approach has strengthened the UAE's ability to address its unique disaster challenges. The UAE's disaster prevention readiness is further emphasized by its geographical susceptibility to natural disasters such as earthquakes, floods, sandstorms, and tropical cyclones. These hazards pose significant risks to the country's urban and economic centers. To mitigate these risks, the UAE has taken proactive measures, including the improvement of building codes and infrastructure resilience, ensuring that new structures are designed to withstand such hazards, thereby reducing potential damage and loss of life (UAE General Civil Aviation Authority, 2019).

In addition to natural disasters, the UAE's rapid urbanization and economic growth make it vulnerable to potential man-made disasters such as industrial accidents and cybersecurity threats. The UAE has established regulations and procedures to ensure the safety of its critical infrastructure, particularly in the energy and industrial sectors. The country also invests in cybersecurity measures to protect its critical information systems, recognizing the potential for cyberattacks that could disrupt essential services and harm the economy (UAE Government, 2017). Furthermore, the UAE's commitment to disaster prevention readiness is driven by the need to protect its growing population and the millions of tourists who visit the country annually. Early warning systems, public awareness campaigns, and evacuation plans are integral components of disaster prevention and preparedness. These measures help minimize casualties and ensure the safety of residents and visitors when disasters strike (NCEMA, 2012). Lastly, the UAE's economic diversification efforts underscore the importance of disaster prevention readiness. With significant investments in sectors like tourism, aviation, and finance, the country's economic stability relies on the uninterrupted operation of critical facilities. Disaster

prevention measures are crucial to minimize business disruptions, safeguard investments, and ensure continued economic growth.

The UAE's energy industry, a critical component of the country's economy, plays a vital role even in the global economy (Alhashmi & Mahmood, 2022). Therefore, it is imperative for the UAE to prioritize the maintenance of the energy sector infrastructure and protect oil and gas facilities from natural and man-made dangers (Copping et al., 2021; Alhashmi & Mahmood, 2022). Considering the current nuclear power plant at Braga and other advancements in the UAE's power sector, it is necessary to evaluate the industry's susceptibility to prepare for potential natural or man-made disaster management (Alteneiji, Ahmed, & Saboor, 2020).

Research by Pathirage and Al-Khaili (2016) employed a multiple case study technique with various case studies from Abu Dhabi, Sharjah, and Dubai to examine disaster susceptibility in the Emirati energy industry and impediments to enhancing rigidity. The study found that terrorism, atmospheric hazards, and geological hazards were identified as the three primary sources of vulnerability in the Emirati energy industry. Thus, the UAE's proactive approach, including implementing strict building codes, enhancing infrastructure resilience, and investing in cybersecurity, aims to reduce the vulnerability of its critical assets and maintain its growth and stability in the face of various disasters. By continuously improving its disaster prevention and mitigation strategies, the UAE is better equipped to protect its population, infrastructure, and economy from potential hazards.

2.5 GROWING NEED FOR AI-DRIVEN DISASTER RESPONSE IN THE UAE

The increasing frequency and severity of disasters globally underscore the urgency of enhancing disaster response capabilities. The Emergency Event Database (EM-DAT, 2021) reported 432 natural disaster-related incidents in 2021 alone, resulting in significant loss of life and property. From 2000 to 2019, 7,348 confirmed disasters caused 1.23 million deaths and affected 4.2 billion people, with economic damages reaching approximately US$2.97 trillion (UNDRR, 2022). The long-lasting consequences of inadequate disaster response further emphasize the need for immediate action (Berktaş, Kara, & Karaşan, 2016).

The UAE, experiencing rapid economic growth and urban expansion, is increasingly vulnerable to both natural and man-made disasters, such as tropical storms, earthquakes, tsunamis, and terrorist attacks (Alhashmi & Mahmood, 2022). Its location, evolving geopolitical landscape, and demographic changes—projected to reach 15.5 million people by 2050, with around 80% being non-indigenous residents, further complicate disaster response efforts. Given the nation's global prominence, enhancing disaster preparedness and resilience is a national priority.

