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FROM BYTES TO INSIGHTS THROUGH A BIBLIOMETRIC JOURNEY INTO AI'S INFLUENCE ON PUBLIC SERVICES

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Abstract:
In the dynamic realm of public services, the integration of artificial intelligence (AI) has emerged as a transformative force, reshaping various sectors, including governance, urban development, healthcare, education, security infrastructure, decision-making processes, and responses to health crises. This article conducts an exploration spanning the years 1984 to 2023, employing bibliometric analysis to analyse global literature retrieved from the Scopus database. The central investigation revolves around the evolution of AI utilisation in public services during this period. Findings indicate a significant surge in AI-related publications, with notable global contributions from countries like China, India, and the United States, and a prevalence of computer science in AI research. Keyword clusters highlight seven prominent themes, ranging from digital governance to modelling health and social welfare in pandemics. Future research directions underscore ethical implications, AI adoption across government agencies, effectiveness in addressing urban challenges, machine learning applications in healthcare and education, security and privacy implications, application in diverse contexts, and AI's role in predicting and managing public health emergencies. This research contributes some necessary information for both academia and practical implementation in public services, laying the groundwork for future studies.

Keywords: artificial intelligence, public services, bibliometric analysis, digital governance, machine learning.

JEL: O38, I18, I23.

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INTRODUCTION

Artificial intelligence (AI) has become a key element in the dynamic realm of public services, revolutionizing various sectors. It has significantly altered governance practices (Taeihagh, 2021), propelled urban development initiatives (Haldorai et al., 2019), enhanced healthcare delivery (Secinaro et al., 2021), reformed educational systems (Popescu et al., 2023), fortified security infrastructure (Schmitt, 2023), refined decision-making processes (Duan et al., 2019), and improved responses to health emergencies (Fernandez-Luque & Imran, 2018). The primary goal of this paper is to analyse and synthesise trends in AI utilisation within the public services sector, posing an overarching question. How has the utilization of AI in public services evolved during this period? To answer this, the study employs a bibliometric analysis, focusing on global literature retrieved from the Scopus database.

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Our bibliometric analysis approach utilized a targeted query that included key AI and public services terms. The search yielded 984 documents that met the inclusion criteria, and subsequent data extraction included details such as publication year, language, journal, authors, and citation count. The visual representation of keyword clusters highlights seven prominent themes, shaping the future research directions outlined in the conclusions. The themes signify the multidimensional impact of AI on public services.

This research contributes to academic inquiry and practical implementation in public services, shedding light on nuanced trends and global collaborations. However, certain limitations, including potential language bias and focus on English-language publications, as well as challenges in assessing publication quality and the dynamic nature of the AI field, warrant acknowledgement. However, these insights provide a foundation for future research, ensuring that AI applications in public services align with social values and contribute positively to the common good.

This paper is structured to provide a coherent exploration of AI's influence on public services. It begins with an in-depth "AI's Impact on Public Services: Key Studies Overview", which examines seminal research in the field. This is followed by the "Research Methodology" section, detailing the approaches and techniques employed in our study. Subsequently, the "Analysis and Results" section presents our findings, offering insights into the practical implications of AI. The paper concludes with "Conclusions and Future Research Directions", where we summarise our discoveries and propose pathways for future research into this transformative technology.

1. AI'S IMPACT ON PUBLIC SERVICES: KEY STUDIES OVERVIEW

Artificial intelligence (AI) has emerged as a transformative force with profound implications for public services across various domains. This review of the literature synthesizes findings from key studies, exploring the impact on healthcare, weather forecasting, public health, decision-making, and citizen interactions. Each study contributes valuable insights, collectively illustrating the multifaceted ways in which AI is reshaping public services.

Chen et al. (2017) and Wahl et al. (2018) exemplify the pivotal role in revolutionizing healthcare services. Chen et al. (2017) introduced a convolutional neural network (CNN) based multimodal disease risk prediction algorithm that achieved a remarkable 94.8% accuracy in predicting chronic diseases. This algorithm, which analyses both structured and unstructured data, holds significant promise in enhancing diagnostic precision and prognosis in healthcare. The study contributes to the broader landscape of public services by showing how AI can improve the quality and efficiency of healthcare delivery.

Wahl et al. (2018) extended the discussion to low- and middle-income countries (LMICs), emphasizing AI's potential to address diverse health challenges. The article underscores the capacity to enhance health service delivery, improve diagnosis, treatment, and monitoring, and contribute to data-driven decision making. However, it also highlights the challenges, including ethical and legal considerations, associated with the implementation of AI in LMICs. This study broadens our understanding of AI's influence on public services by emphasizing its role in promoting global health equity.

Chetoui et al. (2023) explored the use of artificial intelligence to detect and diagnose COVID-19 from chest X-ray images. They found that AI achieved a high precision of 98% and outperformed human radiologists. Fong et al. (2020) address the timely and critical issue of early forecasting during epidemic outbreaks, particularly the 2019-nCoV coronavirus. By leveraging data mining

and machine learning, the article demonstrates how AI can provide accurate forecasts even with limited and uncertain datasets. This study further solidifies the role of AI in public health emergency response and decision-making, highlighting its potential to inform resource allocation and strategic planning in public services. This study demonstrates how AI can help combat pandemics and improve public health outcomes.

Topol (2019) provided an interesting overview of current and future applications of AI in medicine, covering various aspects such as diagnosis, treatment, drug discovery, and patient care. He also discussed the ethical, social, and legal implications of AI in healthcare and the need for human oversight and regulation. This study offers a valuable perspective on how AI can transform healthcare and public services.

Miotto et al. (2018) proposed a novel framework to integrate and analyse heterogeneous health data using deep learning. They showed how AI can extract meaningful insights and patterns from complex and diverse data sources, such as electronic health records, genomic data, and clinical notes. This study shows how AI can enable personalised and precision medicine and improve public health research.

Shi et al. (2017) introduced AI into the realm of weather forecasting, introducing the LSTM (long short-term memory) model. This model, which is capable of capturing spatio-temporal correlations in precipitation data, outperformed traditional models. Tekin et al. (2021) proposed a novel deep learning architecture for forecasting high-resolution spatiotemporal weather data. Their approach extends the conventional encoder-decoder structure by integrating convolutional long-short-term memory and CNN. These studies show how AI can significantly improve the accuracy and efficiency of weather predictions, impacting public services in crucial areas such as transportation, agriculture, and disaster management.

