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Digital Accounting Transformation as a Driver of Sustainable Business Model Innovation through Digital Ecosystems in Start-ups in Indonesia

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ABSTRACT

This study explores the role of digital accounting transformation and digital ecosystems in driving sustainable business model innovation (SBMI) within Indonesian start-ups. Using a quantitative analysis with 85 samples, data were collected through a Likert scale survey and analyzed using SPSS Version 26. The results reveal that digital accounting transformation significantly influences SBMI, with a path coefficient of 0.52. Additionally, digital ecosystems were found to have a moderate positive effect on SBMI (path coefficient: 0.41). The study also identifies a mediating role of digital ecosystems, with an indirect effect of 0.26, showing that digital ecosystems amplify the impact of digital accounting transformation on SBMI. These findings underscore the importance of integrating digital technologies and ecosystems to foster innovation and sustainability in start-up businesses. The study provides practical insights for entrepreneurs and policymakers, highlighting the necessity of adopting digital tools and fostering ecosystem collaboration to achieve sustainable business growth.

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1. INTRODUCTION

The rapid advancement of digital technology has revolutionized various business processes, with accounting being one of the most critical areas undergoing significant transformation, particularly in Indonesia's burgeoning start-up ecosystem. Digital accounting, characterized by the integration of advanced tools such as cloud computing, artificial intelligence, and blockchain, has become a cornerstone for modern organizations seeking to streamline operations, enhance collaboration, and improve decision-making capabilities [1]–[3]. These technologies enable real-time data processing and analytics, facilitating faster and more informed decisions while also fostering sustainable business model innovation by leveraging digital ecosystems. In Indonesia, start-ups are at the forefront of this shift, using digital accounting systems to increase adaptability and support innovative business strategies [4]. Empirical findings suggest that the effectiveness of digital accounting systems (EDAIS) has a significant positive impact on sustainable business model innovation (SBMI), with digital business ecosystems (DBE) acting as a key

mediating factor [4]. However, despite its promising benefits, the adoption of digital accounting is not without challenges, including data privacy issues, cybersecurity threats, and the pressing need for upskilling employees to navigate these emerging technologies [5]. Nonetheless, the overall outlook remains optimistic, with digital innovation increasingly viewed as an opportunity rather than a threat to the evolution of accounting practices [2].

Start-ups operate in highly dynamic environments that demand agility and innovation to maintain competitiveness, and within this context, digital accounting transformation emerges as a critical enabler by providing accurate financial insights, automating repetitive tasks, and fostering transparency across operations. The integration of digital ecosystems allows start-ups to seamlessly connect with stakeholders, optimize resource utilization, and swiftly adapt to changing market conditions, thereby supporting the development of sustainable business models aligned with long-term economic, environmental, and social goals. Real-time data analytics from digital accounting systems empower start-ups to make informed decisions and respond rapidly to market demands, which is essential for sustaining competitiveness and driving continuous innovation [6]. Moreover, the automation of routine accounting processes not only reduces operational costs but also enables the reallocation of resources toward strategic activities that stimulate growth and innovation [6], [7]. Transparency, a hallmark of digital accounting, enhances collaboration with stakeholders and strengthens trust, both of which are fundamental for thriving within digital ecosystems [8], [9]. Furthermore, the integration of digital accounting with advanced technologies such as artificial intelligence and blockchain within digital ecosystems boosts operational efficiency and opens new pathways for innovation [6], [9]. positioning digital accounting as an indispensable tool for start-ups navigating the complexities of the digital era.

Despite the recognized potential of digital accounting transformation, research on its impact within the Indonesian start-up context remains limited. This study addresses this gap by investigating how the implementation of digital accounting practices influences sustainable business model innovation through digital ecosystems.