Over the past two decades, the UAE has faced various disasters, necessitating a robust and adaptive disaster management framework. The government has adopted innovative technologies like drones, IoT devices, and AI-driven solutions to enhance disaster preparedness and response capabilities (Alhashmi & Mahmood, 2022; Diamandis, 2019). However, challenges remain, particularly in integrating AI technologies into existing disaster response strategies.

Artificial Intelligence (AI) has demonstrated its potential in various sectors, including medicine, education, finance, and agriculture (Matheny, Whicher & Israni, 2019; Vaishya, Javaid, Khan & Haleem, 2020; Briganti & Le Moine, 2020; Shi, 2020). AI applications in disaster response—such as predictive analytics, autonomous drones, and real-time data analysis—can significantly enhance decision-making and response efficiency (Ramchurn et al., 2016). AI platforms like Ushahidi and One Concern have already improved disaster response efforts globally (Diamandis, 2019).

Despite these advancements, there is a need to evaluate the UAE's readiness to integrate AI into its disaster management framework. Effective logistical operations are crucial for disaster response, as inadequate coordination can exacerbate disaster impacts (Berkoune et al., 2012; Talarico et al., 2015). Logistical challenges, such as

obstructed roads and insufficient medical support, often lead to higher casualties (Talarico et al., 2015). Technologies like RFID, UAVs, and crowdsourced intelligence have played pivotal roles in improving disaster response efficiency (Majchrzak, Jarvenpaa & Hollingshead, 2007; Kruijf-Korbayova et al., 2015; Hiltz et al., 2014; Reuter & Kaufhold, 2017).

2.6 ISSUES AND CHALLENGES IN ITS IMPLEMENTATION IN UAE

The integration of Artificial Intelligence (AI) into disaster response in the UAE is contingent upon several key readiness factors. these readiness factors such as compliance with international standards, ethical guidelines for AI usage, policy and regulatory framework, technological infrastructure and capability, and government support and incentives. These factors are essential for the effective integration of AI in disaster response. By addressing these factors, the UAE can enhance its disaster response capabilities and build a more resilient and prepared nation.

2.6.1 COMPLIANCE WITH INTERNATIONAL STANDARDS

Compliance with international standards is essential for the UAE's AI systems to achieve interoperability and global alignment in disaster response. By adhering to these standards, the UAE ensures effective collaboration with international disaster response efforts. This compliance facilitates the integration of best practices and technological advancements globally, enhancing AI-driven disaster response. As a result, the UAE can seamlessly provide and receive assistance during cross-border or large-scale emergencies, leading to a more coordinated and efficient response (Alblooshi & Bin Yahya, 2021).

2.6.2 ETHICAL GUIDELINES FOR AI USAGE

Ethical guidelines for AI usage are crucial to ensure that AI technologies operate within morally acceptable boundaries. These guidelines safeguard human rights and dignity while maintaining AI system efficiency. Ethical considerations in AI usage include transparency, accountability, and fairness in decision-making processes. By adhering to these guidelines, the UAE can build trust among stakeholders and the public, ensuring AI systems are used responsibly and do not cause unintended harm. Additionally, ethical guidelines address concerns related to bias, privacy, and the misuse of AI, fostering a more ethical and trustworthy AI-driven disaster response (NCEMA, 2012).

2.6.3 POLICY AND REGULATORY FRAMEWORK

A robust policy and regulatory framework is vital for guiding the development and deployment of AI technologies in disaster response. The presence of AI-specific policies provides a clear framework for implementing AI solutions effectively and ethically. Regulations ensure that AI systems comply with legal requirements and operate within established boundaries. A well-defined policy and regulatory framework also facilitate innovation by providing a stable and predictable environment for AI development. Government support and incentives, such as grants and subsidies, can further encourage the adoption of AI technologies. By establishing comprehensive policies and regulations, the UAE can ensure the responsible and effective use of AI in disaster response (NCEMA, 2012; Almarzouqi, 2017).

