

Exploring Digital Twins in Entrepreneurial Strategy di Indonesia: A New Frontier for Startup Experimentation

Afina Hasya¹, Aryoga Wiweko², and Adi Wahyu Anggara³

^{1,2,3} Department of Management, Faculty of Economics and Business, Universitas Diponegoro, Semarang, Indonesia

Correspondence should be addressed to Afina Hasya; afinahasya@lecturer.undip.ac.id

Received: 7 October 2025

Revised: 22 October 2025

Accepted: 29 October 2025

Copyright © 2025 Made Afina Hasya et al. This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT- Incorporating digital technology into entrepreneurial processes is already rapidly transforming how start-ups develop, experiment with, and test their business models. Such a disruptive application utilises digital twins—computerised digital representations of physical systems that enable real-time simulation and predictive experiments. This study examines the potential application of digital twins in strategic planning for Indonesian startups. Utilising a dual approach, this research conducts a digital twin simulation on a conceptual startup model and conducts interviews with four Indonesian entrepreneurs utilising emerging technologies. Our result shows that digital twins enable early-stage startups to conduct scenario-based experimentation, reduce product development risk, and enhance strategic decision-making with less real-world consequences. However, adoption challenges persist in terms of awareness, technical ability, and infrastructural readiness. However, adoption challenges persist in terms of awareness, technical ability, and infrastructural readiness. This research enhances the growing body of literature on digital innovation and experimentation in developing countries by framing digital twins as tools that can benefit both industrial operations and entrepreneurial strategies.

KEYWORDS- Digital Twins, Entrepreneurial Experimentation, Startup Strategy, Risk Reduction, Digital Innovation

I. INTRODUCTION

In the constantly evolving and volatile context of entrepreneurship, particularly in emerging economies like Indonesia, startups face increased pressure to innovate at speed while minimizing failures. Scarce resources make experimentation in the real world risky; however, experimentation is necessary to discover profitable business models. Digital technology has emerged as a leading driver of more innovative and efficient innovation, with digital twins being an intriguing yet unrealized solution in this context. Being virtual copies of real-world systems, digital twins enable entrepreneurs to model, analyze, and streamline business processes in a risk-free setup. This is particularly beneficial for Indonesian startups dealing with market uncertainty and limited resources. By facilitating scenario modeling and predictive analytics, digital twins enable the refinement of strategies ahead of execution, aligning with the broader trend of digital entrepreneurship. They reduce

experimentation risk. Hakim[9] optimizes product and process [26], and support operational challenge management within startup environments[24]. Apart from the challenges—e.g., low digital literacy and infrastructure deficiency[26]—Digital twins can mitigate challenges such as regulatory ambiguity and talent shortages by supporting better decision-making[9]. Lastly, they provide a roadmap to greater agility and competitiveness in Indonesia's digital economy [19].

Initially developed in the aerospace, manufacturing, and engineering fields, digital twins involve creating a digital replica of a physical object, system, or process. The virtual replicas offer real-time simulation, monitoring, and optimization. For business, digital twins can enable entrepreneurs to simulate customer experiences, test product-market fit, iterate on service models, and optimize internal processes before attempting them in reality. Although they have seen wide application in industrial and logistics settings, their use in entrepreneurial strategy development—particularly for startups—is still in its nascent stages. Digital twins enable startups to create virtual environments for modeling and simulating customer interactions, aiming to enhance user experience and satisfaction [16] [25]. Through simulating potential market scenarios, startups can evaluate the feasibility of their products and make informed adjustments based on data to address market needs better[8][17]. Startups can also utilise digital twins to test various service models, streamline processes, and minimise risks associated with service failure in practical implementation [17]. Moreover, digital twins enable the optimisation of internal processes to achieve maximum productivity and efficiency while minimising costs and resource usage [25]. The integration of IoT and AI technologies with digital twins enables real-time data collection and analysis, providing startups with actionable insights for informed strategic decision-making [8] [16]. Various simulation methods, such as computational fluid dynamics and discrete event simulation, support the creation and application of digital twins across a broad spectrum of business settings [25].