Veale et al. (2018) and Kuziemski and Misuraca (2020) dive into the intricacies of AI in decision-making processes within the public sector. Veale et al.'s examination of machine learning practitioners highlights challenges in aligning AI algorithms with public values. This study reinforces the importance of transparency and public involvement in the design and evaluation of AI systems, establishing a crucial link between AI applications and the values maintained by public services.

Kuziemski and Misuraca (2020) further explore AI's impact on public sector decision-making through case studies in Canada, Poland, and Finland. Cases illustrate how AI can optimize immigration processes, employment services, and personalize digital service experiences. These examples underscore the potential to enhance public service efficiency, effectiveness, and innovation. Simultaneously, the study raises awareness of the ethical considerations associated with AI, emphasizing the need for responsible governance in the public sector.

Lindgren et al. (2019) contribute a critical perspective on the digitalisation of public services, emphasising the broader implications of AI. Their conceptualisation of the public encounter highlights how AI-enabled services alter interactions between citizens and public officials. The study illustrates both potential benefits, such as personalised and proactive services, and risks, including bias and loss of human agency. This analysis deepens our understanding of AI's influence on public services by examining the evolving nature of citizen engagement. The influence on public service delivery and citizen satisfaction is an area of growing interest. Wang and Ma (2022) provide empirical evidence from China, showing that digital interfaces can significantly improve citizen evaluations of public service delivery.

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Or-Meir et al. (2019) shift the focus to the realm of cybersecurity, exploring dynamic malware analysis and its applications. This article illustrates how AI can play a crucial role in the detection, classification, and mitigation of malware attacks. The study emphasizes the relevance of AI in protecting public services, particularly in sectors such as healthcare, transportation, and education. Furthermore, the study by Djenna et al. (2023) offers valuable insights into the development of advanced AI-based cybersecurity solutions, emphasizing the importance of dynamic analysis and the integration of multiple detection techniques to combat evolving cyber threats. The findings could have far-reaching implications for the protection of public services and other critical sectors from malware attacks.

Torvik et al. (2005) contribute to the discussion by introducing a probabilistic similarity metric for measuring semantic similarity between texts. Their work shows how AI can enhance the analysis of textual data, particularly in domains such as education, healthcare, and law. By measuring semantic similarity, AI can facilitate evidence-based decision-making, evaluate public service interventions, and improve overall quality and efficiency of public services.

Aoki (2020) takes a unique approach, investigating public perceptions of AI chatbots in government services. This study provides insight into how citizen trust in AI applications can vary depending on the topic and purpose. By examining trust dynamics, Aoki emphasizes the importance of transparent communication about AI's purpose in public services. This study connects the technical aspects of AI with the social dynamics of public perception, shedding light on the human-centric dimension of AI in public services.

Engin and Treleaven (2019) offer a review of AI applications in various government domains. The paper explores the transformative potential of AI in public services, emphasising its capacity to enhance efficiency, effectiveness, and transparency. The study also highlights the challenges and opportunities associated with the responsible use of AI in the public sector. This work serves as a bridge, connecting the technical capabilities of AI with the broader social and ethical considerations embedded in public service delivery.

The amalgamation of these studies underscores the multifaceted influence of AI on public services. From healthcare and weather forecasting to decision-making, citizen interactions, and cybersecurity, AI emerges as a transformative force with the potential to improve efficiency, effectiveness, and innovation in public services. However, ethical considerations, transparency, and public participation are essential aspects that must be integrated into the deployment of AI to ensure responsible and inclusive service delivery. As the trajectory of AI in public services continues to evolve, it is imperative to navigate the complex interplay between technological advances and societal values for the greater benefit of citizens and communities. Moreover, to evaluate the evolving landscape, a bibliometric analysis allows for a systematic examination of the most impactful studies. Through such an approach, we can discern the trends, patterns, and contributions in AI's integration into public services.

2. RESEARCH METHODOLOGY

The primary objective of this research is to perform an in-depth analysis and synthesis of trends in the utilization of AI in public services. This research aims to evaluate existing studies, contributing to a foundational understanding of future scientific investigations and the optimization of practices within the public services sector. The overarching research question driving our investigation is How has the use of AI in public services evolved over the period 1984-2023, based on a bibliometric analysis of the global literature?

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To better address this primary question, we have formulated several subsidiary research questions that will guide our exploration and shed light on nuanced aspects of the intersection between AI and public services.

- How does the distribution of AI-related publications vary across different years?
- Which academic journals emerge as the most prolific in publishing articles related to AI in public services?
- Which are the top-cited articles in this domain and what insights do they provide into the impact and influence of AI in public services?
- What are the predominant trends in the use of AI within public services, as evidenced by the literature published between 1984 and 2023?

To address these research questions, a bibliometric analysis was performed using the Scopus database, covering global literature from 1984 to 2023. The systematic search, conducted on November 30, 2023, employed a comprehensive query focused on key terms related to AI and public services. The inclusion criteria were established to include articles, conference papers, and book chapters published in English. The query used to extract the papers was: ("artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "natural language processing" OR "computer vision") AND ("public service*" OR "government* service*" OR "civil* service*" OR "citizen* service*" OR "municipal* service*" OR "community* service*"). The query incorporated AI-related terms such as "artificial intelligence," "AI," "machine learning," "deep learning," "natural language processing," and "computer vision." Simultaneously, it included public service-related terms such as "public service," "government service," "civil service", "citizen service," "municipal service," and "community service." This combination, using logical OR and AND operators, aimed to identify documents that specifically addressed the integration of AI technologies within the landscape of public services.

The search yielded 984 documents that met the inclusion criteria. Subsequently, data extraction involved recording details such as the year of publication, language, academic journal, titles, authors, affiliations, document type, keywords, and number of citations. This information was exported in CSV format from Scopus.

For keyword co-occurrence analysis, VOSviewer (van Eck and Waltman, 2011) version 1.6.20 was employed. This analysis facilitated the creation of a visual keyword map, providing insights into the interconnected themes within the literature, the approach being consistent with similar works (Bunea, 2021; Corbos et al., 2022; Corbos et al., 2023; Stefan & Breazu, 2022; Triculescu, 2022).

