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Digital Maturity and Transformation Readiness Across Indonesian Industries

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ABSTRACT

Indonesia is experiencing a rapid digital transformation driven by national initiatives such as Making Indonesia 4.0 and the Digital Economy Roadmap 2030. However, prior studies consistently report uneven digital maturity across industries due to disparities in infrastructure, digital skills, leadership commitment, and strategic alignment. **This study adopts** a Systematic Literature Review (SLR) to synthesize empirical and conceptual evidence on digital maturity and digital transformation readiness across industries in Indonesia and comparable emerging economies. **The review focuses** on six dominant dimensions identified across prior studies, namely digital strategy alignment, IT infrastructure, data analytics capability, leadership commitment, employee capability, and innovation culture. **The synthesis reveals** that banking and financial services exhibit the highest level of digital maturity, followed by manufacturing and logistics. At the same time, MSMEs, education, and healthcare remain in early to developing stages. Leadership commitment, workforce digital skills, and data analytics capability consistently emerge as the most critical drivers of transformation readiness. **This study contributes** theoretically by integrating fragmented findings on digital maturity into a coherent conceptual framework relevant to emerging economies. Practically, the results support national digital policy development and align with SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure) by emphasizing inclusive digital capability development.

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1. INTRODUCTION

Indonesia is experiencing a rapid digital transformation that reshapes how industries operate, compete, and deliver value. Government initiatives such as Making Indonesia 4.0 and the Digital Economy Roadmap 2030 have accelerated the adoption of digital technologies across various sectors, including manufacturing, finance, education, and healthcare [1]. However, despite the strong national commitment, a significant gap remains between Indonesia's digital potential and its actual implementation. Many industries are still in the early stages of transformation, facing persistent challenges related to infrastructure limitations, digital literacy

gaps, and weak strategic alignment [2]. These conditions highlight the growing importance of understanding digital maturity and organizational readiness for successful digital transformation [3].

Despite the increasing relevance of digital transformation, most empirical studies on digital maturity have primarily focused on developed economies. As a result, limited scholarly attention has been given to how emerging economies like Indonesia experience and manage digital transformation processes [4]. Moreover, the level of digital readiness varies substantially across industries, particularly between traditional sectors that rely heavily on manual processes and digitally intensive sectors that operate with advanced technologies. These variations indicate the need for a structured synthesis of existing knowledge to identify key challenges, driving factors, and sectoral disparities in digital maturity within the Indonesian context [5].

Therefore, this study aims to systematically review and synthesize existing empirical and conceptual literature on digital maturity and digital transformation readiness across industries in Indonesia and comparable emerging economies [6]. This study seeks to address three main research questions:

- What patterns of digital maturity are reported across different industries in emerging economies?.
- Which dimensions are consistently identified as the key determinants of digital transformation readiness?.
- How does digital maturity relate to organizational performance and innovation outcomes based on prior studies?.

The significance of this study lies in both its academic and practical contributions. Academically, it extends existing digital maturity discussions by providing a structured synthesis of findings from emerging economy perspectives. Practically, the results offer evidence-based insights for policymakers, industry leaders, and practitioners in formulating digital transformation strategies that are aligned with Indonesia's national development agenda. Through a literature-based approach, this study contributes to supporting Indonesia's transition toward a more resilient, competitive, and innovation-driven digital economy [7].

Figure 1 provides a visual representation of the Sustainable Development Goals (SDGs) most relevant to this study, emphasizing how digital capability development aligns with global frameworks for education quality, economic growth, and innovation infrastructure.

Figure 1. Contribution of Digital Maturity Dimensions to SDG 4, SDG 8, and SDG 9

This study aligns with SDG 8, SDG 9, and SDG 4 by highlighting how digital maturity enhances innovation, productivity, and digital skills development. Overall, the findings position digital maturity as a key driver of sustainable and inclusive socio-economic development in Indonesia [8].

2. LITERATURE REVIEW

2.1. Digital Transformation and Digital Maturity Concepts

Digital transformation involves integrating digital technologies into business operations to reshape value creation, competition, and customer interaction [9]. It is not limited to tool adoption but includes business model innovation, process reengineering, and cultural change [10]. Its development has progressed from basic

automation to advanced use of data analytics, artificial intelligence, and cloud platforms [11]. Digital maturity reflects how systematically digital capabilities are embedded in organizational processes and strategies [12]. It is commonly viewed as a staged progression from initial and developing levels to advanced and optimized stages, where organizations become data-driven and innovation-oriented [13, 14]. These stages help explain industry evolution in Indonesia's digital transformation context [15].