2.6.4 TECHNOLOGICAL INFRASTRUCTURE AND CAPABILITY

Technological infrastructure and capability are foundational to the successful integration of AI in disaster response. This includes access to cloud computing power, data storage, and high-speed internet connectivity. A robust technological infrastructure ensures that AI systems have the computational resources needed to process large volumes of data quickly and accurately. Availability of AI systems and digital communication platforms enables seamless information exchange and

coordination among stakeholders. System reliability and maintenance are also critical to ensuring the continuous operation of AI technologies during emergencies. By investing in technological infrastructure, the UAE can enhance its capacity to leverage AI for disaster response and improve overall readiness.

2.6.5 GOVERNMENT SUPPORT AND INCENTIVES

Government support and incentives play a pivotal role in fostering the adoption of AI technologies in disaster response. Financial backing, strategic initiatives, and policy directives from the government can drive the development and deployment of AI systems. Government support can take various forms, including funding for research and development, tax incentives for AI-related projects, and the establishment of innovation hubs. Additionally, government-led initiatives can promote public-private partnerships and collaboration with international organizations. By providing strong support and incentives, the UAE government can create an enabling environment for AI innovation and ensure the successful integration of AI in disaster response efforts (NCEMA, 2012).

3. DATA COLLECTION

The study focused on personnel employed by the National Emergency Crisis and Disasters Management Authority (NCEMA) in the UAE, specifically those in disaster management departments. With a total staff count of 1,717 (NCEMA, 2012), this subgroup was targeted due to their relevant roles and expertise. The aim was to gain insights into their perceptions and experiences, which were crucial for evaluating the impact of AI on disaster response in the UAE. This approach ensured the research addressed the specific needs and viewpoints of those most pertinent to the study's goals.

To determine the appropriate sample size, the Krejcie and Morgan (1970) table of sample size determination was used. Based on the table, a sample frame of 1,717 had a corresponding sample size of 317. This method ensured an appropriate and representative sample size for the research. The questionnaire was distributed through stratified random sampling of the population based on the size and role of the authority. This structured approach ensured that the data collected would be both comprehensive and representative, providing valuable insights into the perceptions and experiences of the key personnel involved in disaster management within NCEMA.

4. RESULTS AND ANALYSIS

The readiness to integrate Artificial Intelligence in the UAE's disaster response system is marked by a strong emphasis on various critical factors. Key areas include compliance with international standards, ensuring data privacy and security, government support for AI initiatives, and robust technological infrastructure. Additionally, the presence of tailored AI-specific policies and ethical guidelines further underscores the UAE's commitment to responsibly integrating AI into disaster management. Consequently, these elements collectively create a solid foundation for enhancing the efficiency and effectiveness of the UAE's disaster response capabilities using AI technologies. This section, therefore, presents the results of the questionnaire on the importance of readiness factors based on the respondents' perceptions, as detailed in Table 1.

Table 1. Ranking of readiness factors

Groups	Factors of stakeholder's Readiness	Std. Deviation	Mean	Factors rank
Compliance with International Standards	Integration with International AI Frameworks	.777	4.52	1st
	Compliance with International Data Protection Regulations	1.071	4.29	2nd

	Regular Updates and Audits for Compliance	1.013	4.25	3rd
	Adherence to AI Best Practices	.880	4.23	4th
	Alignment with Global AI Safety Standards	.917	4.16	5th
Ethical Guidelines for AI Usage	Bias Mitigation and Fairness	.886	4.38	1st
	Accountability and Responsibility	.923	4.36	2nd
	Human Oversight and Control	.737	4.32	3rd
	Clarity of Ethical Standards	.895	4.22	4th
	Transparency in AI Decision-Making	.898	4.12	5th
Policy and Regulatory Framework	Data Privacy and Security Regulations	4.42	.988	1st
	Presence of AI-Specific Policies	4.36	.830	2nd
	Government Support and Incentives	4.23	.840	3rd
	Compliance with International Standards	4.07	.884	4th
	Ethical Guidelines for AI Usage	3.95	1.026	5th
Technological Infrastructure and Capability	Access to Cloud and Computing Power	.723	4.45	1st
	Availability of AI Systems	.858	4.29	2nd
	Digital Communication Platforms	.770	4.20	3rd
	System Reliability and Maintenance	.915	4.13	4th
Government Support and Incentives	Data Collection and Analysis	1.098	3.81	5th
	Support for Research and Development	.858	4.29	1st
	Availability of Financial Grants	.915	4.25	2nd
	Subsidies for AI Technology Adoption	.770	4.20	3rd
	Access to Tax Incentives	.890	4.19	4th
	Government Partnerships and Collaborations	1.098	3.81	5th