The distribution of papers by year of publication, the top 10 most productive journals, and the top 10 journals by the number of citations were analysed. The results are presented through figures that comprise suggestive tables and graphs, providing an overview of the landscape of AI in public services. Additionally, an assessment of the top 10 most influential papers, based on the number of citations received, enhances our understanding of the seminal contributions in this field.

3. ANALYSIS AND RESULTS

Figure 1 illustrates the fluctuating number of articles published annually from 1984 to 2023, highlighting significant growth in recent years and a peak in publication activity in 2022. Starting from a single article in 1984, there is a clear upward trend in the number of articles published each year, with occasional fluctuations. Notable increases can be seen in certain years, such as

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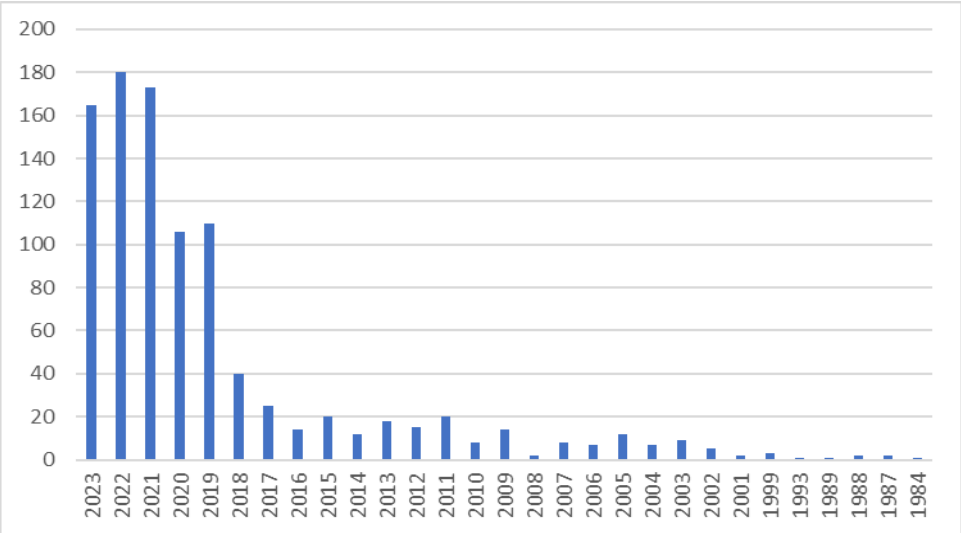
2006 to 2008, 2015, and a substantial jump from 2018 to 2019. The most significant growth occurred in the last five years, with numbers rising from 40 in 2018 to a peak of 180 in 2022.

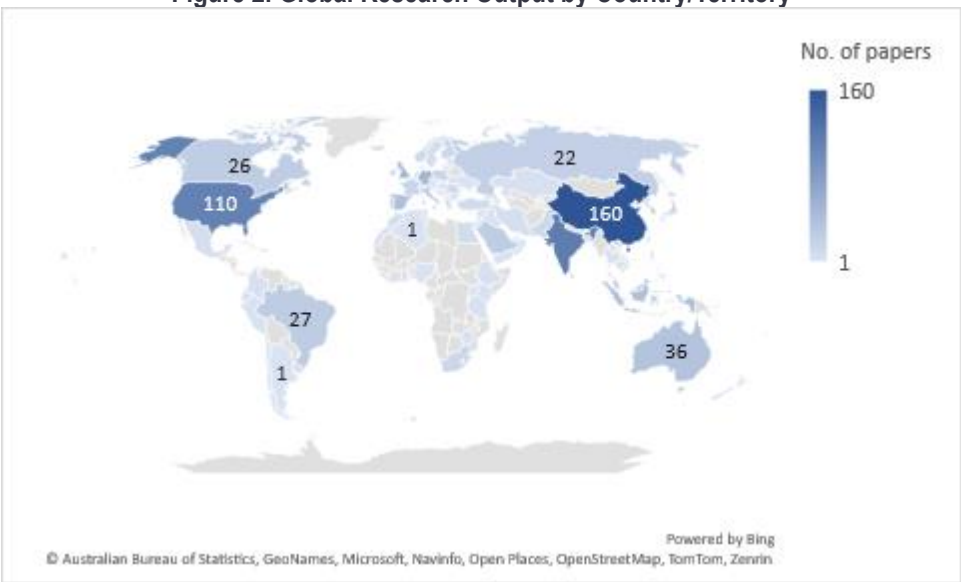
Figure 1. Trends in Publication - A Two-Decade Journey



Source: authors based on Scopus data

Figure 2 shows the distribution of academic articles in various countries and territories, with China, India, and the United States leading the research contributions. The data reveal a diverse global contribution to research on AI in public services, with notable representation from several countries. China leads with the highest number of articles (160), emphasizing its significant role in the advancement of AI applications in the public sector. India and the United States closely follow, with 115 and 110 papers, respectively, showcasing the collaborative efforts of these research-intensive nations. The United Kingdom, Germany, and Indonesia also have substantial contributions, underlining the global interest and involvement in this research domain. Beyond the major contributors, a wide range of countries, including Spain, Australia, Italy, and others, demonstrate a shared commitment to exploring the intersection of AI and public services. The international scope of this research is further emphasized by the inclusion of countries from various continents, reflecting a collective effort to harness the potential of AI for public service innovation.