2.2. Digital Maturity Models and Frameworks

In the context of digital maturity, this study incorporates the role of data pipelines, which are essential for enabling real-time data processing across industries [16]. Data pipelines allow organizations to process large volumes of data, ensuring that predictive analytics can be performed in real-time to support automated decision-making [17]. In addition, integrating cloud architectures and edge computing facilitates scalable data management, ensuring that organizations can handle increasing data loads while maintaining high performance and low latency [18]. The Deloitte Digital Maturity Model emphasizes five key dimensions: customer, strategy, technology, operations, and organization and culture [19].

This study introduces a contextualized framework for digital maturity, specifically designed for emerging economies like Indonesia [20]. Unlike traditional global models, which assume uniform technological and infrastructural capabilities, this framework accounts for local socio-economic conditions, regulatory environments, and sectoral disparities. This new approach recognizes that digital maturity in emerging economies is not linear but is shaped by continuous adaptation to technological, organizational, and environmental shifts. Additionally, this study introduces a comparative synthesis methodology, integrating empirical insights from Southeast Asian economies such as Indonesia, Malaysia, Vietnam, and Thailand [21]. This approach highlights country-specific challenges and provides a deeper understanding of digital transformation readiness within these regions, which global models often overlook [22].

The IDC MaturityScape model conceptualizes digital transformation across five levels, from ad hoc to optimized [23]. Incorporating AI and IoT is crucial for improving operational efficiency and scalability, with AI enabling predictive analytics and IoT enhancing real-time monitoring and automation. These technologies also strengthen cybersecurity through advanced threat detection and data protection [24]. Similarly, Capgemini's framework highlights leadership capability and digital intensity as key drivers.

However, most global models are based on evidence from advanced economies, and applying them directly to emerging economies like Indonesia can lead to contextual bias due to differences in digital infrastructure, regulatory environments, and workforce digital literacy. Reports from the World Bank and ADB emphasize the need to adapt global frameworks to local conditions for more accurate insights [25].

Figure 2. Digital Maturity Achievement Cycle Source: Digital Maturity

As illustrated in Figure 2, the Digital Maturity Achievement Cycle represents a continuous process that begins with defining digital objectives and progresses through key stages such as assessing current capabilities, identifying gaps, securing leadership buy-in, and implementing the transformation initiatives, ensuring sustainable maturity development [26].

2.3. Transformation Readiness in Emerging Economies

Transformation readiness refers to the degree to which organizations and economies possess the structural, technological, and cultural capacity to successfully adopt and sustain digital transformation initiatives [27]. The literature identifies readiness as a multidimensional construct influenced by organizational readiness, technological readiness, and cultural readiness. Organizational readiness is associated with leadership commitment, strategic clarity, and the availability of financial and human resources. Technological readiness reflects infrastructure robustness, system integration, access to digital tools, and data governance capabilities [28]. Cultural readiness relates to employees' openness to change, innovation orientation, and continuous learning behavior.

Comparative studies across Southeast Asian economies such as Malaysia, Thailand, Vietnam, and the Philippines indicate that strong public–private collaboration, national digital policies, and systematic workforce reskilling programs significantly enhance transformation readiness. Within this regional context, prior studies highlight that Indonesia's readiness level continues to be constrained by unequal infrastructure distribution and digital talent shortages, despite strong national digitalization agendas [29].

2.4. The Indonesian Digital Landscape

Indonesia has demonstrated substantial progress in developing its digital economy through government-led initiatives such as Making Indonesia 4.0, which focuses on the digitalization of manufacturing processes, and the Digital Economy Roadmap 2030, which aims to position Indonesia as Southeast Asia's largest digital economy. National reports indicate rapid growth in digital adoption across financial services, e-commerce, education, healthcare, and Micro, Small, and Medium Enterprises (MSMEs) [30]. Nevertheless, the literature consistently reports that digital adoption across Indonesian industries remains uneven. Large corporations, particularly in finance and telecommunications, show more advanced digital integration, while manufacturing firms and MSMEs face persistent barriers related to capital limitations, infrastructure gaps, and insufficient digital skills [31].

