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Artificial intelligence in the United Arab Emirates public sector: a systematic literature review

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ABSTRACT

This systematic literature review examines United Arab Emirates (UAE) public sector artificial intelligence (AI) use, impact, and challenges. Using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) protocol, 20 relevant Scopus articles were selected for the study. Data from selected articles were used to analyse AI's use, benefits, and drawbacks in the UAE's public sector. Quality assessment was done throughout the review process. The results showed that AI is being used more in the UAE's public sector to improve efficiency, cost savings, decision-making, and service delivery. The review also found data, privacy, security, technical, infrastructure, AI, and user challenges. Publication bias and the lack of AI studies in the UAE's public sector limit the study. The findings have major implications for policy and practice, emphasising the need for AI strategies and UAE-specific solutions.

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1. INTRODUCTION

In 1955, Emeritus Stanford Professor John McCarthy coined "artificial intelligence (AI)" as "the science and engineering of making intelligent machines". Researchers initially programmed machines to play chess. Today, the goal is to create machines that can learn like humans. Since this paper focuses on United Arab Emirates (UAE) public sector AI adoption, a generic definition is used: AI allows a digital computer or computer-controlled robot to perform intelligent tasks [1]. Many experts believe that AI will solve some of humanity's most complex problems. AI is dynamic and only includes technological advances with human-like cognitive skills. Many critical technological advancements use AI, a vague concept [2].

A plethora of studies have investigated the potential benefits and application of AI in eventually every aspect and sector such as in education [3], [4], healthcare [5]-[7], agriculture [8], [9], hospitality [10], [11], and public sector administration [12], [13]. AI technology is being more frequently employed as a result of solid databases and increased processing capabilities [14]. In AI's social and economic aspects, IoT and cloud system gadgets are becoming more common. Object identification, robotics, and data-driven product platforms are also growing. Public sector AI is creating global opportunities. AI technologies will change service design and delivery, policy and decision-making, and law compliance and enforcement in government and public-sector ecosystems. AI can boost process and activity efficiency [15], [16], help to

enhance monitoring tasks [17], [18], improve data processing [19], decision making support [20], [21], and improving service design and delivery [22], [23]. To gain the societal and economic benefits of AI and to be best prepared for future problems, it is more crucial than ever to invest in it intelligently. As a result, the UAE has recently explored AI innovatively and creatively. The UAE is a regional pioneer in fields such as smart economy, AI, and human capital. The UAE government is constantly attempting to remain ahead of other governments in terms of high efficiency and excellence in public services. Successful implementation of e-government services was swiftly transformed into a platform for mobile government (smart/m-government). Recently, the UAE has resorted to AI-enabled services, prompting the establishment of the Ministry of Artificial Intelligence [24]. Despite all of those potential benefits, AI adoption in the public sector faces various challenges such as data challenges [25], [26], organizational and managerial challenges [27], [28], skills challenges [29], interpretation challenges [30], ethical and legitimacy challenges [31], and societal challenges and economic challenges [32]. Although AI adoption in the public sector has received increased attention in recent research [33], there is still a gap in research efforts towards understanding the benefits, implications, and challenges of AI adoption within the UAE's public sector.

In literature, one of the main challenges adoption of AI in the public sector has been slower than in the commercial sector during the last few decades [34]. Therefore, government AI use is relatively new. The public sector cannot immediately copy private sector AI and digital transformation plans because it seeks public benefit. In the public sector, AI issues are less understood than in the commercial sector [35]. Governments also worry about how AI systems' complexity and unpredictability will affect public administration. AI's complex effects on public governance are unknown to most governments. The rapid impact of AI on governments worldwide. It is outpacing thought leadership in governance and AI as many countries struggle with AI's cultural, economic, political, and ethical effects, where this information gap threatens development. Modern AI research also addresses computer science-related technological issues and solutions. Outside of tech, AI governance, policy, and regulation research is scarce [36]. Furthermore, there is no agreement on how to address the future issues of AI in the public sector. According to Wirtz *et al*. [12], AI governance and regulation need to be tackled more thoroughly in public administration research. Although "researchers, practitioners and policymakers are starting to pay attention to AI governance, policies, and regulatory issues" [37], a systematic overview of the implications of AI use in government for public governance is still lacking.