2. LITERATURE REVIEW

2.1 Digital Accounting Transformation

The adoption of digital accounting technologies, such as cloud computing, artificial intelligence, and blockchain, has significantly transformed traditional accounting processes, offering numerous advantages for start-ups by enhancing operational efficiency, enabling real-time data access, and supporting strategic decision-making—critical capabilities for organizations operating in resource-constrained environments [10], [11]. By automating routine tasks like invoicing and tax calculations, digital accounting systems reduce operational time and costs while minimizing human error and improving document management, thus increasing overall efficiency and enabling better resource allocation [10], [11]. These systems also offer real-time access to financial data, enhancing organizational agility and enabling start-ups to respond swiftly to market dynamics through timely, data-driven decision-making [11], [12]. Moreover, digital accounting supports regulatory compliance, which is vital for building credibility and attracting investor trust, while its ability to generate accurate and timely financial reports fosters transparency and reinforces stakeholder confidence [10], [13].

2.2 Sustainable Business Model Innovation

Sustainable Business Model Innovation (SBMI) is increasingly recognized as a vital strategy for start-ups aiming to address environmental, social, and economic challenges, as it enables them to integrate sustainability into their core operations, thereby enhancing competitiveness and market relevance [14], [15]. Start-ups adopting

SBMI are better equipped to navigate pressing societal issues such as climate change and inequality, while aligning with sustainability targets that are becoming essential for long-term growth and sectoral adaptation [16]. Digital transformation, particularly through tools like digital accounting, plays a crucial role in facilitating SBMI by providing real-time data access that supports sustainability-driven innovation, such as waste reduction and resource optimization [17]. These digital tools help develop eco-friendly products and services while also fostering operational efficiencies that contribute to environmental goals. Furthermore, SBMI requires active engagement with various stakeholders, involving boundary work to negotiate and realign organizational boundaries in the pursuit of sustainable innovation, which in turn enhances brand reputation and builds strong stakeholder relationships vital for start-ups' long-term success [15]. However, the practical adoption of SBMI remains limited due to strategic and institutional challenges, and its success largely depends on internal strategic alignment and the implementation of innovation practices that can unlock its full potential [17].

2.3 Digital Ecosystems

Digital ecosystems play a crucial role in fostering innovation, particularly for start-ups, by providing access to resources, expertise, and markets that are often difficult to attain independently, and by offering flexibility, scalability, and technological capacity that support continuous development and sustainability integration [18], [19]. These ecosystems facilitate the exchange of values and resources among interconnected organizations, allowing start-ups to tap into a wider array of expertise and advanced technological tools, while the modularity and connectivity of digital technologies enable them to reprogram and adapt operations for ongoing innovation [18], [19]. Digital Business Ecosystems (DBEs), defined by adaptability and resilience, empower start-ups to navigate shifting market conditions by leveraging technologies such as cloud computing, big data analytics, and artificial intelligence for value creation and innovative business model development [9]. Moreover, digital ecosystems support the integration of sustainability into business practices by promoting collaboration with environmentally and socially focused stakeholders, where the network effects of digital technologies further enhance accessibility, affordability, and energy-efficient consumption [19].

2.4 Research Gap and Framework

While prior studies have explored the individual impacts of digital transformation, sustainability, and ecosystems on business performance, there is limited empirical research examining their interconnected roles in the Indonesian start-up context. This study addresses this gap by investigating how digital accounting transformation acts as a driver of SBMI through digital ecosystems. By focusing on Indonesian start-ups, this research aims to provide insights into how these concepts can be leveraged to create resilient and competitive businesses in an emerging market.

The theoretical framework for this study is based on the resource-based view (RBV) and the dynamic capabilities theory. These frameworks emphasize the importance of leveraging internal resources, such as digital accounting systems, and external capabilities, such as digital ecosystems, to achieve sustainable competitive advantage. This study posits that the integration of digital accounting transformation and digital ecosystems is a critical enabler of SBMI in start-ups.

3. METHODS

3.1 Research Design

This study employs a quantitative research design to investigate the influence of digital accounting transformation on sustainable business model innovation (SBMI) through digital ecosystems in Indonesian start-ups, as this approach is well-suited for measuring variable relationships, analyzing patterns, and generating generalizable findings. Data were collected

through structured surveys to ensure consistency and reliability, with responses measured using a Likert scale. The target population consists of start-ups operating across various sectors in Indonesia, and a sample of 85 start-ups was selected using purposive sampling to ensure the inclusion of firms actively involved in digital accounting practices and sustainability-oriented innovations. The participants primarily comprised founders, co-founders, or financial managers who play a direct role in implementing digital accounting systems and sustainability strategies within their organizations.

