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Adapting Civil Servants to the Digital Intelligence Era

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Abstract

Digital transformation in governmen textends beyond administrative digitization, representing a fundamental shift in governance paradigms that repositions civil servants as strategic actors within ecosystems driven by artificial intlligence, big data, and algorithmic systems. This shift demands multidimensional adaptation, including technological competence, cognitive capacity, ethical awareness, and organizational agility. Despite the rapid expansion of literature on digital transformation and e-government, limited attention has been given to the adaptive capacity of civil servants, with existing studies predominantly emphasizing technological and infrastructural dimensions. This study employs a quantitative bibliometric approach, analyzing 445 articles indexed in Google Scholarfrom 2021 to 2026. Using VOS viewer and co-occurrence analysis, the study maps research trends, conceptuall in cages, and the evolution of knowledge structures. The findings reveal that artificial intelligence, digitalization, and data-centric themes dominate the research landscape, while topics such as digital literacy, transformational leadership, organizational culture, and AI ethics remain underexplored. This imbalance indicates a persistent technological bias and highlights a critical gap between system innovation and human resource readiness.The study underscores the need to strengthen adaptive capacity, integrate ethical considerations, and reform organizational culture to ensure that digital transformation fosters a responsive, accountable, and sustainable bureaucracy rather than remaining symbolic or procedural.

Keywords: *Apparatus adaptation, Digital intelligence, Artificial intelligence, Digital transformation of government, Bibliometric analysis*

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Introduction

The rapid development of digital technology has driven the transformation of government governance into an era of digital intelligence. The use of artificial intelligence, large-scale data, and algorithm-based systems in administrative processes and public decision-making requires fundamental bureaucratic adaptation across technological, ethical, and human resource dimensions, as well as in the quality of resulting policies (Seran et al., 2024). Within the Society 5.0 framework, technology is positioned as a strategic instrument to enhance the quality of human life, including the delivery of more inclusive, responsive, and community-oriented public services (Ayu & Nabila, 2025). The digital transformation of government in Indonesia is institutionally realized through the implementation of the Electronic-Based Government System. Effective implementation of the Electronic-Based Government System requires the integration of artificial intelligence and the readiness of civil servants within a smart governance framework. This transformation demands significant changes in governance structures, civil servant

competencies, and public decision-making mechanisms (Andani & Suparman, 2025; Nonci & Sinrang, 2024). As public demands for transparency, accountability, and high-quality public services continue to increase, strengthening the competence and adaptability of civil servants has become an urgent priority. In this context, the success of public services in the digital era is no longer measured solely by administrative outputs, but also by the quality of processes and the level of public trust (Kharchenko, 2023; Muksin et al., 2024).

Although studies on digital transformation of government, the Electronic-Based Government System, and artificial intelligence continue to grow, research that systematically maps the development, knowledge structure, and research trends of civil servant adaptation through bibliometric studies remains limited. Existing studies predominantly emphasize technological and system-oriented aspects, while civil servants, as the primary actors of digital transformation, have not been comprehensively analyzed within the scientific landscape. This indicates a significant gap between the advancement of digital systems and the readiness of human resources in the public sector. Therefore, this study aims to map the development, knowledge structure, and research trends related to civil servant adaptation in the era of digital intelligence. This study addresses the existing gap by providing a comprehensive analysis of how civil servant adaptation has been positioned within the broader discourse on digital transformation. The novelty of this research lies in its effort to offer a more integrative perspective that highlights the imbalance between technological development and human resource readiness, thereby contributing to the development of more adaptive and sustainable governance in the digital era.

Literature Review

Government officials play a central role as key actors in the implementation of digital transformation. The success of bureaucratic digitalization is fundamentally determined by their capacity, readiness, and adaptive ability to respond to technological changes and increasingly data-driven work patterns. Existing studies consistently highlight that digital transformation creates opportunities to enhance the effectiveness, efficiency, and transparency of public services. However, these benefits can only be realized when officials not only possess technical skills but also demonstrate the ability to understand the social, ethical, and strategic implications of digital intelligence within bureaucratic systems (Pratama et al., 2025). A recurring issue identified in the literature is the low level of digital literacy among civil servants, which remains a significant barrier to successful digital transformation. Limited technological competence reduces the quality of public services and constrains bureaucratic performance. This challenge becomes more complex with the integration of artificial intelligence into governance systems, as it reshapes work processes, influences policy formulation, and raises concerns regarding the legitimacy and ethics of public decision-making. Consequently, civil servants are required to develop not only technical proficiency but also critical thinking and ethical awareness in utilizing digital technologies (Gumanti&Uluputty, 2023; Hamna et al., 2025).