Indonesia's digital economy has grown significantly due to initiatives like Making Indonesia 4.0 and the Digital Economy Roadmap 2030, which focus on the digitalization of key sectors. Reports highlight rapid digital adoption in financial services, e-commerce, education, and healthcare [32]. However, adoption remains uneven. Large corporations in finance and telecommunications are digitally advanced, while manufacturing and MSMEs face barriers such as limited capital, inadequate infrastructure, and a lack of digital skills [33]. These documented sectoral disparities provide a critical background for synthesizing digital maturity and transformation readiness across Indonesia's industrial ecosystem [34].

2.5. Conceptual Framework

Based on the synthesis of prior empirical and conceptual studies, this research adopts an integrated conceptual framework that links digital maturity dimensions with transformation readiness and organizational outcomes. The literature consistently identifies five core dimensions: Strategy alignment of digital initiatives with organizational objectives, Technology adoption and integration of digital tools and platforms, People workforce digital skills and leadership support, Process operational efficiency and automation, Culture openness to change, innovation, and learning [35]. The conceptual framework is now anchored in Resource-Based View (RBV) and Technology Organization-Environment (TOE) theory, which guides the understanding of how digital maturity dimensions influence organizational readiness for transformation [30]. According to RBV, organizations can leverage internal resources, such as leadership commitment and employee capability, to develop competitive advantage in their digital transformation efforts. The TOE framework, on the other hand, underscores the role of organizational, technological, and environmental factors in shaping readiness [36].

Based on these theoretical foundations, the research questions have been refined to explore the causal relationships between the dimensions of digital maturity and organizational outcomes, such as operational efficiency and innovation capacity:

- How does leadership commitment influence the digital strategy alignment and technology adoption in organizations?.
- What are the organizational and environmental factors that drive data analytics capability and employee capability in MSMEs?.

This framework serves as a conceptual synthesis, based on recurring patterns from prior studies. The literature shows that stronger digital maturity in the five dimensions enhances transformation readiness and boosts organizational performance and innovation, especially in emerging economies like Indonesia. Figure 3 visually illustrates how strategy, technology, people, process, and culture shape organizational transformation readiness [37].

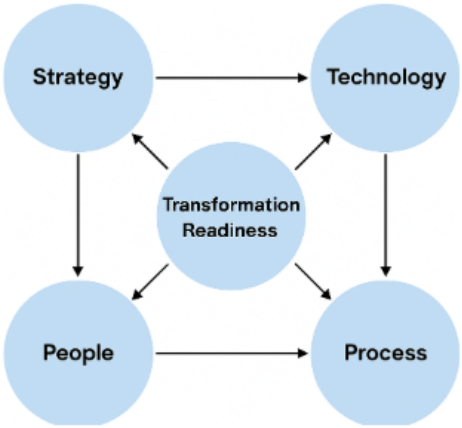

Figure 3. Integrated Digital Maturity and Transformation Readiness Framework

As shown in Figure 3, the five interdependent dimensions jointly enhance digital capability and sustain transformation [38]. This framework highlights that digital transformation is a holistic organizational change shaped by strategy, human capital, operations, and an innovation-oriented culture.

3. RESEARCH METHODS

3.1. Research Design

This study uses a Systematic Literature Review (SLR) to analyze digital maturity and transformation readiness across industries in Indonesia and comparable emerging economies. The approach synthesizes empirical findings, conceptual models, and policy discussions on digital transformation, aiming to identify key themes, determinants, and sectoral patterns of digital maturity from prior studies without primary field data.

3.2. Data Sources and Selection Criteria

The PRISMA-style selection process was used to ensure rigorous article inclusion. Articles were identified through searches in Scopus and Web of Science (WoS) with keywords related to digital maturity, transformation readiness, Industry 4.0, and digital economy. The process followed a four-phase approach.

- Identification studies were identified based on the search terms.
- Screening duplicate articles was removed, and titles and abstracts were screened for relevance.
- Eligibility full-text articles were assessed for inclusion based on predefined criteria peer-reviewed, published between 2021 and 2024, and focusing on digital transformation in emerging economies.
- Final Inclusion articles that met the quality standards were included for full review. A total of 35 articles were included in the final synthesis.

Quality screening used Cohen's Kappa (0.85) for inter-coder reliability. Peer-reviewed articles (2021– 2024) on digital transformation, with full-text availability, were included. After removing duplicates, 35 articles were selected [39].

3.3. Literature Analysis Technique

The selected literature was analyzed using a thematic synthesis approach. The analysis was conducted in three main stages:

- Descriptive mapping to identify publication trends, industry focus, and research domains.