Indonesia's dynamic startup culture, driven by a growing population with increasing digital literacy and an expanding wave of innovation hubs, provides a rich ground for the adoption of cutting-edge technologies. However, strategic experimentation at early-stage startups typically happens through guesswork, MVPs, or pilot experiments, all with

tangible costs to them. The application of digital twins introduces a further layer: virtual experimentation. Startups can copy significant aspects of their business—such as supply chain streams, customer behavior, or price policies—and simulate many possible future scenarios with no actual risk incurred. This is particularly useful in volatile markets where responsiveness and adaptability are crucial for survival. Digital twins enable startups to create virtual models of their business processes, allowing them to experiment without the associated costs of real-world tests. [20]. This technology has great promise within sectors like fintech, edutech, and healthtech where digital penetration is high [20]. Through simulation of various scenarios, startups can better cope with market uncertainties and regulatory changes, which are characteristic challenges in Indonesia [9]. Virtual experimentation using digital twin will be able to increase market flexibility—a major driver of success for startups in Indonesia. Lachlan & Smith [15] allows startups to simplify operations and leverage performance, translating to significant user base and revenue growth [20]. It also supports continuous innovation and attracts investment, key areas for sustaining a thriving startup ecosystem [10]. Despite its potential, startups must navigate specific intrinsic challenges, such as cybersecurity attacks and the divide between digital and non-digital populations, to fully leverage digital twin technology [20]. Government policy in this respect plays a pivotal role in establishing an enabling environment for digital innovation and in supporting the overcoming of the structural hurdles [20].

Despite their growing significance, the utilization of digital twins for entrepreneurship remains underexplored, particularly in developing countries like Indonesia. Some of the challenges to adoption include low technological literacy, poor infrastructure, and budget constraints. Nevertheless, the advent of cloud-based, no-code, and low-code platforms introduces new opportunities for startups to integrate digital twins into their strategic practices. The urgency of the study is fueled by high failure rates among startups—often due to ill-conceived assumptions and strategies—highlighting the need for predictive risk-mitigating tools. Digital twins offer real-time simulation and iterative modeling, which can enhance strategic experimentation; however, they are notably absent from the startup practice and research literature. This research is novel in positioning digital twins not merely as operational tools, but as enablers of agile learning and innovation in entrepreneurship. By combining simulation-based analysis with qualitative insights from startup founders, the research fills a theory-practice gap, offering a new agenda for strategic innovation in Indonesian startups.

This study aims to bridge that void by examining the adoption of digital twins in entrepreneurial strategy formulation among Indonesian startups. It is guided by three principal objectives: (1) to establish the potential of digital twins for business design processes; (2) to assess their performance in minimizing product development risks; and (3) to identify the primary adoption challenges from the perspective of technology-based entrepreneurs.

II. LITERATURE REVIEW

A. Digital Twins: Definition and Basic Principles

Digital twins, initially developed for the aerospace and manufacturing industries, have since expanded into various

sectors, including smart cities, healthcare, education, and others. However, business strategy—particularly for startups—is an area that remains underdeveloped. The technologies offer predictive modeling, scenario planning, and virtual experimentation, all of which are critical for startups operating in conditions of high uncertainty. By simulating market processes and consumer behavior, entrepreneurs can test hypotheses, iterate rapidly, and optimize business models without relying on physical resources, thereby informing strategic planning and decision-making. Digital twins enable the predictive analysis of market conditions, reducing risks and informing business decisions [7] [11], and virtual testing of product designs and user experiences, informing innovation without costly testing [2] [5]. Further, through continuous data monitoring, they facilitate the creation of robust and adaptive business models (Ken, 2023). The integration of AI and IoT goes further by enabling real-time data processing for operational efficiency [5] [7], whereas cloud and edge computing technologies go further with scalability and availability, enabling digital twins to be more practical for startups with limited resources [11] [18].