Empirical evidence further emphasizes that civil servant readiness is a decisive factor in the success of digital transformation initiatives. For instance, the development of Metaverse City in Makassar demonstrates that digital innovation is not solely dependent on infrastructure, but also on the digital literacy and strategic understanding of emerging technologies among civil servants. Without adequate human resource readiness, digital transformation risks remaining procedural and may even increase administrative burdens within the bureaucracy (Ilham et al., 2023).

In addition, the literature indicates that low digital literacy is closely associated with resistance to organizational change. Limited digital capabilities contribute to suboptimal performance and widen the gap between technological advancement and its practical utilization within public institutions (Syahrir et al., 2025). In this context, transformative and visionary leadership emerges as a critical factor in fostering adaptive, innovative, and responsive behavior among civil servants (I. Putra &Syahrul, 2023; Susilowati et al., 2024).

Beyond technical and leadership aspects, digital transformation also requires fundamental changes in organizational culture and mindset. The literature highlights that in the Society 5.0 era, the balance between technological capability and human-centered competencies such as communication, collaboration, empathy, and ethical integrity is essential. Successful adaptation

to digital intelligence depends on the ability of civil servants to integrate technological mastery with social and moral competencies (Ayu & Nabila, 2025). However, bureaucratic transformation often encounters structural barriers, including hierarchical, procedural, and formality-driven organizational cultures. Such conditions frequently result in symbolic or coercive innovation practices that are unsustainable in the long term (Mulyadi et al., 2026).

Overall, the literature suggests that civil servant adaptation in the era of digital intelligence is a multidimensional construct encompassing digital literacy, leadership, organizational culture, and the ethical dimension of technology utilization. These dimensions interact in shaping the success of digital transformation in the public sector. However, previous studies tend to examine these aspects in a fragmented manner, thereby lacking an integrative understanding of how these factors collectively evolve within the broader scientific landscape. This limitation underscores the need for a comprehensive mapping of research developments to better understand the structure, trends, and gaps in the study of civil servant adaptation in digital governance.

Method

This study uses a quantitative approach with bibliometric analysis to map the development of studies on artificial intelligence and civil servant adaptation in the digital era from 2021 to 2026. Bibliometric analysis was chosen because it allows for a systematic examination of the patterns, trends, and intellectual structure of scientific publications through mapping the scientific literature (Rostiany& Tjandra, 2022).The data used in this study consists of 445 scientific articles published between 2021 and 2026, obtained from the Google Scholar database. This database is widely used in bibliometric research to capture the dynamics and evolution of research topics across time periods (Julianti et al., 2025).retrieved using structured keyword combinations. After applying inclusion and exclusion criteria, the final dataset was exported in compatible formats for bibliometric processing.The analysis was conducted using VOSviewer (version 1.6.x), focusing on keyword co-occurrence to identify conceptual structures and thematic relationships. The co-occurrence analysis is based on the frequency with which two keywords appear together in the same document. The strength of association between keywords is calculated using the association strength normalization, defined as:

$$a_{ij}=c_{ij}/(w_i \times w_j)$$

where a_{ij}represents the normalized association strength between items iand j, c_{ij}denotes the number of co-occurrences between iand j, and $w_i$and$w_j$indicate the total occurrences of itemiand j, respectively. This normalization ensures that frequently occurring terms do not disproportionately dominate the network structure.Several parameters and thresholds were applied to enhance analytical robustness. First, a minimum occurrence threshold of 5 was set for keyword inclusion to filter out low-frequency terms and reduce noise. Second, the fractional counting method was employed to balance the weight of co-occurring items across documents. Third, clustering was performed using the VOS (Visualization of Similarities) mapping technique, with a resolution parameter set at 1.00 to generate meaningful thematic clusters.

