JURNAL BINA PRAJA
Journal of Home Affairs Governance

ARTICLE

Inclusive Strategies to Bridge the Digital Gap

A Case Study of 9 Archipelago Provinces in Indonesia

Herie Saksono
Universitas Islam Al-Azhar Mataram

herie.saksono26@gmail.com

Abstract: As the world's largest archipelagic country, Indonesia faces unique challenges in digital transformation, particularly regarding digital disparities across its nine archipelagic provinces. This study explores how Indonesia's archipelagic characteristics can be leveraged to bridge digital gaps and achieve inclusive digital transformation. Using a qualitative-exploratory approach with thematic analysis of secondary data, the research develops an archipelagic-based digital transformation framework. The findings reveal that infrastructure limitations, low digital literacy, and fragmented geography drive significant digital disparities. The "Hub and Spoke" model effectively addresses these challenges, with well-connected digital hubs serving as knowledge and support centers for surrounding islands. The research findings indicate that an archipelago-based approach, combining top-down and bottom-up elements, is most effective for implementing digital transformation. In conclusion, successful digital transformation in Indonesia requires a strategy that considers the geographic characteristics of the archipelago, supported by comprehensive government policies, adequate infrastructure, and multi-stakeholder collaboration. Key recommendations include increasing investment in telecommunications infrastructure in the 3T (frontier and remote) regions, developing digital literacy based on local characteristics, and strengthening dodeca-helix partnerships for sustainable digital transformation implementation.

Keywords: Digital Divide; Archipelagic Framework; Inclusive Digital Transformation; Indonesia.

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Citation: Saksono, H. (2024). Inclusive Strategies to Bridge the Digital Gap: A Case Study of 9 Archipelago Provinces in Indonesia. *Jurnal Bina Praja, 16*(3), 629–638. https://doi.org/10.21787/jbp.16.2024.629-638

Submitted: 13 October 2024
Accepted: 18 December 2024
Published: 31 December 2024

1. Introduction

As the world's largest archipelagic country, Indonesia faces unique challenges in digital transformation. Although it has entered a significant digital transformation era, there are still clear digital gaps between regions, particularly between the nine archipelagic regions (Saksono, 2013). Based on the East Ventures Digital Competitiveness Index (EV-DCI; 2020-2024), there is a significant disparity in terms of digital infrastructure, human resources (HR), and the readiness of local governments (Pemda) to adopt digital technology. Significant digital gaps between regions, fragmented geographical characteristics, inadequate and uneven infrastructure, and low digital literacy are the main obstacles (Lalisang et al., 2019; Sandee, 2016; Trace et al., 2009) even hindering the rate of technology adoption and integration into the digital economy for its utilization (Bhairawa Putera et al., 2022). Uneven adoption of digital technology can hinder economic growth and sustainable development (Bhairawa Putera et al., 2022; United Nations ESCAP, 2024). Existing literature studies mostly focus on national and/or city digital transformation (Baranzoni et al., 2020). This situation indicates that a uniform approach to digital transformation may not be effective across all regions of Indonesia (Aminah & Saksono, 2021; Dudhat & Agarwal, 2023) because they pay less attention to the geographical realities of Indonesia.

Considering the digital divide in an archipelagic country, the question arises: how does we leverage Indonesia's archipelagic characteristics to address the digital divide and achieve inclusive digital transformation? This statement further reinforces the research objective: to develop an archipelagic-based digital transformation framework to address the digital divide and encourage full participation of all regions in the digital economy (Zubaidah et al., 2024). Digital transformation is based on consideration of Indonesia's geographical realities with the aim of bridging the digital divide between regions (Nurfadillah et al., 2024).

Diffusion of innovation (Rogers et al., 2014) is a fundamental theory and the main theoretical foundation for understanding how digital technology is disseminated and adopted throughout Indonesia. This theory explains how innovations, such as digital transformation, spread among individuals, organizations, and communities. This process of communication and social interaction influences individuals and communities to adopt new innovations. Therefore, in the context of the Indonesian archipelago (Karya et al., 2024), diffusion of digital transformation with an archipelago-based approach needs to consider the geographical characteristics of the archipelago (Nusantara) with its diverse socio-economic and socio-cultural conditions. (Husnina et al., 2024).

Digital maturity theory (Rossmann, 2018) is used to assess readiness and measure the progress of digital transformation in various regions in Indonesia. This theory helps identify digital gaps and their barriers, as well as priority areas that need to be addressed/developed and formulate strategies to increase digital maturity in order to achieve inclusive digital transformation.