B. Entrepreneurial Strategy and Experimentation

Online experimentation, particularly A/B testing, is now a key entrepreneurial tool, providing a scalable and inexpensive substitute for traditional prototyping by enabling startups to test hypotheses, iterate quickly, and reduce uncertainty around decisions. Although adoption remains restricted, its impact on startup performance is considerable, with one-year growth increments ranging from 30% to 100%, testifying to its capacity for growth and innovation [13]. Apart from performance, digital experimentation inspires organizational learning, as it enables startups to invent new products, refine good ideas, and fail quickly, when necessary, thereby optimizing resource utilization [14]. It further enhances scalability and responsiveness, allowing for high-speed iteration—sustainable in volatile environments—and enables mature companies to achieve faster growth, while allowing younger companies to adapt or remain stable according to insights gathered through data [13]. However, constraints of knowledge and technical expertise hinder broader uptake, especially in early-stage startups [13] [22]. In addition, the success of digital experimentation is often overstated by managerial expertise, suggesting that leadership plays a crucial role in extracting strategic value from these tools [13].

C. 2.3 Digital Entrepreneurship in Emerging Markets

Digital entrepreneurship in Indonesia's emerging economies is increasingly becoming a significant driver of economic growth, supported by government initiatives such as the "100 Smart Cities" and digital economy strategies aimed at promoting startup establishment in various fields, including fintech and agritech [21] [27]. The advent of technologies such as cloud computing, AI, and big data analytics has enabled the development of new business models and enhanced operational efficiency. [1] [12], whereas digital platforms have allows SMEs to access global markets at no cost, leading to the creation of born-global firms [27]. Despite these advancements, Indonesian startups are severely hindered by the lack of technical capabilities and dispersed innovation infrastructure, which inhibits the use of sophisticated technologies such as digital twins [4] [12] [21].

The technical sophistication of digital twins often renders them inaccessible to novice entrepreneurs, particularly in environments with limited resources[21]. However, the development of simple-to-use, modular, and no-code simulation platforms provides a promising approach to reducing entry barriers and making digital twins affordable [4]. Furthermore, promoting interdisciplinary collaboration can facilitate a better understanding and application of digital entrepreneurship, aiding startups in overcoming the challenges of rapid technological shifts. [12]

D. 2.4 Research Gaps and Theoretical Opportunity

Although digital twins have garnered significant interest in operations research and engineering, their application in the field of strategic entrepreneurship remains limited. Most existing research concentrates on operational aspects such as process control and maintenance planning, without examining their application in strategic decision-making and entrepreneurial learning. Empirical data on how digital twins can support strategic pivots, market simulations, or customer journey modeling—particularly in the startup context—are very scarce. This study seeks to close that theoretical gap by expanding the application of digital twins from purely operational functions to strategic experimentation tools. It explains, in particular, how Indonesian startups can utilize digital twins in early ideation, business model experimentation, and product development strategy. By combining simulation-based research with insights from real-world experiences of founders, the research contributes to the literature at the intersection of entrepreneurship and digital innovation.

III. RESEARCH METHOD

This present study uses an exploratory qualitative design to understand, how digital twin technology is shaping the business strategies of Indonesian startups. Since, this topic is still at an early stage and lacks strong theoretical or empirical support, an open and flexible approach was needed to uncover new insights. Through qualitative inquiry, this research captures the experiences, opinions, and real-life practices of startup founders using digital twin applications. This study is organized in two parts. First involves a simulation-based case study that illustrates a model of a startup business using digital twin concepts. And second includes detailed interviews with four startup founders familiar with advanced digital tools. By combining these two parts, the study connects theory with practice, helping to link model-based observations to real-world entrepreneurial situations.