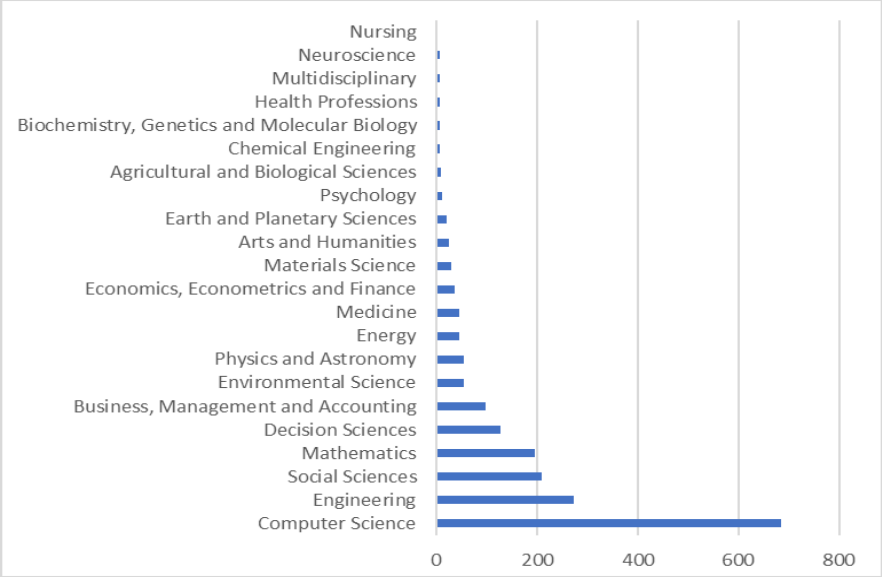
Figure 2. Global Research Output by Country/Territory



Source: authors based on Scopus data

Figure 3 shows that computer science is a very popular and active field of research, with more than twice the number of papers than the second most popular field, engineering. This may reflect the increasing demand and importance of computer science in various domains and applications, such as artificial intelligence, data science, cybersecurity, software engineering, etc. Moreover, the figure illustrates that there is a diversity of research topics and disciplines, ranging from hard sciences such as physics and astronomy, energy, and materials science to soft sciences such as social sciences, business, management, and accounting, and arts and humanities. This may be a good indicator that there is a richness and complexity of research problems and questions that require different approaches and perspectives.

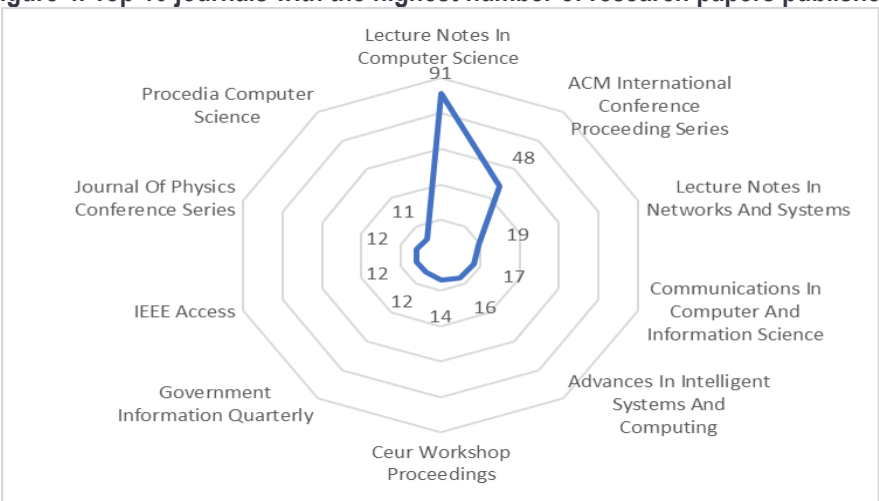
Figure 3. Distribution of research papers by subject area



Source: authors based on Scopus data

Figure 4 reveals that *Lecture Notes in Computer Science* is the most prolific journal, with 91 papers, followed by *ACM International Conference Proceeding Series* with 48 papers, and *Lecture Notes in Networks and Systems* with 19 papers. The least prolific journal among the top 10 is *Procedia Computer Science*, with 11 papers. The figure also shows that most of the journals are related to computer science and engineering, indicating that these are the dominant fields of research. Only one journal, *Government Information Quarterly*, is related to social sciences.

Figure 4. Top 10 journals with the highest number of research papers published



Source: authors based on Scopus data

Table 1 shows the title, authors, source title, and citations of the top 10 research papers published in different subject areas that are most influential on the topic of AI and public services in the Scopus database. The table reveals that the most cited article is *Disease prediction by machine learning over big data from healthcare communities* by Chen et al. (2017), with 730 citations, published in IEEE Access. The article proposes a novel framework for disease prediction using machine learning techniques over big data from healthcare communities. The paper also discusses the challenges and opportunities of applying machine learning to healthcare data.

The second most cited paper is *Deep Learning for precipitation nowcasting: A benchmark and a new model* by Shi et al. (2017), with 373 citations, published in Advances in neural information processing systems. The paper presents a benchmark data set and a new deep learning model for precipitation nowcasting, which is the intensity of task of predicting the rainfall in the next few hours. The paper shows that the new model outperforms the existing methods on the benchmark data set.

The third most cited paper is *Artificial intelligence (AI) and global health: How can AI contribute to health in resource-poor settings?* by Wahl et al. (2018), with 231 citations, published in BMJ global health. The paper provides an overview of the potential and challenges of using artificial intelligence to improve health outcomes in resource-poor settings. The article also suggests some ethical and practical guidelines for implementing AI solutions in global health.

The rest of the articles cover various topics and disciplines, such as fairness and accountability in algorithmic decision making, digitalisation of public services, dynamic malware analysis, author name disambiguation, AI governance in the public sector, innovation policy under industry 4.0 and the transition to sustainability development, and early forecasting model for the COVID-19 outbreak.

Table 1. Top 10 research papers by citations in different subject areas

Title	Authors	Source title	Citations
Disease prediction by machine learning over big data from healthcare communities	Chen, M., Hao, Y., Hwang, K., Wang, L., & Wang, L.	*IEEE Access*	730
Deep learning for precipitation nowcasting: A benchmark and a new model	Shi, X., Gao, Z., Lausen, L., Wang, H., Yeung, D. Y., Wong, W. K., & Woo, W. C.	*Advances in neural information processing systems*	373
Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings?	Wahl, B., Cossy-Gantner, A., Germann, S., & Schwalbe, N. R.	*BMJ global health*	231
Fairness and accountability design needs for algorithmic support in high-stakes public sector decision-making	Veale, M., Van Kleek, M., & Binns, R.	*Proceedings of the 2018 chi conference on human factors in computing systems*	220
Close encounters of the digital kind: A research agenda for the digitalisation of public services	Lindgren, I., Madsen, C. Ø., Hofmann, S., & Melin, U.	*Government information quarterly*	185
Dynamic malware analysis in the modern era—A state of the art survey	Or-Meir, O., Nissim, N., Elovici, Y., & Rokach, L.	*ACM Computing Surveys (CSUR)*	140
A probabilistic similarity metric for Medline records: A model for author name disambiguation	Torvik, V. I., Weeber, M., Swanson, D. R., & Smalheiser, N. R.	*Journal of the American Society for information science and technology*	135
AI governance in the public sector: Three tales from the frontiers of automated decision-making in democratic settings	Kuziemski, M., & Misuraca, G.	*Telecommunications policy*	132

