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Understanding the Challenges of Japan's Smart City Development: An Analysis of the Factors Behind Japan's Low Smart City Ranking

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Abstract: Smart cities are transforming urban landscapes worldwide, integrating digital technologies to enhance efficiency, sustainability, and quality of life. Despite Japan's global leadership in technology and innovation, the country struggles to keep pace with international smart city developments, ranking lower than global leaders. This study investigates the institutional, technological, and socio-cultural challenges that hinder Japan's smart city transformation. This research delineates the fundamental barriers hindering Japan's optimal utilization of digital technologies in urban development, as revealed through an examination of policy documents, global smart city rankings, and governmental initiatives. The findings suggest that while Japan possesses advanced technological capabilities, governance inefficiencies, regulatory complexities, and socio-economic disparities continue to impede its smart city progress. The research culminates by offering suggestions aimed at enhancing policy alignment, fostering public confidence in digital governance, and expediting the incorporation of intelligent technologies into urban service delivery. Addressing these interconnected challenges through an integrated and inclusive approach will be essential for Japan to maximize the benefits of smart city innovations and achieve long-term sustainability in urban development.

Keywords: Smart city, Japan, Digital transformation, Governance, Public trust

1. Introduction

Japan is widely recognized as a global leader in technological innovation, with pioneering advancements in electronics, robotics, and artificial intelligence (AI). As one of the world's largest economies, Japan has consistently led research and development (R&D) and patent filings, demonstrating its technological prowess. However, despite these strengths, Japan's progress in smart city development has not met expectations.According to the *IMD Smart City Index* [1], Japan's major cities have experienced declining rankings in global smart city performance. Tokyo ranked 86th out of 142 cities, falling from 72nd place in the previous year. Osaka ranked 95th, showing only a marginal improvement from its previous 98th position. In contrast, Singapore, Copenhagen, and Zurich rank among the top 10 due to their comprehensive urban digital strategies. These rankings indicate that although Japan demonstrates significant prowess in technological innovation, its capacity to effectively integrate these advancements into holistic smart city frameworks has been constrained. This prompts essential inquiries regarding the fundamental obstacles hindering its

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advancement. First, despite its strong technological and economic foundation, why has Japan struggled to keep pace with global leaders in implementing smart urban strategies? Second, what institutional, economic, and socio-cultural barriers hinder its progress? Finally, how do these challenges impact the adoption and implementation of smart city initiatives?

To answer these questions, this paper explores the main barriers to Japan's smart city development, focusing on governance inefficiencies, public trust in digital transformation, and the socio-economic challenges that limit digital adoption. By analyzing government initiatives, regulatory policies, this study provides critical insights into potential pathways through which Japan can overcome these challenges and enhance the effectiveness of its smart city strategies.

This research contributes to the existing smart city literature by comprehensively analysing Japan's unique structural, technological, and cultural barriers. Unlike previous studies that primarily focus on technological advancements, this paper highlights the governance and societal dimensions of smart city development, emphasizing the role of public trust and policy coordination in digital transformation. The study also extends discussions on data governance and citizen participation, which are crucial yet often overlooked in smart city research.

2. Barriers to Japan's smart city development

2.1. Institutional challenges: fragmented governance and policy coordination

Japan's smart city development has been hindered by institutional barriers, particularly the Fragmented Governance and Policy Coordination. Despite Japan's global reputation for technological excellence, its approach to digital urbanization has been characterized by a lack of cohesive national strategy, inefficient intergovernmental coordination and regulatory constraints that slow the adoption of innovative urban solutions.

One of the primary barriers is the absence of a unified national framework for smart city development. Unlike Singapore, where a centralized governing body oversees smart city initiatives, Japan's approach is highly decentralized, with multiple ministries managing different aspects of urban planning and digital infrastructure. The Ministry of Internal Affairs and Communications (MIC) is dedicated to the development of information and communication technology (ICT) infrastructure, whereas the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is responsible for urban planning initiatives, and the Ministry of Economy, Trade and Industry (METI) advocates for advancements in smart industry initiatives. While this decentralized governance structure allows local governments flexibility, it also creates institutional silos that hinder cross-sectoral collaboration. In contrast to centralized smart governance models such as Singapore's Smart Nation initiative [2], Japan's fragmented institutional framework has resulted in inconsistent interoperability standards, preventing seamless digital integration across municipalities. Consequently, smart city initiatives frequently function in isolation, resulting in inefficiencies in the digital transformation process, which is evident in Japan's comparatively sluggish advancement in governmental digitalization and open data efforts [3].