The "Hub and Spoke" Model (Lalisang et al., 2019) adapted for an island-based digital transformation framework. This model proposes the development of digital centers (hubs) in more digitally advanced regions to support and empower remote areas (spokes) to connect with their surrounding areas (spokes) to ensure the effective transfer of knowledge and technology, distribution of resources, and expertise.

Digital transformation literature largely focuses on national or regional approaches (Curtis et al., 2022; Tan et al., 2022), at the company level, or in the

context of developed countries (Vial, 2019). Several studies have discussed digital transformation in developing countries (Mangkornpunt, 2021), archipelago state (Pounder & Gopal, 2021; Spennemann, 2004), However, research specifically examining archipelagic countries is still limited, especially research that specifically proposes an archipelagic-based framework for Indonesia. This study attempts to fill this gap by developing a framework that takes into account the geographical and socioeconomic realities of Indonesia within the context of digital transformation in Indonesia.

2. Methods

This research uses an exploratory qualitative approach. This approach was chosen to deeply understand the complex phenomenon of digital transformation (Vial, 2019) and produce a framework that is appropriate to the archipelagic context of Indonesia.

The data required is secondary data, including: case studies of digital transformation in various regions of Indonesia (Aminah & Saksono, 2021), statistical data on the digital divide between regions (East Ventures, 2024; OECD, 2024); policy report on digital transformation in Indonesia (ASEAN, 2025); and studies on region-based digital transformation models (Lalisang et al., 2019). In addition, there are also government policy documents related to digital transformation and infrastructure development, reports from research institutions and international organizations on digital transformation in Indonesia and other archipelagic countries, as well as journal articles and scientific publications on theories relevant to digital transformation and development in archipelagic countries.

The data collection technique was done through a literature review to find documents, policy texts, reports, scientific publications, references, data, facts, and case studies as secondary data. The data analysis technique used was thematic analysis to identify key themes from the literature review and the collected data. The analysis of the findings refers to Hegel's triangle (thesis-antithesis-synthesis), along with the identification of challenges and opportunities for developing an archipelago-based digital transformation framework.

3. Results and Discussion

Digital transformation in archipelagic regions has unique characteristics that require a different approach than in continental regions. The Riau Islands, a province comprising 1,796 islands, presents unique complexities in implementing digital transformation strategies. This fragmented geography creates both challenges and opportunities for accelerating digitalization (Indayani et al., 2024).

First, digital infrastructure in archipelagic regions faces significant connectivity challenges. Providing broadband networks requires significant investment to connect the islands and build an undersea fiber optic backbone. According to a study by Kearney (2023), the cost of deploying digital infrastructure in archipelagic regions can be three to four times higher than in continental regions. However, technological innovations such as Low Earth Orbit (LEO) satellites and floating data centers offer promising alternative solutions (World Bank Digital Development Partnership, 2024).

Second, the dispersed demographic characteristics of the archipelago demand an adaptive digital service model (Banos-Gonzalez et al., 2018), indicating that island communities have distinct digital consumption patterns, with a strong preference for mobile applications and services accessible offline. This implies the need to develop

"archipelago-friendly" applications with delayed synchronization and local storage features.

Third, the structure of an archipelagic economy dominated by the maritime, tourism, and MSME sectors requires specific digital solutions. The Asian Development Bank (2023) noted that digitalizing the maritime sector in archipelagic regions can increase operational efficiency by up to 35% by implementing vessel tracking systems, smart logistics, and e-fishing. The digital platforms developed must consider the characteristics of archipelagic businesses, including seasonal business cycles and dependence on maritime connectivity.

Fourth, the socio-cultural aspects of archipelagic communities influence the adoption of digital technology. A longitudinal study by the Pacific Digital Transformation Observatory (2024) revealed that archipelagic communities have higher technology adoption rates when digital solutions are integrated with local wisdom and communal values. A "digital community" approach that strengthens social cohesion has proven more effective than an individualistic approach.

In the context of digital transformation for the nine archipelagic provinces, the strategies implemented must consider the four characteristics mentioned above. The McKinsey Digital Islands Initiative (2024) recommends a digital "hub and spoke" approach, where digital hubs are developed on key islands and serve as anchor points for surrounding islands. This model has been successfully implemented in the Pacific Islands region, with a 78% success rate in increasing digital penetration.