Title	Authors	Source title	Citations
A cross-strait comparison of innovation policy under industry 4.0 and sustainability development transition	Lin, K. C., Shyu, J. Z., & Ding, K.	*Sustainability*	112
Finding an Accurate Early Forecasting Model from Small Dataset: A Case of 2019-nCoV Novel Coronavirus Outbreak	Fong, S. J., Li, G., Dey, N., González Crespo, R., & Herrera-Viedma, E.	*International Journal of Interactive Multimedia & Artificial Intelligence*	108

Source: authors based on Scopus data

The top cited articles, including AI and public services provide insights on the fact that AI has emerged as a transformative force with far-reaching implications for various facets of public services. In healthcare, it aids in disease prediction and prevention through machine learning applied to extensive healthcare data, as exemplified by the innovative framework of Chen et al. (2017). Additionally, AI contributes to advancements in weather forecasting, particularly in precipitation nowcasting using deep learning models, as demonstrated by Shi et al.'s (2017) benchmark dataset and model. Addressing global health challenges in resource-poor settings, Wahl et al.'s (2018) work explores AI's potential, challenges, and ethical guidelines for improving health outcomes. In high-stakes decision making, such as criminal justice, AI provides algorithmic tools, but raises concern of bias and transparency, discussed by Veale et al. (2018).

Furthermore, AI facilitates the digitalisation of public services, enhancing efficiency and citizen engagement, as proposed in Lindgren et al.'s (2019) research agenda. Safeguarding public service security, Or-Meir et al.'s (2019) survey on dynamic malware analysis showcases AI's role in detecting and analysing cyber threats. In scholarly domains, Torvik et al.'s (2005) work on a probabilistic similarity metric for Medline records highlights AI's contribution to information quality and coherence. Governance of AI, as explored by Kuziemski and Misuraca (2020) in democratic settings, underscores the importance of aligning AI with public interests. Moreover, AI shapes innovation and development policies, as seen in the cross-strait comparison of innovation policy under industry 4.0 and the sustainability development transition (Lin et al., 2017). Finally, AI aids in emergency and crisis management, exemplified by Fong et al.'s (2020) accurate early forecasting model for the 2019-nCoV coronavirus outbreak. Collectively, these insights underscore the multifaceted impact of AI on public services, affecting diverse domains critical for societal well-being.

Figure 5 shows how different subfields and topics within artificial intelligence are connected and clustered. Out of a total of 6,990 keywords, 373 meet the threshold of a minimum of five occurrences, leading to the formation of 7 clusters. The size and colour of the nodes indicate their importance and community, respectively. The figure reveals the centrality of artificial intelligence, machine learning, deep learning, natural language processing, and neural networks in the field.

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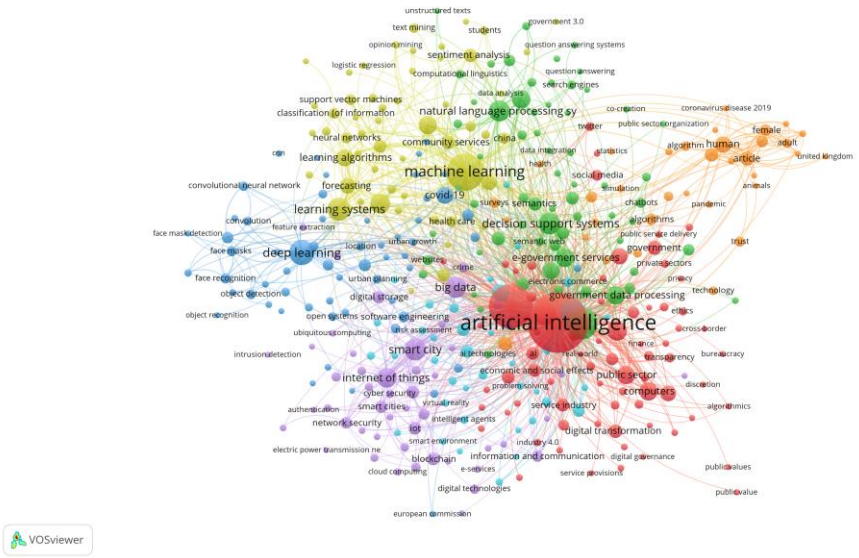
Figure 5. A network visualisation of the field of artificial intelligence and public services



Source: VOSviewer analysis

Cluster 1 (red) delves into the theme of "*Digital Governance and AI-Driven Public Services*." The main theme of the provided keyword cluster appears to revolve around the intersection of artificial intelligence (AI), digitalisation, and governance in the context of public services. Key components include the application of AI and robotics in public administration, the impact on service delivery, considerations of ethics and privacy, and the broader implications for economic growth and social aspects. Additionally, topics such as digital transformation, interoperability, and the role of government in the digital economy underscore the theme of advancing technology and its effects on public sector practices. The group encompasses an exploration of AI applications, technological innovations, and their implications for public service delivery and governance.

Cluster 2 (green) focuses on "*AI Technologies in Government Services.*" This theme encompasses a wide range of topics, including artificial intelligence, chatbots, co-creation, computational linguistics, decision support systems, digital government, e-government services, enterprise architecture, information retrieval, knowledge management, natural language processing (NLP), ontology, open data, query processing, semantic web, and web services. Keywords within this group collectively highlight the integration of AI technologies in public sector organisations, highlighting areas such as human-computer interaction, information systems, and the use of advanced computational and linguistic methods to enhance government services and user experiences.