This study examines UAE public sector AI and contexts. It examines UAE public sector AI adoption benefits and challenges to identify AI use and improvement research gaps. This study covers systematic literature review and research design. Results of UAE public sector AI deployment research are shown. A thorough study record analysis shows research landscape. Recording methods are examined. The research landscape is analysed using field methods. This comprehensive approach ensures the study advances knowledge and guides future research.

2. PROPOSED METHODOLOGY

To analyze the studies, a systematic review of the literature was conducted through the application of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) protocol. The choice of this method is justified by the transparency of the procedures, which makes it easy to replicate and verify the results [38]. The procedures of PRISMA are divided into four phases: a) identification, b) screening, c) eligibility, and d) inclusion.

2.1. Identification

The main questions to be answered, where the objectives to achieve are specified as the review objectives are as follows:

- To gain knowledge about other researchers' approaches to AI in the UAE's public sector.
- To obtain insights about implications and challenges of using AI in the UAE's public sector.
- To identify key areas where AI research was focused in the past few years.

This search strategy was tailored to the Scopus database, and the search terms used are "artificial intelligence" OR "AI" OR "machine learning" OR "ML" AND ("public sector" OR "government").

2.2. Screening

The search returned 10,787 documents. 64 duplicates were removed, leaving 10,723. All 2018–present database searches yielded 7,399 documents. Researchers found 6,609 journal, review, and conference papers. We had 6,437 records after removing 172 non-English documents. Because the search focused on UAE, foreign articles were excluded. This stage removed 6,357 research articles. Retracted records number 80. The above search strategy is used in January 2023.

2.3. Eligibility

The search focused on mapping UAE public sector AI literature. The study uses original research, review papers, and conference papers. We checked and removed all duplications to maintain review quality. After evaluating each article for inclusion and exclusion, we chose 20. Figure 1 shows the literature included and excluded at each level.

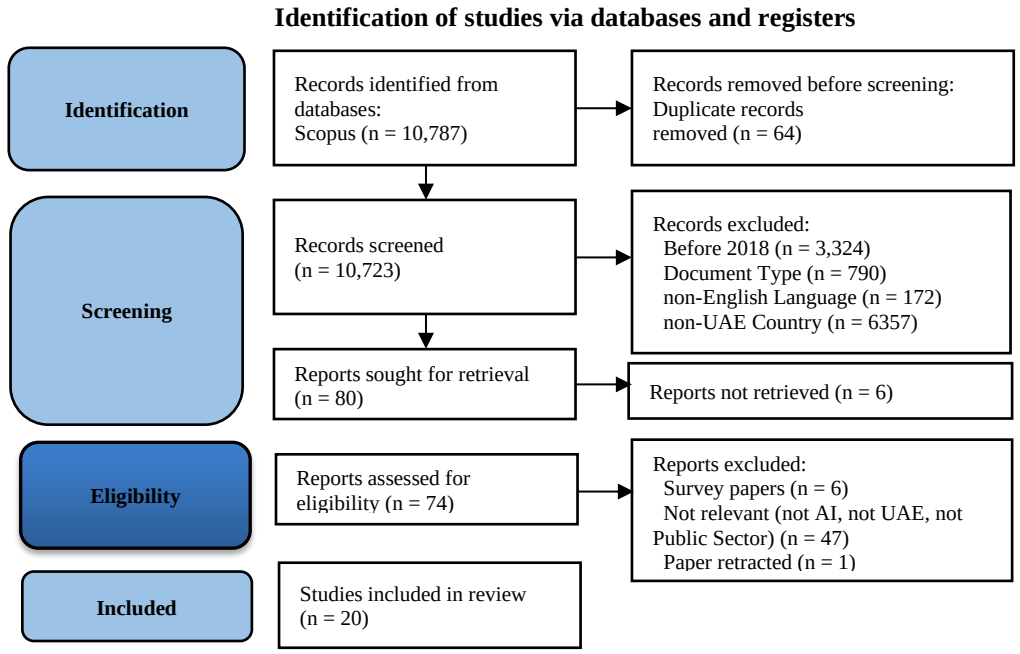

Figure 1. Study selection, assessment, and inclusion (presented using the PRISMA flow diagram)

2.4. Inclusion

The study started with 10,787 identified records meeting the initial search criteria from the Scopus database, the following diagram illustrates the identification, screening and included records in the study. In the data extraction phase, 20 articles were selected and the characteristics extracted are:

- The article must be an original paper, a review paper, and a conference paper. Published reports and case studies are excluded.
- The article must be in the English language.
- Extracted articles are published from 2018 upward.
- The extracted papers are from UAE
- The article must be relevant to AI and within the public sector in the UAE.
- After reviewing the papers: (abstract and skimming)
- The are 6 papers are excluded for no access.
- Further, 6 survey papers are excluded.
- There are 47 papers are excluded for being not relevant, either concerning other territories and countries than the UAE or not related to AI or the public sector.