Table 1 presents the ranking of factors determining the readiness to integrate Artificial Intelligence into the UAE's disaster response management. These factors are categorized into five groups: Compliance with International Standards, Ethical Guidelines for AI Usage, Policy and Regulatory Framework, Technological Infrastructure and Capability, and Government Support and Incentives. The rankings are derived from the perceptions of respondents who participated in a questionnaire survey. The respondents are personnel employed by the National Emergency Crisis and Disasters Management Authority (NCEMA) in the United Arab Emirates (UAE), with a specific focus on individuals working within disaster management departments. Detailed elaboration of the results can be found in the following subsections.

4.1 COMPLIANCE WITH INTERNATIONAL STANDARDS GROUP

For the Compliance with International Standards group, the highest-ranked factor is "Integration with International AI Frameworks," with a mean of 4.52. This prioritization ensures that the UAE's AI systems are aligned with global standards and practices, fostering interoperability and collaboration with international disaster response efforts, and leveraging global AI advancements and best practices. "Compliance with International Data Protection Regulations" ranks second, with a mean of 4.29. Ensuring compliance with these regulations is crucial for safeguarding sensitive data involved in disaster response operations, building trust with international partners and affected populations, and ensuring data privacy and security.

"Regular Updates and Audits for Compliance" is ranked third, with a mean of 4.25. Continuous monitoring through regular updates and audits is vital for

maintaining adherence to international standards, ensuring that AI systems remain up-to-date with evolving regulations, and adapting to new challenges in disaster response. "Adherence to AI Best Practices" comes in fourth, with a mean of 4.23. Following established best practices in AI usage enhances the effectiveness and reliability of AI systems in disaster response, providing a framework for developing robust and efficient AI solutions to handle the complexities of disaster scenarios.

Lastly, "Alignment with Global AI Safety Standards," with a mean of 4.16, emphasizes the importance of maintaining global safety protocols in AI systems. This alignment ensures that AI systems operate safely and ethically, preventing unintended consequences and contributing positively to disaster response efforts. Thus, these findings underscore the necessity of adhering to international standards and best practices in integrating AI into the UAE's disaster response system. By prioritizing these factors, the UAE can ensure that its AI systems are effective, secure, and aligned with global efforts, ultimately enhancing the country's disaster response capabilities.

4.2 ETHICAL GUIDELINES FOR AI USAGE

For the Ethical Guidelines for AI Usage group, "Bias Mitigation and Fairness" emerged as the top priority, with a mean score of 4.38 and a standard deviation of 0.886, reflecting stakeholders' focus on ensuring that AI systems are free from bias and operate fairly. Close behind, "Accountability and Responsibility" ranked second with a mean of 4.36 and a standard deviation of 0.923, highlighting the need for clear responsibility in AI operations. "Human Oversight and Control" was ranked third with a mean of 4.32 and a lower standard deviation of 0.737, stressing the importance of human intervention in AI decision-making processes. "Clarity of Ethical Standards" ranked fourth, with a mean of 4.22 and a standard deviation of 0.895, underscoring the necessity for well-defined ethical guidelines. Lastly, "Transparency in AI Decision-Making" ranked fifth with a mean of 4.12 and a standard deviation of 0.898, emphasizing the value of transparency in how AI systems arrive at decisions.