Cluster 3 (dark blue) encompasses "*AI Applications for Smart Urban Development."* This theme contains a diverse range of topics, including computer vision, convolutional neural networks (CNN), deep learning, face mask detection, geographic information systems, image processing, mobile applications, municipal services, object detection, optimisation, public transportation, recommender systems, recurrent neural networks, remote sensing, traffic control, transfer learning, and urban planning. Keywords within this group collectively highlight the application of artificial intelligence in addressing urban challenges, focusing on areas such as transportation, security, energy efficiency, public services and the overall development and planning of smart cities.

Cluster 4 (yellow) emphasises "*Machine Learning Applications in Healthcare and Education.*" Keywords in this group suggest a focus on the utilisation of machine learning algorithms and

methods for data analysis, predictive analytics, and decision making in the fields of healthcare and education. Specific topics within this theme include big data analytics, classification, clustering algorithms, data mining, machine learning models, healthcare services, diseases diagnosis, patient treatment, forecasting, e-learning, engineering education, sentiment analysis, and social networking in an educational context. The overarching theme centers on the use of machine learning to enhance decision support and analysis processes in healthcare and educational settings.

Cluster 5 (purple) probes "*Smart Technologies and Security Infrastructure*." Keywords in this group indicate a focus on the integration and application of advanced technologies such as ambient intelligence, automation, big data, blockchain, cloud computing, computer architecture, digital technologies, internet of things (IoT), machine learning techniques, and ubiquitous computing. The theme covers various areas, including cybersecurity, disaster prevention, efficiency, electric power transmission networks, embedded systems, emerging technologies, feature extraction, information and communication technologies, intrusion detection, malware, network security, smart cities, smart transportation, and waste management. The overarching concept revolves around the use of smart technologies to enhance security, efficiency, and quality of life in urban environments.

Cluster 6 (light blue) engages with "*Intelligent Systems and Decision-Making in Diverse Contexts*." The keywords suggest a focus on the application of artificial intelligence techniques, intelligent agents, and multiagent systems in various domains such as e-governance, electronic commerce, forestry, project management, sports, and weather forecasting. The theme extends to behavioural research, budget control, data technologies, data visualisation, decision-making processes, digital devices, information management, marketing, risk assessment, and virtual reality. It encompasses the development and application of intelligent systems to improve decision making, problem solving, and user interfaces in diverse fields and contexts.

Cluster 7 (orange) centers on "*Health and Social Welfare Modeling in Pandemics*." Keywords suggest a focus on algorithmic approaches, artificial neural networks, computer simulations, decision support systems, data acquisition, and prediction models in the context of public health emergencies, specifically the COVID-19 pandemic. The theme extends to cover various demographic groups (adolescent, adult, aged, middle-aged), education, emergency services, and the broader aspects of sustainability and sustainable development. It encompasses the application of technology to model and support decision-making in health, social welfare, and public health during pandemics.

Figure 6 shows that from 2016 to 2022, the overlay visualisation of keywords related to AI and public services illustrates a dynamic evolution. In 2016, the focus was on the Internet of Things (IoT), marking the beginning of a more interconnected world with smart devices. The subsequent years revealed distinct shifts: 2017 saw machine learning taking center stage, with increasingly sophisticated algorithms and models. In 2018, deep learning emerged as a pivotal term, signifying advances in neural networks and AI's capability to process intricate data. The year 2019 saw NLP gaining prominence, showcasing enhancements in machines' comprehension and generation of human language. By 2020, the term Smart City highlighted the integration of AI into urban planning for more efficient and sustainable cities. Big Data took the spotlight in 2021, emphasising the importance of handling vast amounts of information. Finally, in 2022, the overarching term "Artificial Intelligence" itself became the most crucial keyword, emphasising its pervasive influence across various sectors and its role in driving innovation. Over this timeline, specific keywords became more prominent, reflecting the expanding applications and impacts of AI, such as machine learning, deep learning, natural language processing, neural networks, big data, Internet

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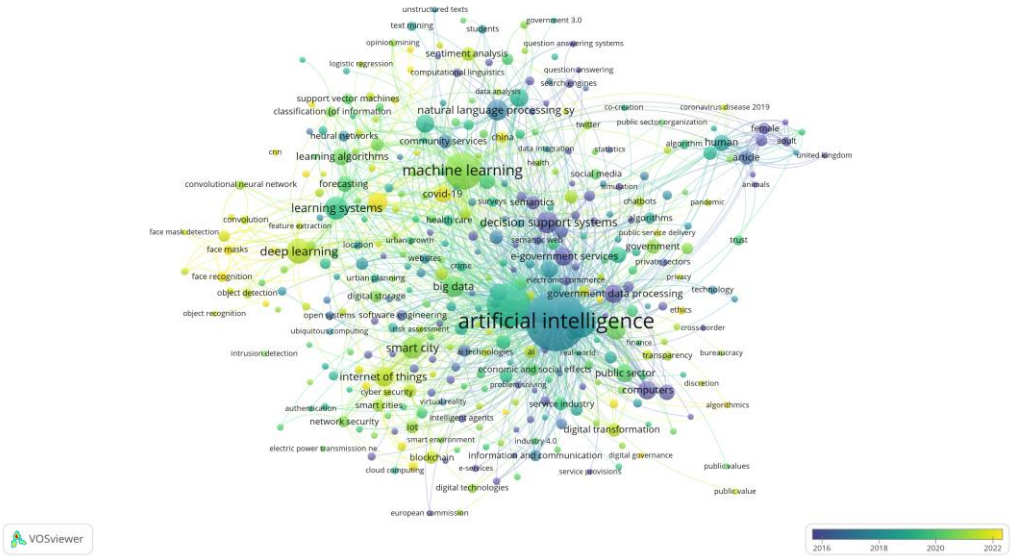
of things, digital transformation, robotics, smart city, and autonomous vehicles. These terms represent key aspects of AI, from its fundamental technologies to its transformative applications in public services.

Figure 6. An overlay visualisation of the field of artificial intelligence and public services



Source: VOSviewer analysis

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This research conducted an analysis spanning the years 1984 to 2023 to discern the trajectory, trends, and global landscape of AI application in public services. The study provides some valuable insights that contribute substantively to both academic inquiry and practical implementation within the public services sector.