- Thematic coding to extract recurring dimensions of digital maturity and transformation readiness.
- Comparative synthesis to contrast findings across different industry sectors and emerging economy contexts.

This approach allows the study to systematically integrate diverse findings into a coherent conceptual understanding of digital maturity and readiness.

3.4. Digital Maturity Dimensions as Conceptual Constructs

Rather than functioning as measurement instruments, the digital maturity dimensions in this study are treated as conceptual constructs derived from literature synthesis [40]. Based on recurring patterns reported in previous studies, six dominant dimensions are consistently identified:

- Digital Strategy Alignment the integration of digital initiatives into long-term organizational strategy.
- IT Infrastructure the scalability, reliability, and cybersecurity readiness of digital systems.
- Data Analytics Capability the use of data-driven insights in decision-making processes.
- Leadership Commitment, executive support, and strategic direction of digital transformation.
- Employee Capability workforce digital literacy, training, and adaptability.
- Innovation Culture openness to experimentation, collaboration, and continuous improvement.

These constructs serve as the analytical foundation for synthesizing how digital maturity and transformation readiness are discussed across industries in emerging economies [41].

Table 1. Digital Maturity Dimensions Synthesized from Prior Literature

Dimension	Definition	Key Aspects / Indicators
Digital Strategy Alignment	The extent to which digital initiatives are integrated into corporate strategy and aligned with long term business objectives.	Integration of digital goals, strategic alignment, clarity of digital roadmap.
IT Infrastructure	The capability, scalability, and reliability of technological systems supporting digital operations.	System integration, cloud adoption, hardware/software adequacy, cybersecurity readiness.
Data Analytics Use	The degree to which data-driven insights are utilized in decision-making and operational processes.	Data accessibility, analytics tools, governance maturity, use of dashboards/reports.
Leadership Commitment	The involvement and support of executives in championing digital transformation initiatives.	Vision-setting, resource allocation, policy support, top-level engagement.
Employee Capability	The proficiency of employees in using digital tools and adapting to new technologies.	Digital literacy, training programs, upskilling, readiness to adopt innovations.
Innovation Culture	The organization's openness to experimentation, collaboration, and continuous improvement.	Support for creativity, tolerance for risk, innovation practices, cross-team collaboration.

The digital maturity dimensions presented in Table 1 provide a structured conceptual foundation for synthesizing how digital maturity and transformation readiness are discussed across prior empirical studies [42]. Each dimension represents a critical aspect of digital capability that has been consistently identified in the literature, encompassing technological, strategic, organizational, and cultural perspectives of digital transformation [43]. Rather than functioning as measurable survey indicators, these dimensions are treated as analytical constructs derived from literature synthesis, enabling a systematic comparison of digital maturity patterns across industries and emerging economy contexts [44].

Digital strategy alignment refers to the extent to which digital initiatives are embedded into organizational strategy and long-term business planning [45]. IT infrastructure reflects the scalability, reliability,

and cybersecurity readiness of technological systems supporting digital operations [46]. Data analytics capability represents the degree to which organizations utilize data-driven insights for operational and strategic decision-making. Leadership commitment captures the role of executive support in driving and sustaining digital transformation [47]. Employee capability reflects workforce digital literacy, training, and adaptability to technological change. Innovation culture represents organizational openness to experimentation, collaboration, and continuous improvement [48].

Collectively, these dimensions serve as the conceptual basis for synthesizing transformation readiness across industries, rather than as variables for statistical measurement [49]. Through this conceptual framework, the study systematically integrates existing empirical evidence to explain how digital maturity supports organizational performance and innovation capacity in emerging economies such as Indonesia [50].

3.5. Data Synthesis Approach

Data analysis in this study is conducted through a qualitative synthesis of findings from prior empirical and conceptual literature, rather than through statistical testing [51]. The selected studies are systematically reviewed to identify dominant patterns, recurring themes, and sector-specific characteristics related to digital maturity and digital transformation readiness [52].

The synthesis process focuses on comparing how digital maturity dimensions namely digital strategy alignment, IT infrastructure, data analytics capability, leadership commitment, employee capability, and innovation culture are discussed across different industry sectors and emerging economy contexts [53]. This approach enables the identification of consistent drivers of transformation readiness, persistent barriers to digital adoption, and the strategic implications of digital maturity for organizational performance and innovation [54].