These results indicate that the integration of AI in disaster response systems involves prioritizing several critical factors. Bias mitigation and fairness, with the highest mean score of 4.38, underscore the crucial need for AI systems to operate without bias, ensuring equitable assistance to all affected populations. A biased system could lead to unequal distribution of aid, which would be unacceptable in disaster scenarios. Accountability and responsibility, with a mean score of 4.36, highlight the necessity for clear responsibility in AI operations. This ensures that there is always a human or group accountable for AI actions, which is vital for addressing any issues during disaster response.

Human oversight and control, ranked third with a mean score of 4.32, emphasize the importance of human intervention in reviewing and validating AI decisions. This is crucial for adapting to the complexities of real-world disasters, where quick and critical decision-making is often required. Clarity of ethical standards, with a mean score of 4.22, signifies the importance of well-defined ethical guidelines that ensure AI operates within acceptable moral boundaries, respecting human dignity and rights while maintaining efficiency.

Lastly, transparency in AI decision-making, with a mean score of 4.12, remains important. Transparency builds trust among stakeholders and the public by providing insights into how AI systems arrive at decisions, which is essential for improving future responses. In summary, while all factors are important, the prioritization reflects a focus on ensuring fairness, accountability, human oversight, ethical clarity, and transparency in the integration of AI in disaster response systems. This structured approach aims to enhance the overall effectiveness and trust in AI during disaster response efforts.

4.3 POLICY AND REGULATORY FRAMEWORK

The findings within the "Policy and Regulatory Framework" group are essential for understanding the readiness to integrate AI into the UAE's disaster response system. The highest-ranked factor, "Data Privacy and Security Regulations" (mean: 4.42), highlights the critical role of ensuring the secure handling of data in AI-based disaster response systems. This prioritization ensures that sensitive information is protected, which is crucial for building trust among stakeholders and affected populations. The "Presence of AI-Specific Policies" ranks second, with a mean of 4.36, underscoring the importance of having tailored policies to guide AI implementation. Such policies provide a clear framework for developing and deploying AI technologies effectively and ethically, ensuring that AI usage aligns with national and international standards.

"Government Support and Incentives" comes in third, with a mean of 4.23. Government backing for AI initiatives is vital for fostering innovation and encouraging the adoption of AI technologies in disaster response. Financial and strategic support from the government can significantly enhance the development and deployment of AI systems. "Compliance with International Standards" ranks fourth, with a mean score of 4.07. Adhering to global standards ensures that the UAE's AI systems are interoperable and can collaborate effectively with international disaster response efforts. This compliance also facilitates the integration of best practices and advancements in AI technology.

Lastly, "Ethical Guidelines for AI Usage" ranks fifth, with a mean of 3.95. Although ranked lower relative to other components, ethical guidelines remain significant. They ensure that AI systems operate within morally acceptable boundaries, respecting human rights and dignity while maintaining efficiency. These factors collectively highlight the importance of a robust policy and regulatory framework in enhancing the readiness to integrate AI into the UAE's disaster response system. Prioritizing data privacy and security, tailored AI-specific policies, government support, international compliance, and ethical guidelines will ensure that AI systems are effective, secure, and ethically sound, ultimately improving disaster response capabilities in the UAE.

4.4 TECHNOLOGICAL INFRASTRUCTURE AND CAPABILITY

The findings within the Technological Infrastructure and Capability group provide significant insights into the readiness to integrate AI into the UAE's disaster response system. "Access to Cloud and Computing Power" emerged as the top factor, with a mean score of 4.45. This highlights its crucial role in supporting AI integration in disaster response systems by ensuring that there are sufficient computational resources to process large amounts of data quickly and efficiently, which is essential during emergencies. The "Availability of AI Systems" ranked second, with a mean of 4.29, emphasizing the need for accessible AI tools. This factor highlights the importance of having readily available AI solutions that can be deployed swiftly in disaster scenarios to enhance decision-making and response effectiveness.