Recognizing the need for a more integrated approach, the Japanese government launched the Super City Initiative [4] in 2020 to develop urban data platforms that facilitate multi-sectoral data integration and sharing. However, as noted in the *Smart City Guidebook* [5], the initiative lacked a comprehensive implementation strategy, leading to uneven adoption across municipalities. Local governments faced technical challenges including inadequate ICT infrastructure, limited expertise in handling big data, while the absence of clear national data-sharing protocols further hindered cross-regional interoperability. Consequently, instead of fostering a cohesive smart city network, the initiative resulted in a patchwork of fragmented local projects, limiting the scalability of smart city solutions across key urban domains such as transportation, disaster prevention, and healthcare.

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Moreover, fragmented governance not only affects the efficiency of smart city development but also exacerbates public skepticism toward digital initiatives, as inconsistencies in data governance further erode trust in digital transformation efforts. Mitigating governance fragmentation and implementing a cohesive data-sharing framework are essential not only for improving the efficacy of smart city projects but also for reinstating public confidence in the digital transformation process.

2.2. Public participation and data privacy concerns

A significant barrier to Japan's smart city development lies in limited public participation and persistent concerns over data privacy and security. Japan's smart cities are conceptualized with a focus on residents, utilizing digital technologies to improve urban life. Nevertheless, their execution is predominantly guided by governmental initiatives. Despite government efforts to promote public participation, many citizens remain skeptical about the management and use of urban data. This skepticism, driven by concerns over potential misuse and privacy violations, has significantly hindered the widespread acceptance and expansion of smart city initiatives. Public trust in digital governance remains notably lower than in global smart city leaders. The *IMD Smart City Index* reveals that only 35.2% of Tokyo residents are willing to share personal data to enhance urban management. Compared to global smart city leaders such as Singapore and Copenhagen, where public trust in data-sharing initiatives exceeds 60%, Japan's figures highlight a significant trust deficit. This gap suggests that Japan's digital governance strategies may lack adequate transparency measures or citizen empowerment mechanisms to foster confidence in data-driven policymaking.

The *Smart City Guidebook* [5] further highlights that Japan's smart city initiatives face challenges balancing technological advancement with privacy protection. The lack of well-defined, uniform national regulations governing inter-agency data sharing has resulted in disparate privacy policies among municipalities, intensifying public apprehension. In light of these issues, Japan has enacted revisions to its personal information protection legislation aimed at enhancing data security and privacy protections [6]. However, while these measures aim to enhance public confidence, they also introduce regulatory complexities that may challenge smart city development. Stricter privacy laws can create potential barriers to cross-departmental data sharing, particularly affecting industries reliant on real-time data exchange, such as urban mobility and emergency response systems. Thus, while Japan's regulatory framework seeks to protect citizen data, the lack of a harmonized approach risks limiting the efficiency of smart city initiatives.

2.3. Socio-economic challenges in Japan's smart city development

Despite Japan's substantial advancements in technological innovation, some socio-economic barriers continue to hinder its progress in smart city development. These include an aging population struggling to adapt to digital services, economic disparities limiting access to smart city infrastructure, and cultural resistance toward automation and digital governance. In contrast to leading smart cities such as Singapore and Copenhagen, which have effectively integrated technology across multiple urban domains, Japan faces structural and demographic challenges that limit its ability to implement smart urbanization inclusively.

The subsequent sections will examine three significant socio-economic obstacles impeding the advancement of smart cities in Japan: (1) Population Aging and Digital Integration, (2) Economic Inequities and Digital Financial Obstacles, and (3) Cultural Resistance to Technological Change. These interconnected elements underscore the intricate dynamics among technology, policy, and societal factors, illustrating that Japan's digital transformation transcends mere infrastructural concerns, encompassing issues of social equity and public confidence.

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2.3.1. Demographic aging and digital adaptation

Japan's demographic composition presents a significant challenge to its smart city transformation. As the world's most aged society, with 29.1% of its population aged 65 and above (Statistics Bureau of Japan, 2023), the country faces substantial challenges in integrating digital technologies into urban governance. Compared to South Korea, where elderly internet adoption has surpassed 70%, Japan's digital inclusion among older adults remains significantly lower, further hindering smart city expansion [7]. Japan's Society 5.0 initiative seeks to incorporate digital technologies across multiple societal sectors; however, its execution in relation to an aging demographic has been uneven, prompting apprehensions regarding accessibility and inclusivity [8].

One of the primary limitations stems from disparities in digital literacy. As a super-aging society, Japan has nearly 30% of its population aged 65 or older. Moreover, digital technology usage remains limited among older age groups, with more than 40% of individuals aged 70–79 never using digital devices [7], limiting their engagement with smart services. This digital exclusion affects multiple aspects of smart city functionality, including access to e-government services and cashless payment systems. Additionally, the OECD (2021) [9] reports that 41% of Japanese adults aged 55-65 lack basic ICT skills which is higher than the OECD average of 34%. Although the Japanese government has introduced digital literacy initiatives, such as smartphone training programs for seniors, participation remains low, with only 22% of the target population enrolling in any form of digital training. This limited adoption of digital education programs exacerbates socio-economic disparities, as older individuals are increasingly excluded from digital government services, financial transactions, and emerging smart city innovations.