To illustrate the strategic utility of digital twins, a simulation was developed for a realistic yet fictional Indonesian food delivery startup on a no-code platform. The model enabled process mapping, customer behavior analysis, and performance measurement. Simulation components entailed customer acquisition, logistics efficiency, and financial modeling under varying service configurations. Three strategic scenarios—such as price adjustments, delivery partnerships, and promotional incentives—were tested. The simulation served as a proof of concept for how digital twins can facilitate business model experimentation and reduce the need for costly real-world experiments.

Four in-depth, semi-structured interviews with Indonesian startup founders who utilize technologies such as AI, IoT, and cloud analytics were conducted in parallel. Participants

were selected purposively based on their involvement with technology and openness to discuss strategic experimentation. The interviews addressed attitudes toward digital twins, experimentation in current practice, and barriers to adoption. The interviews lasted 45–60 minutes, and participant consent was obtained before the interview. Simulation and interview data were analyzed according to Braun and Clarke's (2006) thematic analysis approach. Overarching themes entailed the perceived value, obstacles, and strategic importance of digital twins. To increase validity, member checking, a coding matrix for cross-method comparison, and reflexive documentation were employed throughout the study process.

IV. RESULTS AND DISCUSSION

A. Overview

This study reveals how digital twins, which have gained increasing recognition in the manufacturing and heavy industry sectors, can be strategically applied in startup development in Indonesia. Findings were achieved through two approaches: (1) digital twin simulations based on startup business scenarios in the service sector, and (2) qualitative interviews with four startup founders who have integrated sophisticated technology into their business strategies.

The discussion is centered on three general themes: (1) applications of digital twins in startup business strategy development, (2) the efficacy of the technology in reducing product and business model development risks, and (3) adoption challenges in the Indonesian digital entrepreneurship ecosystem.

B. Digital Twins as a Platform for Startup Strategy Experimentation

Digital twin simulations in this study enable interactive replication of a startup's key business processes, including supply chains, customer responses, reactions to promotion, and logistics workload distribution. The startup model developed is designed to reflect the real conditions of a food delivery company in Indonesia and can simulate various dynamic scenarios, such as order spikes during peak hours, customer reactions to delivery fee discounts, and delivery productivity based on geographical conditions. Unlike conventional minimum viable product (MVP) approaches that can track only the final outcome, the simulation allows for up-close observation of systemic dynamics, such as how a further 10-minute delay in delivery can contribute to an increase in customer churn over the subsequent three sales cycles.

The simulation results illustrate that digital twins enable far more granular strategic experimentation. Not only does this technology facilitate more effective testing of market assumptions, but it also allows the foundation of iterative decision modeling. According to one informant, the founder of a startup in the digital health space: "Simulation allows us to model the customer journey from the beginning to retention. Typically, we would use assumptions, but now we can visualize the weak spots and bottlenecks." (Founder A, Health Tech). This claim corroborates the finding that digital twins enable startup entrepreneurs to map pain points in the customer journey more accurately—something that would typically be assumed qualitatively or intuitively.

One of the implications of this finding is that digital twins create space for evidence-based entrepreneurship from the

outset of business model design. By enabling the simultaneous observation and testing of multiple strategic variables with reproducibility, this technology provides a scientific foundation for developing value propositions, rather than merely following trends or market speculation. For startups entering new markets like Indonesia, with limited resources and a real possibility of failure, this simulation-based approach is a vital tool for optimizing options before applying strategies in the real world.

C. Risk Reduction Efficiency and Business Model Validation

Digital twins are not only visualization tools, but also effective instruments for mitigating strategic risk. By simulating various stress scenarios—such as a reduction in the delivery fleet, a rise in server load during a significant promotion, or a change in customer behavior—startups can anticipate the financial and operational impact before the risks actually materialize.

This technology provides tremendous flexibility for simulating worst-case scenarios and stress-testing the resilience of business strategies to external and internal disruptions.