The discernible surge in AI-related publications, reaching its pinnacle in 2022, underscores the increasing importance of AI in shaping and advancing public services. Fluctuations in publication activity reveal nuanced shifts in scholarly focus and heightened interest during specific periods.

The study showcases a diverse global contribution to AI in public services research, with significant participation from countries such as China, India, and the United States. Collaborative endeavours among these research-intensive nations underscore the international resonance of AI's intersection with public services.

The dominance of computer science in AI research underscores its pivotal role in shaping AI, data science, and related technologies. The diverse spectrum of research topics across the hard and soft sciences emphasises the complexity and richness of the challenges addressed in this interdisciplinary field.

As the intersection of AI and public services continues to evolve, the identified themes in this research document encompass crucial areas such as digital governance, machine learning applications in healthcare and education, smart urban development, smart technologies, intelligent systems, and health and social welfare modelling in pandemics. Table 2 outlines specific future research directions within each theme, providing a roadmap for scholars to explore, analyse, and contribute to AI ongoing discourse on the integration in diverse societal contexts.

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Table 2. Future Research Directions for Key AI and Public Service Themes

Theme	Future Research Directions
Digital Governance and AI-Driven Public Services	1. Investigate the ethical implications of AI applications in digital governance, focusing on responsible use. 2. Explore the challenges and solutions for interoperability to integrate AI into government structures. 3. Assess the long-term impact of digital transformation on governance and citizen engagement.
AI Technologies in Government Services	1. Conduct a comparative analysis of AI adoption across government agencies. 2. Explore the role of NLP and chatbots in improving user experiences. 3. Investigate open data and semantic web technologies in information retrieval and decision support systems.
AI Applications for Smart Urban Development	1. Examine the effectiveness of AI in addressing urban challenges. 2. Investigate the socioeconomic impact of AI in smart urban development. 3. Explore the role of AI in disaster prevention and response in urban environments.
Machine Learning Applications in Healthcare and Education	1. Review machine learning applications in healthcare, focusing on disease prediction and personalised treatment. 2. Explore machine learning in education and its impact on personalised learning and student outcomes. 3. Investigate ethical considerations in healthcare and educational machine learning.
Smart Technologies and Security Infrastructure	1. Assess the security and privacy implications of AI with smart technologies. 2. Explore the use of AI to optimise waste management systems. 3. Investigate the role in enhancing the resilience of critical infrastructure.
Intelligent Systems and Decision-Making in Diverse Contexts	1. Explore the application of intelligent systems in electronic governance. 2. Investigate the role in project management, risk assessment, and budget control. 3. Examine the integration of AI with virtual reality in diverse contexts for immersive user experiences.
Health and Social Welfare Modeling in Pandemics	1. Assess the effectiveness of AI models in predicting and managing public health emergencies. 2. Explore the application in addressing social welfare challenges during pandemics. 3. Investigate ethical considerations and guidelines for AI in modelling health crises.

Source: authors

The visual representation of keyword clusters not only highlights the prevailing themes, but also serves as a testament to the interdisciplinary nature of AI research in public services. The convergence of AI with various domains has led to innovative solutions and transformative changes in the way public services are delivered and managed. As AI continues to evolve, it is imperative that researchers, practitioners, and policymakers work in tandem to ensure that its application in public services remains aligned with societal values and contributes positively to the common good. The insights gleaned from this research provide a solid foundation for future endeavours, paving the way for a future where AI and public services synergise to create a more equitable, efficient, and innovative society. This research has opened new horizons for understanding and leveraging AI in public services. It is hoped that the insights and directions outlined here will inspire continued exploration and innovation in this vital field, ultimately leading to improved public welfare and a better future for all.

While this study provides information on the trends and themes surrounding the utilisation of AI in public services, it is important to acknowledge certain inherent limitations. First, the reliance on English-language publications from databases like Scopus introduces a potential language bias, limiting the inclusivity of non-English literature. Additionally, the study's focus on AI in public services may inadvertently neglect interdisciplinary works, potentially impacting the

comprehensiveness of the synthesised insights. The quality and rigour of the included publications pose challenges given the variability in research methodologies and citation practices. Keyword co-occurrence analysis, while insightful, may oversimplify complex relationships between concepts. Furthermore, the dynamic nature of the AI field necessitates acknowledgment that certain conclusions may evolve with future developments. Despite these limitations, this study lays a foundation for understanding the multifaceted landscape of AI in public services, providing directions for future research to address and build upon these challenges.

AUTHORS CONTRIBUTIONS

The authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

REFERENCES

Aoki, N. (2020). An experimental study of public trust in AI chatbots in the public sector. *Government Information Quarterly*, *37*(4), 101490. https://doi.org/10.1016/j.giq.2020.101490

Bunea, O. I. (2021). A Bibliometric Analysis on the Link between Circular Economy and Supply Chain. *Revista de Management Comparat Internațional*, *22*(4), 555-569. https://doi.org/10.24818/RMCI.2021.4.555

Chen, M., Hao, Y., Hwang, K., Wang, L., & Wang, L. (2017). Disease prediction by machine learning over big data from healthcare communities. *IEEE Access*, *5*, 8869-8879. https://doi.org/10.1109/ACCESS.2017.2694446

Chetoui, M., Akhloufi, M. A., Bouattane, E. M., Abdulnour, J., Roux, S., and Bernard, C. D. A. (2023). Explainable COVID-19 Detection Based on Chest X-rays Using an End-to-End RegNet Architecture. *Viruses*, *15*(6), 1327. https://doi.org/10.3390/v15061327

Corbos, R. A., Bunea, O. I., & Breazu, A. (2022). A Bibliometric Analysis of Scientific Production Concerning Online Consumer Reviews and The Sale of Home Appliances. *Management and Marketing Journal*, *20*(2), 249-262. https://doi.org/10.52846/MNMK.20.2.10

Corbos, R. A., Bunea, O. I., & Triculescu, M., 2023. Towards Sustainable Consumption: Consumer Behavior and Market Segmentation in the SecondHand Clothing Industry. *Amfiteatru Economic, 25*(Special Issue 17), pp. 1064-1080. https://doi.org/10.24818/EA/2023/S17/1064

Djenna, A., Bouridane, A., Rubab, S., & Marou, I. M. (2023). Artificial Intelligence-Based Malware Detection, Analysis, and Mitigation. *Symmetry*, *15*(3), 677. https://doi.org/10.3390/sym15030677