As a result, Japan's aging population faces a growing digital divide, referring to the disparity between those who have access to and can effectively utilize digital technologies and those who lack the necessary skills or resources, which in turn limits the country's ability to achieve an inclusive smart city transformation. Addressing these challenges will require targeted digital inclusion strategies, such as expanded digital education, simplified user interfaces and AI-assisted accessibility tools, to ensure that elderly populations are not left behind in Japan's technological advancement.

2.3.2. Economic disparities and digital financial barriers

Another major socio-economic barrier to smart city development in Japan is the economic disparity in digital accessibility. While urban centers like Tokyo and Osaka benefit from extensive fiber-optic internet coverage, AI-driven mobility solutions, and digital governance platforms, rural and lower-income communities remain largely excluded. The OECD Digital Government Index ranks Japan below leading smart city nations in user-driven digital services, indicating a gap between technological advancement and practical citizen engagement.

One of the most pressing issues is cash reliance among elderly populations. Japan remains one of the most cash-dependent advanced economies, with over 60% of transactions still conducted using physical currency in 2023 [10]. This cash reliance disproportionately affects elderly consumers, many of whom are hesitant to adopt digital payment methods due to concerns over security, unfamiliarity with technology, and a preference for traditional financial practices.

This hesitance not only exacerbates the digital divide but also impedes the development of digital payment systems, affecting critical areas such as contactless public transit, e-commerce, and online governmental services. In the absence of strategic policy measures aimed at enhancing digital literacy and fostering confidence in digital transactions, Japan's shift towards a more digitally inclusive economy will continue to be obstructed by socio-economic and generational inequalities.

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2.3.3. Cultural resistance to digital transformation

Beyond structural and economic factors, cultural attitudes toward technology adoption further complicate Japan's smart city tra nsition. Despite the widespread use of automation and AI in countries like Singapore, South Korea, and the United States, Japanese society remains hesitant to fully embrace AI-driven governance and digital automation. This hesitance stems from cultural inclinations favoring in-person engagements and apprehensions regarding data security. This phenomenon is observable not only with in governance frameworks but also in the practical deployment of artificial intelligence, encompassing eldercare robotics and automated public service systems.

While Japan has experimented with robotic eldercare solutions, a study on emotional AI acceptance in healthcare settings indicates that many elderly citizens remain hesitant to rely on AI for caregiving, emphasizing the continued importance of human interaction and emotional support in elderly care [11]. Because human caregivers offer empathy, nuanced communication, and social connection—qualities that AI struggles to replicate. While AI can assist with routine tasks, it lacks the emotional intelligence needed to foster trust and psychological well-being, making human presence indispensable in holistic elderly care.

3. Conclusion

This research has examined the primary obstacles currently obstructing the advancement of smart cities in Japan, offering insights into the reasons why, despite its global prominence in technological innovation, Japan remains behind in international smart city rankings. The findings highlight three interconnected factors that critically influence Japan's digital transformation, extending previous literature which primarily focused on technological capabilities by emphasizing governance and socio-cultural dimensions: fragmented governance and policy misalignment, persistent public skepticism toward digital governance rooted in data privacy concerns, and socio-economic disparities exacerbated by demographic aging and cultural resistance to digital adoption.

Japan's decentralized governance has led to fragmented urban policies, hindering the Super City Initiative's effectiveness. The absence of coherent national frameworks and standardized data-sharing protocols results in inconsistencies and inefficiencies, compromising interoperability among municipalities. Public trust in digital governance lags behind global smart city leaders like Singapore and Copenhagen, largely due to concerns over data misuse and privacy. Despite recent regulatory improvements, achieving a balance between privacy protection and efficient data exchange remains difficult. Socio-economic factors, particularly an aging population, exacerbate these challenges. Many elderly individuals face limited digital literacy and are hesitant to adopt technological solutions, while economic disparities create significant gaps in digital infrastructure access, particularly in rural and low-income areas, obstructing inclusive urban digitalization.

Addressing these complex challenges necessitates an integrated policy framework that prioritizes governance coordination, transparency, and public engagement to restore citizen trust in digital initiatives. Policymakers should promote digital inclusion through targeted educational programs for the elderly and invest in infrastructure to close the digital divide between urban and rural areas. Additionally, culturally sensitive integration of AI and automation that aligns with societal preferences for human-centric interactions is essential to mitigate cultural resistance. In summary, Japan's smart city development transcends mere technological or infrastructural issues; it demands significant governance reforms, enhanced societal trust, and inclusive strategies to effectively utilize Japan's technological potential. By implementing comprehensive policy reforms focused on institutional coordination, social engagement, and cultural acceptance, Japan can make substantial progress toward its smart city goals, promoting sustainable and inclusive urban development.

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