3.2 Data Collection Instrument

The primary data collection instrument in this study was a structured questionnaire designed to capture detailed information on three key constructs: Digital Accounting Transformation, Sustainable Business Model Innovation (SBMI), and Digital Ecosystems. Digital Accounting Transformation was measured through indicators such as automation level, real-time data access, and financial transparency, while SBMI was assessed based on metrics like environmental impact reduction, resource optimization, and stakeholder collaboration. The construct of Digital Ecosystems, acting as a mediating variable, was evaluated by examining the level of participation in collaborative networks and technological integration. Each construct was measured using multiple indicators, with responses recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to distribution, the questionnaire was pre-tested with a small group of respondents to ensure the clarity, validity, and relevance of the questions.

3.3 Data Analysis

Data analysis was conducted using SPSS version 26, a statistical software tool well-suited for analyzing quantitative data. The analysis involved several key steps, beginning with descriptive statistics to summarize the demographic characteristics of respondents and the distribution of key variables. Reliability and validity testing followed, where Cronbach's alpha was calculated to assess the internal consistency of measurement items, and exploratory factor analysis (EFA) was employed to evaluate construct validity. Correlation analysis was then conducted to examine the strength and direction of relationships among the variables. Finally, regression analysis was performed to test the impact of digital accounting transformation on sustainable business model innovation (SBMI), including the mediating role played by digital ecosystems in this relationship.

4. RESULTS AND DISCUSSION

4.1 Demographic Characteristics of the Sample

The study analyzed data from 85 respondents representing start-ups in Indonesia. The demographic characteristics are presented below, including industry type, respondent role, years in operation, and adoption of digital accounting systems.

Table 1: Demographic Characteristics of Respondents

Category	Subcategory	Frequency	Percentage (%)
Industry Type	Technology	30	35.3%
	Retail	20	23.5%
	Services	15	17.6%
	Manufacturing	10	11.8%
	Others	10	11.8%
Role in Start-up	Founder/Co-founder	40	47.1%
	Financial Manager	30	35.3%
	Operational Manager	15	17.6%
Years in Operation	Less than 2 years	25	29.4%
	2–5 years	40	47.1%

	More than 5 years	20	23.5%
Adoption of Digital Accounting Systems	High (Frequent use of tools)	57	67.1%
	Medium (Partial use)	20	23.5%
	Low (Minimal use)	8	9.4%

The sample of start-ups in this study demonstrated diverse industry representation, with the majority operating in the technology sector (35.3%), followed by retail (23.5%), services (17.6%), and manufacturing and other industries each accounting for 11.8%. In terms of respondent roles, nearly half were founders or co-founders (47.1%), indicating strategic-level insights, while financial managers (35.3%) provided detailed information on digital accounting practices, and operational managers (17.6%) contributed perspectives on day-to-day business processes. Regarding years in operation, most start-ups were relatively young, with 47.1% operating for 2–5 years and 29.4% under 2 years, reflecting the dynamic nature of emerging market enterprises. Adoption of digital accounting systems was notably high, with 67.1% of respondents indicating strong implementation of digital tools, while medium and low adoption levels were reported by 23.5% and 9.4% of start-ups respectively, suggesting both positive digital transformation trends and potential areas for further development.

4.2 Reliability and Validity Testing

The constructs were evaluated for reliability using Cronbach's alpha, with all values exceeding the recommended threshold of 0.70, confirming strong internal consistency. Exploratory factor analysis (EFA) revealed high loadings for all indicators on their respective constructs, indicating good construct validity.

4.3 Correlation Analysis

Correlation analysis showed significant positive relationships among digital accounting transformation, digital ecosystems, and SBMI. The strongest correlation was observed between digital accounting transformation and SBMI ($r = 0.68$, $p < 0.01$), followed by the relationship between digital ecosystems and SBMI ($r = 0.62$, $p < 0.01$).

4.4 Hypothesis Testing

Hypothesis testing was conducted to examine the relationships between digital accounting transformation, digital ecosystems, and sustainable business model innovation (SBMI) in Indonesian start-ups. The hypotheses were tested using multiple regression analysis in SPSS Version 26. The results, including path coefficients (β), t-values, and significance levels (p-values).