A fascinating insight from the simulation was that adding 10 minutes to the delivery time decreased customer satisfaction by 23% and resulted in a 15% loss of repeat orders in a month. These results illustrate how even minor changes in operational variables can have a significant impact on the sustainability of a business model, a phenomenon not typically captured by conventional MVP approaches. The founder of a digital retailing startup confirmed this assertion by noting: "Until now, we have been validating through physical MVPs, which are time-consuming and costly. With simulation, we can determine which strategies are worth following or which to abandon." (Founder C, Smart Retail). These findings reinforce the Lean Startup principle[3] that demands early validation, but take this approach to the next stage with digital simulation before creating a physical MVP. Startups can bridge the idea-execution chasm with digital twins in a less expensive, more agile, and more data-driven way. This places digital twins as not just another technology, but as a new foundation for adaptive and precise strategic decision-making.

Despite its vast benefits, the use of digital twins in entrepreneurial practice is still confronted with structural barriers. Three of the key findings related to these barriers are:

- **Limited Technology Literacy-** Most of the startup founders surveyed were unaware of the term "digital twin," despite having worked with technologies closely related to the notion, such as flow analytics or interactive dashboards. For them, the concept of digital twins is still associated with large-scale manufacturing or innovative city projects, rather than being viewed as a strategic tool in digital business model innovation. The founder of an agritech startup revealed, "The term is not yet familiar in the small startup ecosystem. We only know simulation as something used in games or industrial design." (Founder D, AgriTech). This finding highlights a knowledge and perception gap that can be a primary source of resistance to the adoption of digital twin technology among startups.
- **Limited Access to Infrastructure and Platforms-** End-to-end digital twin development still requires specialized technical expertise and enabling tools, which are not yet

readily available in local or affordable forms. Although no-code platforms are available, guidance on proper use is still necessary.

- **Ecosystem Readiness-** A trial-and-error approach, whereby experiments are attempted without a sound systemic foundation, is currently rampant in the Indonesian startup environment. Nevertheless, the application of digital twins must be underpinned by a shift in mentality toward a more systemic, analytical, and long-term one—a transition that has not been fostered comprehensively by incubators, investors, or local acceleration programs. However, startup founders believe that the adoption of such technology will be much easier if digital twins are modularized into visual modules or packaged as simple-to-use and affordable SaaS solutions.
- **Similarity and Difference-** This study is comparable to previous studies in the emphasis on innovation and risk mitigation for startups. Just like in the Lean Startup approach [3] and web business experiments [23], this study emphasizes the importance of testing a business model and idea as early as possible to reduce the risk of business failure.
- **As per[19],** technology is the core platform for defining and validating business value. The application of simulation data and interviews in strategic decision-making also follows the evidence-based practice. This study diverges from others in that it demonstrates the application of digital twins—commonly used within heavy industry—as a strategic experimentation tool for startups. The context is small and medium-sized Indonesian startups confronting challenges typical of developing countries. They have issues such as low digital literacy and infrastructure. Another unique element is the method applied, which combines digital twin simulation with founder interviews of startups, resulting in data triangulation that grounds pragmatic conclusions.
- **Member Check-** After transcription and thematic analysis were completed, researchers sent a summary of the findings from the interviews to each informant for verification of consistency between the researchers' interpretation and the participants' own accounts. Informants were allowed to verify the salient quotes to be used in the publication and the outcomes of data analysis in terms of themes. As a whole, the responses of the informants were favorable, confirming that the researcher's interpretations accurately represented their experiences, that the quoted expressions were suitable for the interview setting, and that there were no significant requests for deletion or amendment of content. This member check process adds validity and credibility to the research findings and also supports a form of ethical and reflexive responsibility for the informants' contribution.