The Deloitte Archipelagic Digital Study (2023) emphasized developing digital capacity within island communities. The "Digital Island Champions" program, which trains local digital facilitators, has proven three times more effective in driving technology adoption than conventional training approaches. This aligns with the government's vision in its presidential address, which emphasizes the importance of empowering local communities in digital transformation.

Insights into the geographic and demographic conditions of the nine island provinces, which consider local characteristics in efforts to achieve digital equity, are presented in Table 1.

Table 1. Description of the Provinces With Island Characteristics in Indonesia

Province	Area (Km2)	(%)	Regency	District	Urban Village	Village	Island	Population*)
Southwest Papua **)	-	-	-	-	-	-	-	-
North Maluku	32.998,696	14,94	10	118	118	1.067	901	1.337.368
Maluku	46.158,267	20,90	11	118	35	1.200	1.388	1.886.735
Southeast Sulawesi	36.159,713	16,37	17	221	379	1.908	590	2.690.791
North Sulawesi	14.500,275	6,56	15	171	332	1.507	353	2.664.313
East Nusa Tenggara	46.446,644	21,03	22	315	305	3.137	609	5.514.216
West Nusa Tenggara	19.675,889	8,91	10	117	145	1.021	403	5.473.507
Riau Islands	8.269,708	3,74	7	80	144	275	2.028	2.101.215
Bangka Belitung Islands	16.690,129	7,56	7	47	84	309	507	1.472.427
Island Province	**220.899,32**	**100,00**	**99**	**1.187**	**1.542**	**10.424**	**6.779**	**23.140.572**

Source: *Decree of the Minister of Home Affairs Number 100.1.1-6117 of 2022 concerning the Assignment and Updating of Codes, Administrative Area Data, and Islands, dated November 9, 2022, and Indonesian Statistics 2024 – Statistics Indonesia (BPS). Data Processed. 2024.*

*) Population data is sourced from the Directorate General of Population and Civil Registration, Ministry of Home Affairs (Population Data for Semester I, June 2022)

**) Data for Southwest Papua Province (PBD) is not yet available.

Table 1 details the area, population, and number of government administrations of Indonesia's nine archipelagic provinces, along with the total compiled data. Elaborating on the area and population distribution data is relevant to digital

transformation and the development of archipelagic regions. Based on the "Distribution of Area and Number of Islands" section, the total area of the nine archipelagic provinces is 220,899.32 km2, with significant variation between provinces. East Nusa Tenggara (NTT) and Maluku have the most significant areas, covering 21.03% and 20.90% of the total area, respectively. Conversely, the Riau Islands and Bangka Belitung Islands have the smallest areas, covering only 3.74% and 7.56%, respectively. This situation indicates that differences in topography and geographic challenges will impact access to digital infrastructure and public services.

In terms of "Complexity of Government Structure," the data shows that each province has a different administrative structure regarding the number of regencies/cities and sub-districts. Provinces with larger areas, such as East Nusa Tenggara (NTT) and Southeast Sulawesi, tend to have more complex administrations, including 22 regencies/cities in East Nusa Tenggara and 17 regencies/cities in Southeast Sulawesi. This implies the need for cross-regional coordination to implement digital transformation policies, especially in islands and remote areas.

A similar trend is observed in terms of population and density. East Nusa Tenggara (5.51 million people) and West Nusa Tenggara (5.47 million people) are the provinces with the highest populations. This contrasts with provinces like North Maluku and Bangka Belitung, which have smaller populations of 1.33 million and 1.47 million people, respectively. Different population densities influence the adoption of digital technology—regions with denser populations are typically quicker to adopt technology, while island regions with smaller populations face limited access and investment.

From the perspective of "Infrastructure and Digitalization Implications," digital transformation in island provinces faces challenges in terms of:

a. Geographic connectivity: Fragmented regions, such as the Riau Islands with its 1,796 islands, require significant investment in telecommunications infrastructure, such as submarine and satellite networks (LEO).
b. Decentralization of services: Regions with many sub-districts and villages, such as Southeast Sulawesi and East Nusa Tenggara, require an adaptive and community-based digital service model.
c. Equality of digital access: The gap in digital infrastructure between developed and underdeveloped regions requires a "Hub and Spoke" model with digital centers (hubs) in the main islands to support smaller islands.