3. RESULTS AND DISCUSSION

This section summarises our extensive analysis of UAE public sector AI adoption research articles. The report provides a research landscape overview with descriptive analysis. This includes approach analysis findings to illuminate researchers' methods. It also includes content analysis on UAE public sector AI use, benefits, and challenges.

3.1. Descriptive analysis

Descriptive analysis examines annual study numbers. Published papers on UAE public sector AI use from 2018 to 2022 are shown in the graph. This topic has seen a 133% increase in papers published from 3 in

2018 to 7 in 2022. The UAE's public sector's increased AI paper output suggests that researchers are actively seeking new ways to use AI to improve public services.

The dataset contained records from a variety of subject areas, (see Figure 2), where computer science had the most records (n=15), followed by engineering (n=15), social sciences, energy, and environmental science. Business, management and accounting, decision sciences, biochemistry, chemical engineering, genetics and molecular biology, earth and planetary sciences, immunology and microbiology, and physics and astronomy had fewer records. Records are distributed by subject area based on research topic popularity, data, and funding. Computer science includes AI, machine learning, and data science. Also popular is engineering, which is needed to develop new technologies and solve complex problems. The social sciences include economics, sociology, and psychology. Climate change and resource depletion make energy and environmental science important.

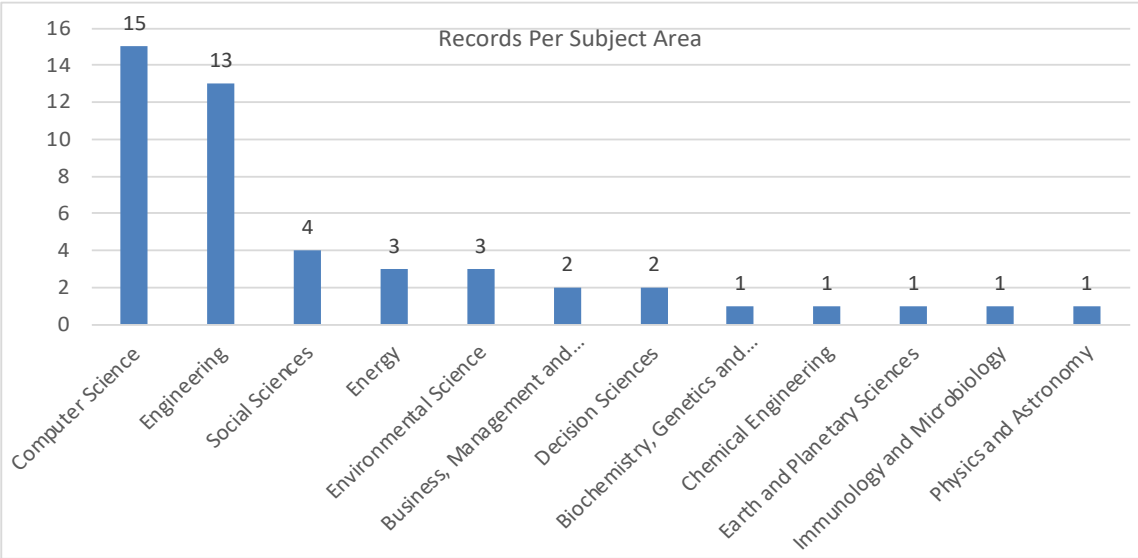

Figure 2. Records distribution by subject area

In analyzing artificial intelligence applications (AIA) in the UAE's public sector, publication trends show a split between conference proceedings (60%, 12 records) and academic journals (40%, 8 records). The dominance of conference papers, often chosen for their timely publication and peer interaction opportunities, suggests the fast-paced evolution of AI research. Academic journals, with stringent review processes, provide a more permanent record, indicating research depth. The eight journal articles span various disciplines, notably computer science, with journals like Applied Computing and Informatics and Journal of Artificial Intelligence Research, reflecting computational research's importance. Interdisciplinary engagement is evident with environmental journals like the Journal of Cleaner Production and journals focusing on technology's societal and health impacts, such as Health and Technology. The 12 conference papers, sourced from distinct proceedings, mainly discuss information and communications technology (ICT). Conferences like the International Forum on Research and Technology for Society and Industry and the E3S Web of Conferences extend beyond ICT, exploring its intersections with societal and environmental issues. This variety emphasises the topic's multifaceted academic and social relevance. The review's citation data showed a significant increase from 2019 to 2021, but a slight drop in 2022. With the launch of many nationwide strategies and initiatives to advance the UAE's use of advanced technologies, such as the UAE's 2021 AI strategy, academia and the public sector may be more interested in AI and its applications.