"Digital Communication Platforms" ranked third, with a mean of 4.20, underscoring their importance in enabling seamless communication. Effective communication is vital during disaster response, and robust digital platforms ensure that information flows smoothly between different stakeholders, aiding coordination and collaboration. "System Reliability and Maintenance" was ranked fourth, with a mean score of 4.13. This highlights the necessity of maintaining dependable systems. Reliable AI systems are critical in disaster response as they ensure continuous operation and effectiveness, even under challenging conditions.

Lastly, "Data Collection and Analysis" ranked fifth, with a mean of 3.81, reflecting its vital but slightly less prioritized role. While data collection and analysis are crucial for informed decision-making and ensuring compliance with international standards, it is ranked lower compared to the immediate operational needs of cloud power, AI

system availability, communication platforms, and system reliability. These factors collectively underline the importance of having robust technological infrastructure and capabilities to support the integration of AI in the UAE's disaster response system. Prioritizing access to computational power, availability of AI tools, seamless communication platforms, reliable systems, and effective data analysis will enhance the overall effectiveness and readiness of AI-driven disaster response efforts in the UAE.

4.5 GOVERNMENT SUPPORT AND INCENTIVES GROUP

These findings on government support and incentives group are crucial for understanding the readiness to integrate AI into the UAE's disaster response system. The highest-ranked factor, "Support for Research and Development" (mean: 4.29), underscores the importance of government backing for innovation and AI advancements. This support is vital for fostering a conducive environment for AI development, enabling the creation of advanced AI solutions tailored for disaster response. Following closely is "Availability of Financial Grants" (mean: 4.25). Financial aid is significant for promoting AI adoption, providing the necessary funds for research, development, and implementation of AI technologies in disaster response systems.

"Subsidies for AI Technology Adoption" ranks third (mean: 4.20). Subsidies are important for reducing the costs associated with integrating AI technologies, making it more feasible for various entities to adopt and implement AI in disaster response operations. "Access to Tax Incentives" is ranked fourth (mean: 4.19). Tax-related support plays a substantial role in fostering AI investments by providing financial relief and incentives for organizations to invest in AI technologies.

Lastly, "Government Partnerships and Collaborations" (mean: 3.81) highlight the role of strategic partnerships in advancing AI initiatives. While this factor is ranked slightly lower than direct financial support mechanisms, it emphasizes the importance of collaboration between the government and various stakeholders to drive AI advancements. Hence, these factors collectively highlight the critical role of government support and incentives in enhancing the readiness to integrate AI into the UAE's disaster response system. By prioritizing research and development, providing financial grants, offering subsidies, and ensuring tax incentives, along with fostering strategic partnerships, the UAE can create a robust environment for AI integration, ultimately improving disaster response capabilities.

5. CONCLUSION

The findings of this study emphasize the critical need for aligning the integration of AI in the UAE’s disaster response system with international standards and best practices. By prioritizing fairness, accountability, human oversight, ethical clarity, and transparency, the UAE can ensure that AI-driven disaster response efforts are both effective and trustworthy. A robust policy and regulatory framework are essential to enhance readiness for AI integration. Key considerations include ensuring data privacy and security, establishing tailored AI-specific policies, securing government support, complying with international regulations, and upholding ethical guidelines. These measures will contribute to the development of AI systems that are secure, ethically sound, and highly effective in disaster response. Furthermore, strengthening the UAE’s technological infrastructure is vital for successful AI integration. Access to computational power, availability of AI tools, seamless communication platforms, and reliable data analysis capabilities will collectively enhance AI-driven disaster response efforts. Government support and incentives also play a crucial role in fostering AI readiness. Investments in research and development, financial grants, tax incentives, and strategic partnerships will create a robust ecosystem for AI implementation, ultimately improving national disaster resilience. By addressing these key factors, the UAE can enhance its disaster preparedness and response capabilities, leveraging AI as a transformative tool to mitigate risks, improve response efficiency, and safeguard communities against future disasters.

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