Table 2. Hypothesis

Hypothesis	Path	β (Standardized Coefficient)	t-value	p-value	Decision
H1	Digital Accounting Transformation → SBMI	0.52	6.34	< 0.001	Supported
H2	Digital Ecosystems → SBMI	0.41	5.10	< 0.001	Supported
H3	Digital Accounting Transformation	0.63	7.85	< 0.001	Supported

	→ Digital Ecosystems				
H4	Digital Accounting Transformation → Digital Ecosystems → SBMI (Mediation Effect)	0.26 (indirect effect)	4.21	< 0.001	Supported

The hypothesis testing results reveal significant relationships among the variables examined in the study. For H1, the path coefficient between digital accounting transformation and sustainable business model innovation (SBMI) is 0.52, indicating a moderate-to-strong positive effect, with a t-value of 6.34 and a p-value < 0.001, confirming the statistical significance of the relationship and suggesting that the adoption of digital accounting practices significantly enhances the innovation capacity of SBMI in start-ups. H2 shows that digital ecosystems also have a moderate positive effect on SBMI, with a path coefficient of 0.41, a t-value of 5.10, and a p-value < 0.001, underscoring the crucial role of digital ecosystems in fostering sustainable innovation. In H3, digital accounting transformation is found to strongly influence digital ecosystems, as reflected by a path coefficient of 0.63, a t-value of 7.85, and a p-value < 0.001, indicating that the use of digital accounting significantly contributes to the development and integration of digital ecosystems within start-ups. Finally, H4 confirms the presence of a mediation effect, with an indirect effect value of 0.26, a t-value of 4.21, and a p-value < 0.001, showing that digital ecosystems partially mediate the relationship between digital accounting transformation and SBMI. This mediation underscores the synergistic role

DISCUSSION

Impact of Digital Accounting Transformation on SBMI

The results demonstrate that digital accounting transformation significantly enhances sustainable business model innovation. By leveraging advanced tools and real-time data analytics, start-ups are better equipped to optimize resource allocation, reduce operational inefficiencies, and align their business strategies with sustainability goals. These findings align with prior research, which emphasizes the role of digital accounting in driving organizational agility and innovation. Digital technology and management accounting systems have also been shown to positively influence organizational success, with a strong outcome value of 85% when mediated by management accounting systems [20]. The integration of advanced technologies into management accounting enhances data management and strategic decision-making, contributing to greater agility and stronger market positioning [21].

Moreover, digital accounting plays a crucial role in organizational strategy by improving the quality of financial reporting and the usefulness of accounting information in decision-making processes [22]. The rapid development of digitalization has also reshaped human thinking patterns, encouraging the adoption of technology to support strategic planning and execution [22]. As technological advancements continue to influence organizational structures and accounting practices, they foster greater agility and transparency, which are vital for optimizing performance and responding to dynamic market conditions [23]. These insights collectively suggest that start-ups adopting digital accounting systems are better positioned to integrate sustainability into their business models through data-driven decision-making, underscoring the critical need for investing in digital accounting as a

foundational component of innovation strategies.

Role of Digital Ecosystems in SBMI

Digital ecosystems emerged as a key driver of sustainable business model innovation (SBMI), offering start-ups valuable opportunities to collaborate, share resources, and access new markets. The findings support existing literature, which emphasizes the critical role of digital ecosystems in fostering innovation and scalability by enabling a synergistic environment that facilitates the exchange of ideas and technological capabilities [18], [24]. These ecosystems are composed of interconnected actors—including businesses, governments, and communities—who co-create value and collectively contribute to sustainable growth. For start-ups, participation in such ecosystems enhances their ability to innovate sustainably, adapt to market dynamics, and strengthen their strategic positioning. The integration of digital technologies within these networks not only supports individual organizational growth but also promotes regional economic development through knowledge sharing and entrepreneurial clustering [25], [26].