3.2. Approach analysis

This section discusses the objectives and goals of the studies included in the review, the research method followed and what theories were mentioned in the study. Qualitative (n=9), quantitative (n=9), and two records used a mixed method (i.e. quantitative and qualitative) which are [39] and [40]. The objectives of each the 20 papers that were included in the study are in Table 1.

Table 1. Included studies overview and objectives

Study references	Objectives
Halaweh [41]	To discuss the societal impacts of AI at a macro (country-wide) level.
Alqaryouti *et al.* [42]	To help government entities gain insights on the needs and expectations of their customers. By proposing an aspect-based sentiment analysis approach.
Rajak *et al.* [43]	To automatic waste-classification system using a deep learning algorithm to classify waste
Ghandour and Woodford [44]	To investigate the ethical, societal and legal challenges associated with AI development in the context of the UAE government.
Mohasses [45]	To review the performance of existing Chatbots in the Dubai government and make recommendations on how the Dubai government extends the deployment of Chatbots even further to serve its residents better.
Chaudhry *et al.* [46]	To analyze the role of internet of things (IoT) and AI in place making of Dubai.
Marri *et al.* [47]	To investigate the impact of AI on government e-service in Dubai.
Alhashmi *et al.* [48]	To explore out the critical success factors assist in implementing AI projects in the health sector.
Siyam *et al.* [49]	To investigate how governments can increase citizens' e-participation on social media.
Kizhisseri *et al.* [50]	To present a neural network tool for predicting the capital cost of desalination plants based on reverse osmosis technology.
Shuja *et al.* [51]	To investigate the effects of online sessions on existing on-campus and country-wide network facilities and proposing possible solutions for network resource optimization. propose and utilise machine learning classifiers to sort a person's risk based on their social distance from their contacts.
Zgheib *et al*. [52]	To propose an AI system based on neural networks (NN) method to predict whether a person has caught COVID19 disease or not.
Zualkernan *et al.* [53]	To propose a smart system to automatically detect social distance violations on the edge.
Shah *et al.* [54]	To develop a new marine life surveillance and protection system that performs regular monitoring in the fishing area to ensure law compliance.
Zia *et al.* [55]	To propose an AI-powered autonomous robot for deep mask-wearing detection to enforce proper mask wearing in educational settings.
Ajala *et al.* [40]	To propose a sophisticated approach for the analysis of extreme views expressed on social media.
Abuzaid *et al.* [56]	To assess the knowledge, attitude, willingness and organisational readiness in integrating AI into nursing practice.
Alhalabi *et al.* [39]	To propose a novel conversational AI-based M-Government mobile application that facilitates access to various government services and increase the availability, reliability and accessibility of those services.
Almaiah *et al.* [57]	To investigate users' experiences with AIA for governmental purposes in the Gulf area.
Otoum *et al.* [58]	To address the limitations associated with analysing extreme views on social issues through a proposed sophisticated approach.

This period saw a significant trend in research methods. As shown in Figure 3, quantitative studies have increased significantly over time. Most studies in the dataset are qualitative (52%). The second most common research method is quantitative, accounting for 38% of studies. 10% of studies use mixed methods. It's important to consider the context of these researches to understand this trend. The UAE government's initiatives sparked public sector AI interest. As the UAE government adopted AI, policy and strategy were the main priorities. Qualitative research methods are needed to understand nuanced perspectives, contextual complexities, and generate rich, detailed insights during conceptualization and foundational laying. However, as 2022 approached, things changed. This area saw more involvement from academia and industry. They changed the research focus to practical AIA. This transition towards measurable results naturally favours quantitative research methods. Quantitative studies can test hypotheses, validate models, and draw generalizable conclusions, making them ideal for AIA. The industry's preference for scalability, generalizability, and actionable insights may have fueled quantitative methods.