Instead of constructing a quantitative Digital Maturity Index (DMI), this study develops a conceptual synthesis framework that integrates insights from previous studies to explain how digital maturity supports transformation readiness at the organizational and industry levels [39]. The results of this synthesis provide a structured basis for cross-industry comparison and policy-oriented discussion relevant to Indonesia's digital economy development [55].

4. RESULTS AND DISCUSSION

4.1. Patterns of Digital Maturity Across Industries

Based on the synthesis of prior empirical studies, clear sectoral differences in digital maturity consistently emerge across industries in emerging economies, including Indonesia. The banking and financial services sector is widely reported as the most digitally mature industry due to strong regulatory frameworks, early adoption of fintech innovations, advanced cybersecurity systems, and intensive use of data analytics. The findings are now presented in a more structured manner to enhance transparency and verification.

Table 2. Digital Maturity Stages Across Industries

Industry	Maturity Stage	Key Drivers	Evidence Strength
Banking & Financial Services	Advanced	Strong regulatory frameworks, fintech adoption, data analytics	High
Manufacturing	Developing	Adoption of Industry 4.0, automation, IoT integration	Moderate
MSMEs	Initial	Limited digital skills, capital constraints	Low
Education	Developing	Basic digital tools, limited data analytics	Moderate
Healthcare	Developing	Telemedicine, regulatory challenges, interoperability concerns	Moderate

The characteristics mentioned above reflect the digital maturity stages across industries as shown in Table 2. This table outlines the varying maturity levels, key drivers, and evidence strength for sectors such as banking, manufacturing, MSMEs, education, and healthcare, highlighting the diverse challenges and opportunities faced by each industry in their digital transformation journey.

In contrast, education, healthcare, and MSMEs are consistently categorized in the early to developing stages of digital maturity. Educational institutions primarily rely on basic learning management systems and

administrative digital platforms, with limited use of advanced analytics for decision-making. Healthcare organizations adopt digital solutions mainly for record management and telemedicine services, yet they remain constrained by data interoperability challenges, regulatory complexity, and cybersecurity concerns. MSMEs exhibit the lowest levels of maturity due to financial limitations, low digital awareness, and restricted access to skilled digital talent. Nevertheless, the literature indicates a gradual shift toward digital payments, social media marketing, and e-commerce platforms among MSMEs, signaling increasing transformation readiness.

4.2. Dominant Drivers of Digital Transformation Readiness

Digital transformation readiness is primarily influenced by four key factors. Leadership commitment is the most crucial factor, driving digital vision, strategic investment, and the courage to innovate. Employees' digital capabilities and skills are also crucial, as technological success depends on human resource literacy and readiness. Furthermore, data analytics capabilities serve as a strategic driver for data-driven decision-making. Finally, IT infrastructure resilience is crucial to support cloud computing, system integration, and cybersecurity, particularly in the MSME, education, and healthcare sectors.

4.3. Digital Maturity and Organizational Performance

The reviewed literature consistently confirms a positive relationship between digital maturity and organizational performance. Digitally mature organizations demonstrate higher levels of operational efficiency, faster innovation cycles, improved customer satisfaction, and stronger competitive positioning. Banking and logistics sectors, for example, benefit from real-time transaction processing, predictive analytics, and seamless digital service delivery, which directly enhance productivity and service reliability. In the manufacturing sector, the application of automation and smart production systems leads to reduced downtime, improved quality control, and enhanced supply chain transparency. Meanwhile, organizations with low digital maturity tend to experience inefficiencies, slow decision-making processes, and limited innovation capacity. These contrasting performance outcomes reinforce the argument that digital maturity serves as a strategic capability rather than merely a technological upgrade.

4.4. Indonesia's Digital Transformation in the ASEAN Context

When positioned within the broader ASEAN digital ecosystem, Indonesia exhibits strong digital growth potential but continues to face uneven transformation patterns. Countries such as Singapore, Malaysia, and Thailand demonstrate higher national readiness due to consistent public–private collaboration, digital infrastructure investments, and coordinated workforce development policies. Indonesia's transformation progress is driven by strong national initiatives such as Making Indonesia 4.0 and the Digital Economy Roadmap 2030, yet regional disparities and digital talent shortages constrain more balanced development. The literature further highlights that urban-based industries in Indonesia progress faster than rural-based organizations, reflecting unequal access to broadband infrastructure and advanced digital services. This disparity underscores the importance of targeted digital inclusion policies to ensure that digital transformation contributes to equitable economic growth.