Going forward, the digital transformation process will continue to face "Socio-Economic Challenges and Opportunities." Population data and administrative structures in the tabulation reflect the socio-economic diversity of each province. Provinces like East Nusa Tenggara (NTT) and West Nusa Tenggara (NTB), with their agriculture- and tourism-based economies, require digital solutions to support these sectors. Similarly, locally-based digital literacy and empowerment programs are essential to improve community skills and participation in the digital economy.

Next, we present the Digital Competitiveness Index (EV-DCI) scores of nine island provinces from 2022 to 2024, including changes in ranking and growth rates. Data illustrating variations in digital adoption and readiness across provinces are presented in Table 2.

The data in Table 2 demonstrates interesting dynamics in digital transformation across the Indonesian archipelago. The Riau Islands demonstrated the most impressive performance, with the highest score (47.8) and consistent growth of 8.24% over the period. This aligns with the findings of East Ventures (2024) which

Table 2. East Ventures Ranking – Digital Competitiveness Index (EV-DCI) 2023–2024 Digital Competitiveness Index) Provinces With Island Characteristics 2023–2024

Provincial Area	Digital Competitiveness Index (EV-DCI) Scores by Year 2022–2024				Ranking Changes *)
	2022	2023	2024	2022–2024 Rate (%)	
Southwest Papua	-	36.4	31.8	-12.64	↓ 7
North Maluku	30.3	33.7	31.1	1.31	↓ 1
Maluku	32.5	38.1	36.1	5.39	↓ 6
Southeast Sulawesi	36.1	35.2	37.8	2.33	↑ 3
North Sulawesi	39.8	39.1	38.5	-1.65	↓ 2
East Nusa Tenggara	32.5	34.4	34.8	3.48	↑ 3
West Nusa Tenggara	32.3	37.1	35.5	4.84	↓ 1
Riau Islands	40.8	45.9	47.8	8.24	↑ 1
Bangka Belitung Islands	32.2	38.3	38.2	8.92	↓ 1
Province with Island Characteristics	-	-	-		

*Source: East Ventures – Digital Competitiveness Index 2020–2024. Data Processed 2024. *Note: Ranking Changes Reviewed in 2023–2024*

indicates that geographic proximity to Singapore and its status as a special economic zone significantly contribute to digital acceleration in the region. Some provinces, such as the Bangka Belitung Islands and the Riau Islands, show significant improvement, while Southwest Papua experiences a decline. Therefore, it is crucial to initiate a focused and contextual digital transformation to bridge the digital divide between regions and promote inclusive economic growth (Sudrajat & Andhika, 2021).

The Bangka Belitung Islands Province recorded the highest growth rate, at 8.92%, demonstrating positive momentum in digital technology adoption. However, in contrast to this trend, Southwest Papua Province experienced a substantial decline of 12.64%. According to Roman (2024), this reflects fundamental challenges in developing digital infrastructure in eastern Indonesia.

There is a clear polarization in digital maturity levels between provinces. North Sulawesi (38.5) and Southeast Sulawesi (37.8) show moderate performance with minimal fluctuation, while North Maluku (31.1) and Southwest Papua (31.8) still struggle with the fundamental challenges of digital transformation. According to Bhairawa Putera et al. (2022), this disparity is largely influenced by the inequality of telecommunications infrastructure and variations in the level of digital literacy in society.

A three-year trend analysis revealed that 7 out of 9 provinces showed positive growth, encouraging digital transformation momentum. However, as revealed (OECD, 2024), this uneven growth rate has the potential to widen the digital divide between regions if not managed with the right strategy.

The ranking changes demonstrate the dynamics of interprovincial competition in digital transformation. While Southwest Papua saw a decline in its score, the province actually rose seven places, signaling a significant shift in the national digital competitiveness landscape. Ing et al. (2023) suggests that this phenomenon needs to be seen in a broader context, considering that digital transformation is not just about infrastructure, but also the readiness of the digital ecosystem as a whole.

This trend underscores the importance of a more nuanced approach to implementing digital transformation policies in island regions. World Bank Digital Development Partnership (2024) recommends more adaptive and contextual strategies, taking into account the unique characteristics of each archipelagic region, including geographic, demographic, and socio-economic conditions in the planning and implementation of digital transformation programs (Rofi et al., 2021).

Research findings indicate that the significant digital divide between regions in Indonesia is a major obstacle to digital transformation. The Riau Islands' Digital Competitiveness Index showed a moderate increase from 2020 to 2024, with significant gaps in digital infrastructure between districts/cities, and the need for improved digital human resource readiness to support digital transformation.