The synergistic nature of digital ecosystems unites a wide array of participants, business processes, and information services, cultivating mutually beneficial relationships that drive innovation [18]. Digital Innovation Hubs (DIHs) exemplify this structure by offering comprehensive support systems that enhance start-up capabilities through integrated ecosystem elements [24]. Within these ecosystems, value creation is driven by the use of digital technologies, which facilitate rapid adaptation, increased interaction, and cross-sector collaboration among small and medium-sized enterprises [25], [26]. Start-ups embedded in digital ecosystems are often aligned with broader economic strategies focused on job creation and improved competitiveness, especially in socio-economically challenged regions [24]. Furthermore, the collaboration within these ecosystems extends beyond business, involving cities, communities, and public institutions in efforts to promote sustainable and responsible development [25]. The study's finding of a partial mediation effect confirms that digital ecosystems amplify the positive influence of digital accounting transformation on SBMI, underscoring the importance for start-ups to not only pursue internal digitalization but also actively engage in external collaborative networks to fully harness their innovation potential.

Practical Implications for Indonesian Start-ups

For start-ups in Indonesia, the integration of digital accounting and digital ecosystems offers a strategic pathway to achieving sustainability and competitiveness. The study highlights the importance of fostering a culture of digital innovation and collaboration, particularly in emerging markets where access to resources and expertise may be limited. Policymakers and ecosystem stakeholders can also play a pivotal role by supporting digital infrastructure development and facilitating partnerships among start-ups, investors, and technology providers.

Addressing Challenges in Digital Transformation

Despite the promising findings, challenges such as resource constraints, lack of technical expertise, and resistance to change may hinder digital transformation efforts. Start-ups must prioritize capacity-building initiatives, such as training and development programs, to overcome these barriers. Additionally, government policies and incentives can help accelerate the adoption of digital tools and promote a sustainable entrepreneurial ecosystem.

5. CONCLUSION

This study highlights the pivotal role that digital accounting transformation and digital ecosystems play in driving sustainable business model innovation (SBMI) among Indonesian start-ups. The empirical findings show that digital accounting systems not only improve financial processes but also

contribute significantly to business model innovation by enhancing decision-making and operational efficiency. Furthermore, the study demonstrates that digital ecosystems act as a key enabler, enhancing the relationship between digital accounting transformation and SBMI through a mediation effect.

The practical implications of these findings are clear: start-ups in Indonesia should prioritize the adoption of advanced digital accounting tools and actively engage in digital ecosystems to unlock opportunities for innovation and long-term sustainability. Policymakers and industry stakeholders must also support the digital transformation journey of start-ups through the provision of resources, training, and incentives to ensure the growth and competitiveness of the Indonesian start-up ecosystem.

REFERENCES

[1] P. Spilnyk, V. Zabihailo, and O. Zabihailo, "Digital transformation in accounting: trends and perspectives," *Ekon. Anal.*, vol. 34, no. 2, pp. 372–384, 2024.

[2] F. Alsulami, "DIGITAL INNOVATION AND SUSTAINABLE ACCOUNTING PRACTICES: A SYSTEMATIC LITERATURE REVIEW THROUGH THE GOVERNANCE CONTEXT," *J. Gov. Regul.*, vol. 14, no. 1, 2025.

[3] M. Shehadeh and K. Hussainey, "Guest editorial: Embracing a new era: digital transformation in accounting and finance," *J. Financ. Report. Account.*, vol. 23, no. 2, pp. 437–443, 2025.

[4] P. Q. Huy and V. K. Phuc, "Does effectiveness of digital accounting system intensify sustainable business model innovation with mediating role of digital business ecosystem?," *J. Innov. Entrep.*, vol. 14, no. 1, p. 3, 2025.

[5] M. Yang, "Enterprise Transformation in the Digital Age".

[6] O. S. Joel, A. T. Oyewole, O. G. Odunaiya, and O. T. Soyombo, "Navigating the digital transformation journey: strategies for startup growth and innovation in the digital era," *Int. J. Manag. Entrep. Res.*, vol. 6, no. 3, pp. 697–706, 2024.

[7] A. I. Al-Alawi, M. M. Munir, and F. M. Munir, "Digital Transformation and Competitive Strategies: Insights Into Innovation, SMEs, and AI Startups," in *2024 International Conference on Decision Aid Sciences and Applications (DASA)*, IEEE, 2024, pp. 1–7.