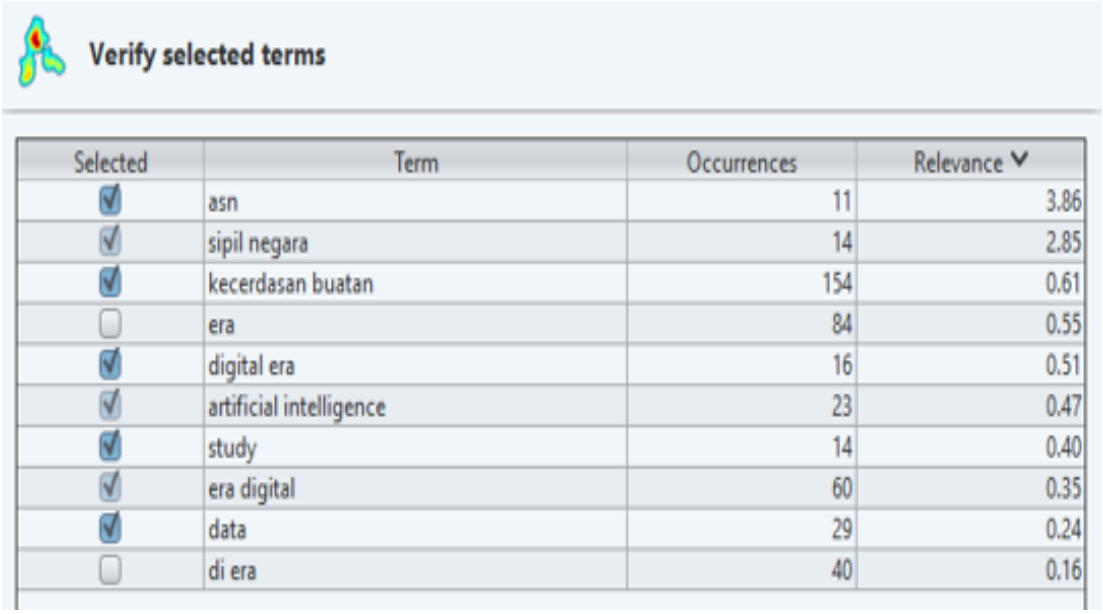
Network visualization, overlay visualization, and density visualization were utilized to interpret the data. Network visualization illustrates the relationships among keywords, overlay visualization highlights temporal trends, and density visualization identifies areas of high research concentration. The distance between nodes reflects the strength of their relationship, while node size indicates frequency, and color represents cluster membership.Through these parameter settings and analytical procedures, the study ensures methodological rigor, reproducibility, and a more precise identification of dominant themes, emerging topics, and structural gaps in the literature.

Result and Discussion

The bibliometric analysis in this study was conducted using VOSviewer software. The initial stage was keyword verification (Verify Selected Terms). This step aimed to ensure that the analyzed terms were conceptually relevant, representative of the study's focus, and free from redundant meanings. This stage was crucial to ensure that the mapping and visualization of the keyword network accurately and validly reflected the thematic structure of the research. The verification results indicated that several keywords were selected for further analysis, namely "artificial intelligence" (154 articles), "digital era" (60 articles), "digital era" (16 articles), "artificial intelligence" (23 articles), "data" (29 articles), "study" (14 articles), and the institutional terms "civil servant" (14 articles) and "ASN" (11 articles). These keywords were selected because of their thematic specificity and strong conceptual linkages in shaping the structure of the research network related to digital transformation and civil service adaptation. Conversely, despite their relatively high frequency of occurrence, the keywords "era" (84 articles) and "di era" (40 articles) were not selected for further analysis because they were too general, contextual, and did not directly represent a specific analytical construct.

The exclusion of these terms aimed to maintain the sharpness of the analysis and avoid distortion of the thematic structure due to the dominance of generic terms. All keyword verification results and their frequency of occurrence are presented in Figure 1 as the basis for forming research networks and clusters.