Urban areas are generally more digitally advanced than rural, underdeveloped, and island regions. This research found that infrastructure limitations and inequities persist, such as unequal internet access (Sandee, 2016), the digital literacy gap, and a lack of resources in remote and island regions, which are predicted to be other inhibiting factors. Several case studies have shown that the "Hub and Spoke" model can effectively address these challenges. Well-connected digital centers can serve as sources of knowledge, training, and support for both the region and the surrounding islands. These findings provide a map of the digital maturity levels in island regions with varying geographical locations and conditions, the factors that hinder and support digital transformation in island regions, and the potential of the "Hub and Spoke" model, which is believed to be able to bridge the digital divide in Indonesia.

Traditional, uniform, top-down approaches are ineffective in addressing the digital divide because they fail to address unique geographic and socio-economic challenges. The geographical characteristics of the Indonesian archipelago require a more localized approach. These approaches often focus on large cities and neglect the needs of remote areas (Sandee, 2016; Spennemann, 2004). This situation further confirms that digital transformation is essential for increasing regional competitiveness. Digitalization can accelerate public services and regional economic growth (Manoby et al., 2021).

On the other hand, a bottom-up approach that focuses on local initiatives appears more responsive to community needs. However, this approach is often limited by limited resources and capacity (Bhairawa Putera et al., 2022). This situation is caused by the digital infrastructure gap and limited digital talent, which hinders technology adoption. Consequently, an island-based approach risks creating digital silos and hindering national synergy. Therefore, national coordination and standardization remain essential.

The most effective approach is a combination of top-down and bottom-up approaches, where the central government plays a role in establishing comprehensive policies and providing basic infrastructure. In contrast, regional governments (Pemda) and local communities must be involved in planning and implementing local solutions, thus creating shared responsibility for implementing and adapting technology according to their specific needs. In other words, a comprehensive strategy is needed that integrates infrastructure and human resource development, supported by collaboration between the central and regional governments, to accelerate digital transformation.

The "Hub and Spoke" model can be an appropriate framework for this approach, with digital centers as "hubs" that connect and support the digital transformation of surrounding remote and/or island areas as "spokes" (Lalisang et al., 2019). An archipelago-based digital transformation framework must balance local needs with national strategies. Regional digital hubs can serve as a bridge between the central government and regional governments.

The digital transformation approach is formulated by elaborating innovation diffusion, digital maturity, and the "Hub and Spoke" model. This is a specific model with an approach that takes into account the unique characteristics of an

archipelagic nation like Indonesia, particularly when attempting a comprehensive, inclusive, and implementable digital transformation.

4. Conclusion

Digital transformation in Indonesia is a complex and multidimensional process, requiring a holistic and inclusive approach. The Riau Islands demonstrate significant potential for digital transformation but still face infrastructure and human resource challenges. The unique geographic, social, and economic challenges of each island and/or archipelago necessitate an approach tailored to the local context. Therefore, an island-based approach tailored to the local context, combining top-down and bottom-up elements, and utilizing a "Hub and Spoke" model can effectively address the digital divide and promote inclusive economic growth. Digital transformation in Indonesia holds significant potential to improve public welfare and drive economic growth.

However, the success of digital transformation depends heavily on the ability of the government and society to address existing challenges and capitalize on emerging opportunities. The island-based approach proposed in this study can be crucial in achieving these goals.

Strategies to enhance digital competitiveness need to consider the geographical characteristics of the archipelago. This requires an active role for the government in creating supportive policies, creating a conducive environment for innovation and investment, providing adequate infrastructure, and facilitating collaboration between the central government, regional governments, and other stakeholders to accelerate digital transformation.

In this context, the following are recommended:

a. To the (Central) Government, in accordance with its authority, to increase investment in telecommunications infrastructure, especially in the 3T regions and islands in the maritime border areas between countries, so that it can be ensured that there is equal access to digital services (internet):
b. To the Provincial and Regency/City Regional Governments (Pemda) based on their authority to improve digital literacy, empower MSMEs, and develop a digital ecosystem specifically designed to improve public digital skills to meet the needs of the community at various levels of education and ages from various geographical origins, especially in island and rural areas.
c. The public is encouraged to collaborate in building partnerships (dodeca-helix) in utilizing digital technology and to continue comprehensive research to evaluate the effectiveness of the implementation of the "Hub and Spoke" model and to identify other factors that influence the success of digital transformation, so that the success of digital transformation for sustainable development can be ensured.

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