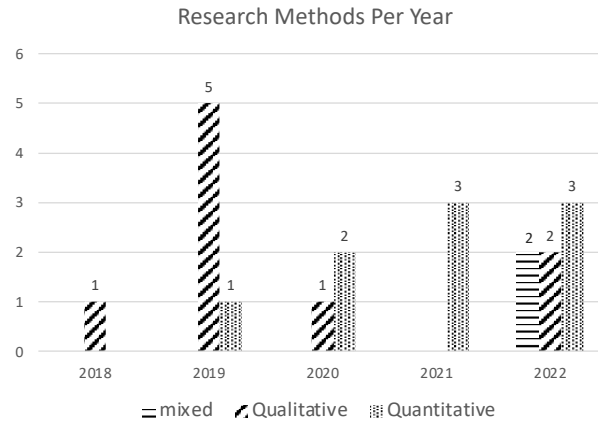

Figure 3. Research methods

Last, this review examined the theories mentioned in the literature. Almaiah *et al.* [57] found that three studies mentioned certain theories. They used diffusion theory to study Gulf users' AI government application experiences [57]. The UAE M-Government application's usefulness and satisfaction were examined using the automation model's acceptance [39]. The extended TAM model was used by [48] to examine the key success factors for health sector AI projects. The UAE's public sector's AI topic requires more sophisticated and focused theories, which may explain the limited theoretical background. AI's impact on the public sector is still in its infancy, which may explain why current studies lack a theoretical foundation.

3.3. Content analysis

This section explains our systematic literature review findings from the comprehensive content analysis of the selected records. We focus on the multifaceted aspects of government AI deployment. We examined the articles to understand how AI has been used, its benefits, its challenges, and its public governance dimensions.

3.3.1. How was artificial intelligence utilised and in which capacity?

In our systematic literature review, the authors sought to understand AI use across UAE public sectors. This is summarised in Table 2 from our content analysis. The following subsections analyse the content, drawing conclusions and patterns from the listed records. The use of robotics in police and customer service shows AI's widespread use. The ability of AI-powered robots to serve as enforcement agents and service providers shows AI's transformative power. The educational sector will benefit greatly from AI. AI-powered robots for mask-wearing detection [55] are an innovative COVID-19 pandemic response.

Table 2. AI utilisation in the UAE's public sector context and in specific capacity.

Context	How
Cross-sectorial	Police officer robot, customer service robot, respond to customer calls and inquiries regarding banking services [41]
Education	AI-powered autonomous robot for deep mask-wearing detection [55], Applying machine learning clustering techniques to form student communities [51]
Environment	Waste management: convolutional neural network for waste classification [43], Water desalination plants\Utilities: multi-layer feedforward neural network with back propagation learning predicting the capital cost of desalination plants [50]
Government Services	Conversational AI-based M-Government mobile application [39], Enhance the development of the services [57], Enhance the development of the services [57], Machine learning techniques predict user engagement [49], AI in government service, determination of the water quality [47], Chatbots to enhance services [45], Aspect-based sentiment analysis approach [42], Mining of big data to enhance municipal services [46]
Healthcare	Integrating AI into nursing practice [56], Study of AI adoption in UAE healthcare [48], Pneumonia detection [58], AI system based on Neural Networks (NN) method to predict COVID19 infections [52], Using Visual recognition to detect social distancing [53]
Law enforcement and public security	Visual recognition technology to enhance detection accuracy [54], Examine extreme views on social media [40]
UAE legislations	Ethical, societal and legal challenges associated with AI development in the context of UAE government [44]

Using machine learning to form student communities, Shuja *et al.* [51] suggests personalised learning using AI's predictive analytics. AI has great environmental potential, from waste management to water utilities. Convolutional neural networks [43] classify waste precisely, while desalination plant capital cost prediction models [50] offer fiscal benefits. Additionally, government services may be the first to adopt AI. From chatbots [45] improving service delivery to AI-driven water quality determination [47], applications are varied. Aspect-based sentiment analysis [42] and big data mining [46] demonstrate the commitment to AI-driven proactive governance. Healthcare has seen some of the most important AI implementations.

AI's role in improving healthcare outcomes is shown by its integration into nursing [56], AI-driven studies on healthcare adoption [48], and neural network COVID-19 infection prediction [52]. Undoubtedly, AI improves public security and law enforcement. Modern security measures include visual recognition [54] and social media analysis for extreme views [40]. Finally, AI's rise is changing UAE regulation. Exploring AI's ethical, societal, and legal challenges [44] shows a conscious effort to balance innovation and ethics.