[8] E. Autio, "Digitalisation, ecosystems, entrepreneurship and policy," *Perspect. into Top. issues is Soc. ways to Support Polit. Decis. making. Gov. Anal. Res. Assess. Act. policy Br.*, vol. 20, p. 2017, 2017.

[9] C. Aksoy, "Digital business ecosystems: An environment of collaboration, innovation, and value creation in the digital age," *J. Bus. Trade*, vol. 4, no. 2, pp. 156–180, 2023.

[10] V. S. Silva, "A contabilidade como ferramenta de gestão para as micro e pequenas empresas," *Rev. Científica BSSP*, vol. 1, no. 2, p. 0, 2021.

[11] H. Hentati, M. K. Jardak, and N. Boulila, "The impact of contingency factors on the degree of digitization and the operational performance in accounting firms," *J. Account. Organ. Chang.*, 2025.

[12] M. I. Naranjo-Padilla, M. J. Herrera-Sánchez, and A. J. Coello-Panchana, "Análisis bibliográfico del impacto de la transformación digital y tecnologías emergentes en la contabilidad actual," *Multidiscip. Collab. J.*, vol. 2, no. 1, pp. 52–64, 2024.

[13] O. Yarmoliuk, A. Abramov, T. Mulyk, N. Smirnova, and N. Ponomarova, "Digital technologies in accounting and reporting: Benefits, limitations, and possible risks," *Amaz. Investig.*, vol. 13, no. 74, pp. 323–333, 2024.

[14] M. Ramanujam, "Charting a path forward: Key factors in applying sustainability to infrastructure," *J. Urban Regen. Renew.*, vol. 11, no. 1, pp. 8–15, 2017.

[15] M. Velter, "Journeying Towards Sustainable Business Models." Doctoral Thesis, Maastricht University, 2022.

[16] S. Bakhit Al Daraai and A. Madbouly, "Key Success Factors for Sustainable Business Model Innovation: A Theoretical Perspective," *Arab. Key Success Factors Sustain. Bus. Model Innov. A Theor. Perspect. (November 15, 2024)*, 2024.

[17] M. Geissdoerfer, "Sustainable business model innovation: Process, challenges and implementation." 2019.

[18] W. Li, Y. Badr, and F. Biennier, "Digital ecosystems: challenges and prospects," in *proceedings of the international conference on management of Emergent Digital EcoSystems*, 2012, pp. 117–122.

[19] A. Pundziene and A. Gadeikiene, "Digital Ecosystems for Sustainable Society. Current Developments and Future Research Pathways," in *2023 IEEE International Conference on Technology and Entrepreneurship (ICTE)*, IEEE, 2023, pp. 1–7.

[20] W. A. Astuti and Y. Augustine, "The effect of digital technology and agility on company performance with management accounting system as mediation," *Int. J. Res. Appl. Technol.*, vol. 2, no. 1, pp. 11–29, 2022.

[21] C. Rosmala, "Digital Transformation in Management Accounting: Towards Efficiency and Competitive Advantage," *J. Financ. Behav. Account.*, vol. 4, no. 1, pp. 1–8, 2024.

[22] M. Meiryani, S. Adiwijaya, J. Beckham, Y. Sun, A. Juwita, and S. Sabrina, "Digitalization in Accounting Financial & Business Strategy," in *Proceedings of the 2022 13th International Conference on E-business, Management and Economics*, 2022, pp. 177–184.

[23] Y. Sonjaya and S. Prasetianingrum, "Harnessing the Power of Digitalization and Accounting Information Systems for Enhanced Efficiency and Accuracy," *Adv. J. Ekon. Bisnis*, vol. 2, no. 3, pp. 121–135, 2024.

[24] E. Gumbo and M. Moos, "Integrating ecosystems: The synergistic effects of digital innovation hubs on start-up growth," *South. African J. Entrep. Small Bus. Manag.*, vol. 16, no. 1, pp. 1–11, 2024.
[25] M. Romanelli, "Towards sustainable ecosystems," *Syst. Res. Behav. Sci.*, vol. 35, no. 4, pp. 417–426, 2018.
[26] F. Sussan and Z. J. Acs, "The digital entrepreneurial ecosystem," *Small Bus. Econ.*, vol. 49, pp. 55–73, 2017.