4.5. Implications for Indonesia's Digital Economy

Indonesia's digital economy shows uneven progress, with advanced sectors driving innovation while less mature industries hinder overall transformation. This study proposes a digital maturity model tailored to Indonesia and ASEAN, accounting for regulatory, socio-economic, and sector-specific challenges such as data interoperability and cybersecurity in education and healthcare.

Key priorities for digital transformation include:

- Banking Integrate AI for predictive analytics and cybersecurity. Action: Implement AI models by Q4 2024.
- MSMEs Focus on affordable cloud solutions and digital marketing. Action: Launch national training programs by 2025.
- Education Implement digital literacy and data interoperability standards. Action: Start upskilling campaigns by 2024.
- Healthcare Strengthen cybersecurity and data interoperability. Action: Develop national guidelines by 2025.

These findings emphasize aligning Indonesia's digital transformation with SDGs 4, 8, and 9 to ensure sustainable, inclusive development.

5. MANAGERIAL IMPLICATIONS

Based on prior empirical findings, several managerial implications for industry leaders, policymakers, and digital transformation practitioners in Indonesia can be drawn. Organizational leaders must strengthen digital strategy alignment, ensuring digital transformation is integrated into long-term business planning rather than treated as a technological upgrade. Key actions include establishing quarterly digital maturity assessments, incorporating digital goals into annual business plans, and setting metrics for success, such as tracking employee participation in digital literacy training, aiming for 80% workforce upskilling. Sector-specific priorities include integrating AI in banking for personalized customer experiences, adopting cost-effective cloud solutions for MSMEs, and improving data interoperability and cybersecurity in healthcare. A clear strategic direction allows organizations to manage transformation risks, prioritize investments, and foster long-term innovation.

Additionally, human capital development is crucial for enhancing digital maturity, particularly in sectors like MSMEs, education, and healthcare, where continuous digital upskilling and leadership development are essential to reduce resistance to change and enhance adaptability. These actions support SDG 4 (Quality Education) by strengthening the digital competencies of the workforce. Differences in digital maturity across industries highlight the need for sector-specific transformation strategies high-maturity sectors like banking and logistics can serve as benchmarks for data analytics adoption and cybersecurity governance, while lower-maturity sectors should focus on building foundational digital infrastructure. Policymakers should prioritize targeted regulatory support, financial incentives, and cross-sector collaboration to bridge digital readiness gaps, aligning with SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure) for a resilient, sustainable, and equitable digital transformation in Indonesia.

6. CONCLUSION

This study provides a comprehensive synthesis of digital maturity and digital transformation readiness across industries in Indonesia and comparable emerging economies based on a systematic literature review. The findings consistently show that banking, financial services, logistics, and large-scale manufacturing sectors demonstrate relatively advanced levels of digital maturity due to strong regulatory support, robust IT infrastructure, and sustained leadership commitment. In contrast, MSMEs, education, and healthcare sectors remain in early to developing stages of digital transformation, primarily constrained by limited resources, digital skill gaps, and weak strategic integration.

The synthesis further confirms that digital strategy alignment, IT infrastructure, data analytics capability, leadership commitment, employee capability, and innovation culture are the most critical dimensions shaping digital maturity and transformation readiness. Organizations that actively cultivate these dimensions tend to achieve higher operational efficiency, stronger innovation capacity, and greater resilience to technological change. The literature also indicates that digital maturity functions as a strategic organizational capability rather than merely a supporting technological tool.

From an academic perspective, this study contributes by integrating fragmented digital maturity research into a coherent conceptual framework that is relevant to emerging economy contexts. From a practical perspective, the findings support the formulation of targeted digital transformation policies, capability-building programs, and sector-specific roadmaps to strengthen Indonesia's national digital competitiveness. Furthermore, the study reinforces the strategic alignment between digital transformation and the achievement of SDG 4, SDG 8, and SDG 9, emphasizing the importance of inclusive digital literacy, sustainable economic growth, and resilient digital infrastructure. As Indonesia continues its transition toward a digitally driven economy, addressing structural disparities in digital readiness will be essential to ensuring equitable, innovative, and sustainable transformation across all sectors.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: YD and YI; Methodology: YI; Software: YD and RE; Validation: RE and YI; Formal Analysis: YI and YD; Investigation: RE; Resources: YI; Data Curation: YD; Writing Original Draft Preparation: YD and RE; Writing Review and Editing: RE and YD; Visualization: YI. All authors, YD, YI, and RE, have read and agreed to the published version of the manuscript.

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