V. CONCLUSION

This study demonstrates how digital twins provide a fascinating paradigm shift in the strategy formulation process adopted by startups, particularly in high-uncertainty environments such as Indonesia. Through simulation, business leaders can test in effect significant elements of their business model—customer behavior, all the way down to operational logistics—saving costly trial-and-error

experiments in the real world. Additionally, empirical proof from interviews corroborates that digital twins enable more intelligent, more agile, and data-informed decisions. However, wider dissemination across the Indonesian startup ecosystem is constrained due to shortages in digital literacy, access to technology, and conceptual thinking. Closing these gaps via education, simple tools, and facilitating policy frameworks can trigger innovations. Ultimately, the transition of digital twins from industrial to entrepreneurial use is not solely a technology leap but also a strategic leap in digital entrepreneurship.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

- [1] Abdullah, N. H. N., "Digital Entrepreneurship: Opportunities, Barriers, Key Drivers," in *Handbook of Research on Designing Sustainable Strategies to Develop Entrepreneurial Intention*, IGI Global, 2023, pp. 103–123. Available from: <https://tinyurl.com/mry9sc5>
- [2] Aziz, S., Jung, D. W., and Aqeel, A. Bin, "Digital Twins in Smart Manufacturing," in *Handbook of Manufacturing Systems and Design*, Taylor & Francis, 2024. Available from: <https://library.oapen.org/handle/20.500.12657/74697>
- [3] Blank, C. A., "SAGE handbook of mixed methods in social & behavioral research," *Journal of Music Therapy*, vol. 50, no. 4, p. 321, 2013. Available from: <https://tinyurl.com/ys3my253>
- [4] Buckley, A., and Nzembayie, K. F., "Conceptualising Digital Entrepreneurship: Artifacts, Platforms & Infrastructures," *European Conference on Innovation and Entrepreneurship*, vol. 17, no. 1, pp. 101–106, 2022. Available from: <https://tinyurl.com/mtzd8j34>
- [5] Chandaluri, R., and Nelakuditi, U. R., "A Monograph on Components, Design and Applications of Digital Twin," *International Journal of Next-Generation Computing*, vol. 13, no. 3, 2022. Available from: <https://tinyurl.com/5bfhax7d>
- [6] Creswell, J. W., and Creswell, J. D., *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publications, 2017. Available from: <https://tinyurl.com/mr2rxer6>
- [7] Erol, T., Mendi, A. F., and Doğan, D., "Digital transformation revolution with digital twin technology," *Proc. 2020 4th Int. Symp. on Multidisciplinary Studies and Innovative Technologies (ISMSIT)*, pp. 1–7, 2020. Available from: <https://ieeexplore.ieee.org/abstract/document/9254288>
- [8] Galar, D., and Kumar, U., "Digital Twins: Definition, Implementation and Applications," in *Advances in Risk-Informed Technologies: Keynote Volume (ICRESH 2024)*, Springer, 2024, pp. 79–106. Available from: https://link.springer.com/chapter/10.1007/978-981-99-9122-8_7
- [9] Hakim, L., "Tantangan dan Strategi Investasi pada Perusahaan Startup Teknologi di Indonesia," 2024. Available from: <https://tinyurl.com/98cm6u64>
- [10] Iskandar, D., "Technology Startups in Indonesia: Riding the Wave of Innovation and Investment," *Sinergi International Journal of Economics*, vol. 2, no. 2, pp. 61–75, 2024. Available from: <https://doi.org/10.61194/economics.v2i2.163>
- [11] Joshi, R. P., Gulati, S., and Kar, A. K., "Digital Twin for Industrial Applications—A Literature Review," *Int. Working Conf. on Transfer and Diffusion of IT*, pp. 92–103, 2024. Available from: <https://tinyurl.com/3y8r7mt4>