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda. *International journal of information management*, *48*, 63-71. https://doi.org/10.1016/j.ijinfomgt.2019.01.021

Engin, Z., & Treleaven, P. (2019). Algorithmic government: Automating public services and supporting civil servants in using data science technologies. *The Computer Journal*, *62*(3), 448-460. https://doi.org/10.1093/comjnl/bxy082

Fernandez-Luque, L., & Imran, M. (2018). Humanitarian health computing using artificial intelligence and social media: A narrative literature review. *International journal of medical informatics*, *114*, 136-142. https://doi.org/10.1016/j.ijmedinf.2018.01.015

Fong, S. J., Li, G., Dey, N., González Crespo, R., & Herrera-Viedma, E. (2020). Finding an Accurate Early Forecasting Model from Small Dataset: A Case of 2019-nCoV Novel Coronavirus Outbreak. *International Journal of Interactive Multimedia & Artificial Intelligence*, *6*(1), 132-140. http://dx.doi.org/10.9781/ijimai.2020.02.002

Haldorai, A., Ramu, A., & Murugan, S. (2019). Artificial Intelligence and Machine Learning for Future Urban Development. In: Computing and Communication Systems in Urban Development. Urban Computing. Springer, Cham. https://doi.org/10.1007/978-3-030-26013-2_5

Kuziemski, M., & Misuraca, G. (2020). AI governance in the public sector: Three tales from the frontiers of automated decision-making in democratic settings. *Telecommunications policy*, *44*(6), 101976. https://doi.org/10.1016/j.telpol.2020.101976

Lin, K. C., Shyu, J. Z., & Ding, K. (2017). A cross-strait comparison of innovation policy under industry 4.0 and sustainability development transition. *Sustainability*, *9*(5), 786. https://doi.org/10.3390/su9050786

Lindgren, I., Madsen, C. Ø., Hofmann, S., & Melin, U. (2019). Close encounters of the digital kind: A research agenda for the digitalization of public services. *Government information quarterly*, *36*(3), 427-436. https://doi.org/10.1016/j.giq.2019.03.002

Miotto, R., Wang, F., Wang, S., Jiang, X., & Dudley, J. T. (2018). Deep learning for healthcare: review, opportunities and challenges. *Briefings in bioinformatics*, *19*(6), 1236-1246. https://doi.org/10.1093/bib/bbx044

Or-Meir, O., Nissim, N., Elovici, Y., & Rokach, L. (2019). Dynamic malware analysis in the modern era—A state of the art survey. *ACM Computing Surveys (CSUR)*, *52*(5), 1-48. https://doi.org/10.1145/3329786

Popescu, R. I., Sabie, O. M., & Trușcă, M. I. (2023). The Contribution of Artificial Intelligence to Stimulating the Innovation of Educational Services and University Programs in Public Administration. *Transylvanian Review of Administrative Sciences*, *19*(70), 85-108. http://dx.doi.org/10.24193/tras.70E.5

Schmitt, M. (2023). Securing the Digital World: Protecting smart infrastructures and digital industries with Artificial Intelligence (AI)-enabled malware and intrusion detection. *Journal of Industrial Information Integration*, *36*, 100520. https://doi.org/10.1016/j.jii.2023.100520

Secinaro, S., Calandra, D., Secinaro, A., Muthurangu, V., & Biancone, P. (2021). The role of artificial intelligence in healthcare: a structured literature review. *BMC medical informatics and decision making*, *21*, 1-23. https://doi.org/10.1186/s12911-021-01488-9

Shi, X., Gao, Z., Lausen, L., Wang, H., Yeung, D. Y., Wong, W. K., & Woo, W. C. (2017). Deep learning for precipitation nowcasting: A benchmark and a new model. *Advances in neural information processing systems*, *30*. https://doi.org/10.48550/arXiv.1706.03458

Ștefan, S.C., & Breazu, A. (2022). Exploring the Research on Health Care Competitiveness: The Covid-19 Pandemic Perspective. *Business Excellence & Management*, *12*(2), 19–34. https://doi.org/10.24818/beman/2022.12.2-02

Taeihagh, A. (2021). Governance of artificial intelligence. *Policy and society*, *40*(2), 137-157. https://doi.org/10.1080/14494035.2021.1928377

Tekin, S. F., Karaahmetoglu, O., Ilhan, F., Balaban, I., & Kozat, S. S. (2021). Spatio-temporal weather forecasting and attention mechanism on convolutional lstms. *arXiv preprint arXiv:2102.00696*, *4*. https://doi.org/10.48550/arXiv.2102.00696

Topol, E. (2019). *Deep medicine: how artificial intelligence can make healthcare human again*. Hachette UK.

Torvik, V. I., Weeber, M., Swanson, D. R., & Smalheiser, N. R. (2005). A probabilistic similarity metric for Medline records: A model for author name disambiguation. *Journal of the American Society for information science and technology*, *56*(2), 140-158. https://doi.org/10.1002/asi.20105

Triculescu, M. (2022). A bibliometric analysis on organizational behavior. *Revista de Management Comparat Internațional*, *23*(4), 517-524. https://doi.org/10.24818/RMCI.2022.4.517

Van Eck, N. J., & Waltman, L. (2011). 'Text mining and visualization using VOSviewer'. *ISSI Newsletter, 7*(3), 50-54. https://doi.org/10.48550/arXiv.1109.2058

Veale, M., Van Kleek, M., & Binns, R. (2018, April). Fairness and accountability design needs for algorithmic support in high-stakes public sector decision-making. In *Proceedings of the 2018 chi conference on human factors in computing systems* (pp. 1-14). https://doi.org/10.1145/3173574.3174014

Wahl, B., Cossy-Gantner, A., Germann, S., & Schwalbe, N. R. (2018). Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings?. *BMJ global health*, *3*(4), e000798. https://doi.org/10.1136/bmjgh-2018-000798

Wang, C., & Ma, L. (2022). Digital transformation of citizens' evaluations of public service delivery: evidence from China. *Global Public Policy and Governance*, *2*(4), 477-497. https://doi.org/10.1007/s43508-022-00054-x