3.3.2. Benefits of using artificial intelligence in the UAE's public sector?

AI its many benefits make UAE public sector AI research popular. Benefits include government services, economics, society's health, law enforcement/compliance, efficiency, the environment, and creativity. Services in the UAE's public sector improve with AI. AI can improve government service

availability, reliability, and accessibility, increasing citizen satisfaction and e-government participation [41]. AI can also reveal citizens' needs and expectations, improving government services [42]. This study also found economic benefits. AI boosts the digital economy, creates jobs, and improves education, making residents happier [43]. AI improves government services, saving money and boosting the economy. UAE government AI improves health. AI can reduce COVID-19 spread, speed pneumonia detection, predict infections, and help doctors provide evidence-based care [47]. Benefits improve society's health. Police and compliance are another public sector AI uses. AI has transformed law enforcement compliance monitoring and enforcement. AI can regulate school masks. For ecosystem protection, AI-driven systems can monitor marine conservation protocols [48]. AI can improve waste classification and precision, according to research. AI improves government service clarity and employee productivity [49]. Data-driven government decisions are supported by AI [59]. Environmental conservation is increasingly involving AI. AI helps manage solid waste and protect marine life [60].

3.3.3. Challenges of utilising artificial intelligence in the UAE's public sector

AI in UAE's public sector ushers in a new technological era, but it also presents challenges. Complexities exist in five main challenge categories. Initial issue: data constraints. Data quality and volume are needed for AI models. However, data scarcity, social media data noise and bias, and camera positioning data quality issues hinder AI model development [51]. Sentiment analysis is unreliable with biassed data [52]. Second, using AI in the public sector raises concerns about data privacy, ownership, and stewardship and centralised learning solution security [54]. Data abuse and unauthorised access raise ethical concerns that may damage AI-driven initiatives' credibility.

Third: tech and infrastructure constraints. AI computations are computationally intensive. The public sector may have trouble getting these resources financially and logistically. Traditional centralised learning solutions' processing, storage, and communication limitations hinder real-time large dataset processing [40]. Fourth, AI models have limits. Machine learning models may be light and inaccurate. Gender bias may affect predictive models. Chatbots' limited functionality and the lack of precise, automated sentiment analysis tools may make AIA for public sector projects less reliable [58]. Fifth, user-centric challenges highlight AI's humanity. People prefer traditional systems to AI. AI adoption is hindered by stakeholder rejection, profession-wide AI ignorance, and automated tool oversimplification concerns. Effective AI integration requires coordinated education and communication. If data, technical, and user issues are addressed, AI can transform the public sector. Technology, ethics, and user education are needed to address these issues.

3.3.4. Scope of research on the implications of artificial intelligence use in government for public governance

Our review delineates the scope of selected articles on AI's impact on public governance, analyzing administrative level, AI type, and governance implications. Most studies address AI's effects globally, with fewer on national or local levels. Regarding AI types, many broadly use the term 'AI', with eight not specifying subtypes. Six focus on specific AI forms like machine learning or deep learning, often combining general AI perspectives with specific technologies like machine learning, natural language processing, and others, including virtual reality and robotics. The implications for public governance, although not directly stated in most articles, align with our broad definition of public governance, encompassing all related regulations and practices. We identified seven governance types relevant to AI use in government: collaborative, organizational, service, participative, policy and strategy, legislative and regulatory, and ethical governance.

4. CONCLUSION

In the realm of our study, utilizing the Scopus database, conducted a thorough systematic literature review, including 20 articles from 2018 onward, reflecting the growing interest in AI's application in public governance. The literature, comprising qualitative studies, literature reviews, conference proceedings, and non-theoretical research articles, revealed an increase in AI-related publications in the UAE's public sector, especially from 2019. The disciplinary origin of these articles was predominantly Computer Science (30%) and Engineering (28%), with 60% presented at conferences and a recent trend towards quantitative methodologies. The benefits of AI in the UAE's public sector include enhanced efficiency, cost savings, improved decision-making, and better service delivery, alongside increased safety, accuracy, and reduced human errors. Challenges identified include data-related issues, privacy and security concerns, technical and infrastructure limitations, and user-centric obstacles. The articles focused on AI's ability to automate the management of open data portals, adapt to changing public policies, and enhance government service user

experiences. Despite these insights, there's a need for further research on AI's long-term effects on public sector employment and public perception of AI in governance, addressing any existing apprehensions.

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