Figure 1. Verification of Selected Terms in Bibliometric Analysis

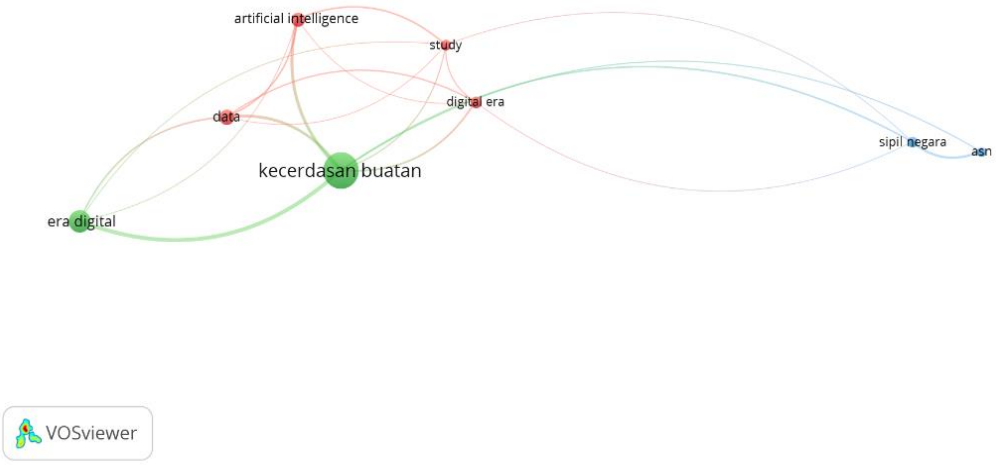


Selected	Term	Occurrences	Relevance
☑	asn	11	3.86
☑	sipil negara	14	2.85
☑	kecerdasan buatan	154	0.61
☐	era	84	0.55
☑	digital era	16	0.51
☑	artificial intelligence	23	0.47
☑	study	14	0.40
☑	era digital	60	0.35
☑	data	29	0.24
☐	di era	40	0.16

Source: *Data processed by the researcher (2026)*

After the keyword verification process is complete, the analysis continues with the bibliometric network visualization stage to examine the patterns of relationships, proximity, and clustering among the selected keywords. This stage aims to identify the thematic structure of the research and the dominant position of each concept within the digital intelligence research landscape.The bibliometric network visualization is presented in Figure 2, which demonstrates the interrelationships between the concepts of artificial intelligence, the digital era, data, and civil service in the analyzed research.

Figure 2. Bibliometric Visualization of Digital Intelligence



Source: Data processed by the researcher (2026)

The visualization in Figure 2 shows that artificial intelligence is the key node with the strongest relationship to the terms digital era, digital era, and data. Conversely, the connection between the concept of digital technology and the state civil apparatus (ASN) appears relatively weak, indicating a research gap between technology development and the study of bureaucratic actors as implementers of digital policy. This finding underscores the need for research that focuses more on the role, readiness, and capacity of ASN in facing AI-based transformation in the digital era.

Bibliometric analysis shows that studies on digital intelligence in bureaucracy are developing rapidly and forming overlapping thematic clusters. The dominance of keywords such as artificial intelligence, digital era, artificial intelligence, data, and state civil servants (ASN) confirms that the discourse on government transformation no longer focuses solely on technology adoption, but rather on repositioning the role of civil servants within a digital intelligence-based governance system. This finding reinforces the view that digital transformation in government must be understood as a complex socio-technical process, not simply a technological innovation (Pratama et al., 2025; Seran et al., 2024)

The strong link between AI, the digital era, and ASN indicates that civil servants are the key to the success of digital transformation. Civil servant digital literacy has been proven to be a fundamental prerequisite for ensuring technology contributes to improving the quality of public services (Gumanti&Uluputty, 2023; Ilham et al., 2023). Without such capacity, technology has the potential to widen the gap between digital systems and daily bureaucratic practices, as demonstrated by low civil servant performance due to limited digital literacy and organizational adaptability (Syahrir et al., 2025).

Transformative and visionary leadership plays a strategic role in bridging the gap between technological innovation and changes in civil servant work behavior. Studies (I. Putra &Syahrul, 2023; Susilowati et al., 2024) confirm that digital literacy supported by participatory leadership can encourage innovative work behavior among civil servants. Bibliometric findings linking studies and data to civil servants indicate increasing academic attention to data-driven approaches and organizational learning in digital bureaucracy.

The strong connection between the keywords "data," "AI," and "digital era" reflects the paradigm shift of the SPBE (Educational, Social, and Cultural) toward smart governance based on artificial intelligence. The transformation of SPBE requires not only system integration but also changes in public decision-making processes, which are increasingly data-driven (Andani& Suparman, 2025; Nonci&Sinrang, 2024). However, increasing reliance on AI also raises ethical challenges, algorithmic transparency, and bureaucratic accountability (Hamna et al., 2025; Seran et al., 2024).

The competency model for civil servants in the digital era demands a balance between technological mastery and ethical-humanistic capacity (Kharchenko, 2023). This aligns with the concept of Society 5.0, which positions technology as a means to improve the quality of human life, not an end in itself (Ayu & Nabila, 2025). Therefore, the digital transformation of the bureaucracy must simultaneously integrate technical, ethical, and social dimensions.