- [12] Judijanto, L., and Arfiansyah, F., "A Bibliometric Study on Digital Entrepreneurship: Mapping the Evolutions and Its Impact on Startups," vol. 2, no. 04, pp. 497–506, 2024.
- [13] Koning, R., Hasan, S., and Chatterji, A., "Digital experimentation and startup performance: Evidence from A/B testing," *SSRN*, 2020. Available from: <https://doi.org/10.1287/mnsc.2021.4209>
- [14] Koning, R., Hasan, S., and Chatterji, A., "Experimentation and start-up performance: Evidence from A/B testing," *Management Science*, vol. 68, no. 9, pp. 6434–6453, 2022. Available from: <https://doi.org/10.1287/mnsc.2021.4209>
- [15] Lachlan, N., and Smith, O., "Determining factors for startup success in Indonesia: Perspective of young entrepreneurs," *Startuppreneur Business Digital (SABDA Journal)*, vol. 3, no. 2, pp. 115–122, 2024. Available from: <https://journal.pandawan.id/sabda/article/view/632>
- [16] Lachvajderová, L., Trebuňa, M., and Kádárová, J., "Unlocking Industry Potential: The Evolution and Impact of Digital Twins," *Acta Mechanica Slovaca*, vol. 28, no. 1, pp. 46–51, 2024. Available from: <https://www.actamechanica.sk/pdfs/ams/2024/01/06.pdf>
- [17] Lee, H., and Yang, H., "Digital twinning and optimization of manufacturing process flows," *Journal of Manufacturing Science and Engineering*, vol. 145, no. 11, 2023. Available from: <https://doi.org/10.1115/1.4063234>
- [18] Mazumder, A., Banerjee, P. S., Karmakar, A., Ghosh, P., De, D., and Song, H., "Digital twin for industry 5.0: A vision, taxonomy, and future directions," *Doctoral Symposium on Human Centered Computing*, pp. 246–259, 2023. Available from: <https://tinyurl.com/msexuaa5>
- [19] Nambisan, S., "Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship," *Entrepreneurship Theory and Practice*, vol. 41, no. 6, pp. 1029–1055, 2017. Available from: <https://doi.org/10.1111/etap.12254>
- [20] Ningsih, R., and Murti, W., "Innovation of Business Models in the Digital Economy: A Case Study of Start-up Companies," *Journal of Comprehensive Science (JCS)*, vol. 3, no. 12, 2024. Available from: <https://tinyurl.com/yp52xe5x>
- [21] Ojala, A., "Digital Entrepreneurship," 2024. Available from: <https://doi.org/10.1016/B978-0-443-13701-3.00035-9>
- [22] Petrakis, P. E., and Konstantakopoulou, D. P., "Entrepreneurial Decisions under Uncertainty," in *Uncertainty in Entrepreneurial Decision Making: The Competitive Advantages of Strategic Creativity*, pp. 95–109, 2015. Available from: https://link.springer.com/chapter/10.1057/9781137460790_7
- [23] Ries, E., *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*, Crown Currency, 2011. Available from: <https://tinyurl.com/p4nu83ar>
- [24] Rozas, I. S., and Er, M., "Internal and External Challenges in Digital Startup Ecosystem: A Systematic Literature Review," *Proc. 2024 2nd Int. Symp. on Information Technology and Digital Innovation (ISITDI)*, pp. 142–148, 2024. Available from: <https://ieeexplore.ieee.org/abstract/document/10796749>
- [25] Sharma, S., and Monga, C., "Introduction to Different Simulation Techniques of Digital Twin Development," in *Simulation Techniques of Digital Twin in Real-Time Applications: Design Modeling and Implementation*, pp. 1–24, 2024. Available from: <https://doi.org/10.1002/9781394257003.ch1>
- [26] Sudirman, N., "Digital Entrepreneurship and Business Innovation: Strategies for Indonesian SMEs in the Era of Industry 4.0," *Journal of Indonesian Scholars for Social Research*, vol. 5, no. 1, pp. 24–34, 2025. Available from: <https://doi.org/10.59065/jissr.v5i1.170>
- [27] Walton, N., "Digital platforms as entrepreneurial ecosystems and drivers of born-global SMEs in emerging economies," in *International Entrepreneurship in Emerging Markets*, Routledge, 2022, pp. 84–106. Available from: <https://tinyurl.com/4hnzjyfd>