Bibliometric results also show that digital transformation cannot be separated from organizational culture. Bureaucratic innovation is often hampered by hierarchical structures and a dominant orientation toward formality. Criticism of the practice of symbolic innovation through public service innovation competitions suggests that forced innovation can actually weaken the civil servant's learning culture (Mulyadi et al., 2026). Therefore, civil servant adaptation needs to be built by strengthening a reflective and sustainable organizational culture (Hanifah & Frinaldi, 2025).

The integration of previously unpublished citations demonstrates that the transformation of digital intelligence within the bureaucracy also impacts the relationship between the state and its citizens. Studies on the dynamics of government-citizen relations from the perspective of state administrative decisions emphasize the importance of accountability and administrative justice in the digital era (A. P. T. Rezeki& Frinaldi, 2025). Similarly, studies on land and food sustainability demonstrate that data-driven policies require officials capable of translating digital information into equitable public decisions (A. Rezeki& Frinaldi, 2024).

The transformation of the Public Administration taxonomy in response to environmental informatics demonstrates that the discipline of public administration itself is undergoing a conceptual repositioning due to the penetration of digital technology (A. Putra et al., 2025). Social interaction and cultural understanding also remain relevant, as digital transformation does not eliminate the social dimension of bureaucracy but rather demands that officials be more adaptive and communicative (T. Rezeki et al., 2023)

The integration of community-based studies enriches the discussion with a co-production perspective on digital governance. Studies by (Frinaldi et al., 2024; Frinaldi, Mubarak, et al., 2025; Frinaldi et al., 2026) and (Mubarak et al., 2024) showed that the success of public programs, including sanitation, waste management, and green infrastructure, is largely determined by collaboration between the government and the public. These findings, particularly regarding digital intelligence, imply that AI and digital systems should be designed to support participation, not replace it.

Multidimensional collaboration in post-disaster recovery also emphasizes the importance of actor synergy in complex governance (Frinaldi, Vanny, et al., 2025). Therefore, digital intelligence in bureaucracy ideally strengthens collaborative mechanisms and public trust, rather than creating distance between the state and citizens.

Implication

The findings of this study demonstrate that the scientific landscape of digital government transformation is still dominated by a technocratic approach that positions artificial intelligence (AI), big data, and system integration as the primary determinants of bureaucratic reform success. This trend is consistent with studies on the transformation of SPBE toward AI-based smart governance (Andani& Suparman, 2025; Nonci&Sinrang, 2024) and analyses of the efficiency and transparency of digital administration (Frinaldi et al., 2024; Muksin et al., 2024). However, bibliometric mapping results indicate that dimensions of apparatus adaptation, including digital literacy (Gumanti&Uluputty, 2023; Syahrir et al., 2025), transformative and visionary leadership (Putra &Syahrul, 2023; Susilowati et al., 2024), organizational culture (Mulyadi et al., 2026), and ethical considerations in the use of AI, still receive relatively little attention in the evolving body of knowledge (Hamna et al., 2025; Seran et al., 2024). This situation highlights the conceptual tension between technological determinism and socio-technical perspectives in digital public administration studies.

Based on this debate, this study proposes the development of a middle-range theory on Adaptive Digital Bureaucracy, a conceptual framework that positions the adaptive capacity of the apparatus as a mediating variable between technological innovation and governance performance. Theoretically, the implications of this research strengthen the argument that digital

transformation must be understood as a multidimensional process that simultaneously integrates technology, human competencies, and institutions (Kharchenko, 2023). Practically, these findings indicate the need for policy reorientation that focuses not only on digital infrastructure development but also on strengthening advanced digital literacy, transformative leadership, internalizing AI ethics, and reforming organizational culture so that digital transformation is not reduced to symbolic or procedural innovation (Ilham et al., 2023; Mulyadi et al., 2026). Thus, digital transformation of government has the potential to produce a responsive, adaptive, and sustainable bureaucracy.

Conclusion

This research shows that studies on digital government transformation in the era of digital intelligence are still dominated by technological perspectives, particularly artificial intelligence, big data, and system integration within the SPBE framework. A bibliometric analysis of 445 articles from 2021–2026 revealed that the adaptation of civil servants, as the primary actors in digital transformation, has not yet become a primary focus in the evolving body of knowledge. The dimensions of digital literacy, leadership, organizational culture, and AI ethics emerged with less intensity than the themes of technology and data. These findings highlight the gap between digital system development and the readiness of bureaucratic human resources. Therefore, digital government transformation needs to be directed at strengthening the adaptive capacity of civil servants to create a responsive, accountable, and sustainable bureaucracy.

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