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RESEARCH ARTICLE

Mapping the Underlying Factors of Firms' Economic Performance: Antecedents of Digital Transformation and ESG Reporting

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ABSTRACT

Digital transformation represents a purposeful strategy for achieving a competitive edge and stronger economic performance. At the same time, sustainability disclosure practices can also improve economic outcomes, while their effects vary across different contexts. However, a paucity of research base of SMEs obscures how they position themselves in both arenas; this study addresses that gap through an empirical analysis. The study examines whether digital leadership, digital orientation, digital culture, and ESG reporting drive SMEs' economic performance; regarded as antecedents of digital transformation, do these factors improve ESG reporting; whether digital leadership shapes digital orientation and culture; and whether ESG reporting mediates the link between the antecedents of digital transformation and performance. Aligned with these questions**,** the study is grounded in the dynamic capabilities theory, the upper echelon's theory, and stakeholder theory to vindicate the relationships with the research model as the basis. Utilizing data collected from Malaysian SMEs with 360 firm-level observations, the hypotheses are assessed. The findings reveal that digital leadership and ESG reporting are significant determinants of firms' economic performance, while digital orientation and digital culture are not necessary qualifications for performance. ESG reporting partially mediates the relationship between digital orientation, digital culture, and firms' economic performance; however, it does not mediate the relationship between digital leadership and firms' economic performance. Additionally, digital leadership induces digital orientation and digital culture, which in turn drive ESG reporting. This study, thus, features digital leadership and ESG reporting as key transformation drivers, adding to SMEs' economic performance and improving sustainable business practices.

Contribution/Originality: This study is one of the few to examine the antecedents of digital transformation, ESG reporting, and a firm's economic performance in the manufacturing industry in an emerging economy context.

1. Introduction

As digital technologies have diffused across the global economy, and the momentum of digital transformation means no industry remains insulated, delivering clear business success (Nasiri et al., 2022; Chen et al., 2021; Sousa-Zomer et al., 2020). But the very success of global business, especially the industrial sector, while making much-needed contributions to economic development, has mounted its side effects, such that higher output often brings more emissions, waste, and non-transparent supply chains, while information gaps leave the stakeholders guessing (Zhang & Ma, 2021; Mokhtar et al., 2024). Well-designed sustainability reporting offers a basic infrastructure to materialize these impacts, improve comparability, and, under some governance structures, deliver real improvements in environmental and social outcomes (Christensen et al., 2021). In this regard, recent accounting and management studies emphasize that the credibility and quality of ESG reporting depend heavily on the reliability and analytical depth of the underlying data systems (Hussien et al., 2025). Integrating digital knowledge structures enhances the interpretive value of ESG disclosures, transforming them from stationary compliance documents into dynamic, stakeholder-oriented communication tools that bridge the credibility gap and reinforce trust (Seele, 2016). However, the increasing push for digital transformation now raises an important concern: how can digital advancement be directed to achieve both sustainability reinforcement and enhanced economic performance, rather than amplifying existing imbalances? In this study, economic performance refers to the financial payoff resulting from a firm's productive and strategic activities, particularly within digitally transforming environments (Wu et al., 2024; Zhang & Ma, 2021).

In small and medium enterprise (SME) settings across emerging markets, like Malaysia, a related pattern is taking shape around the digitalization of businesses and sustainability disclosure. However, the diffusion of digital transformation in the Malaysian manufacturing industry remains largely unstructured and exploratory (Tay et al., 2021). This limited and uneven adoption signals an important research concern: while digital tools promise operational efficiency and sustainability benefits, many Malaysian manufacturing SMEs lack the coherent strategy and institutional support to translate these technologies into measurable performance outcomes. Recent studies report that building digital capabilities can lift SMEs' sustainability outcomes and resilience, and that ESG reporting tends to work better when firms have the tools and data to support them (Li et al., 2025b; Xu et al., 2022). Nonetheless, effects remain highly context-dependent, shaped by a firm's level of capacity and the maturity of its digital ecosystem.

From a practical perspective, SMEs represent over 90% of the global businesses and account for more than half of global employment (World Bank, 2025; Kannan & Gambetta, 2025). Their footprint on both environmental and economic systems makes the debate a pressing concern (Das et al., 2020; Zhang & Ma, 2021). More narrowly, emerging evidence suggests that digital transformation can be a promoter of sustainability, with stronger improvements where disclosure systems are in place, emphasizing that data, tools, and reporting infrastructure amplify the payoff (Lyu et al., 2025). Given their scale and

collective influence, economic performance among SMEs delivers greater market competitiveness and risk resilience, which underlines its importance for sustainable development (Tolossa et al., 2024; McCann & Yao, 2023). This inspires the ongoing efforts to identify the firm-level antecedents of digital transformation that shape and enhance economic performance. Although countless SMEs operate outside the scope of mandatory ESG reporting, growing attention is being given to the development and adoption of digital and IT-based solutions that can help them capture, manage, and report environmental data more effectively (O'Reilly et al., 2025). Nevertheless, evidence is mixed on whether efficiency improvements can coexist with improvements in sustainability in the context of SMEs, reflecting compatibility and potential trade-offs (Kesidou et al., 2025). By contrast, large enterprises, especially those in the European Union settings subject to the Corporate Sustainability Reporting Directive, are already consolidating disclosure practices (Kosi & Relard, 2024). Given their visibility and the expectations placed on them, they are channeling resources into governance and data systems to meet compliance requirements and integrate digital tools with ESG reporting.

In developed economies, digital transformation, a primary growth engine for SMEs, is associated with higher profitability and stronger economic performance (Clemente-Almendros et al., 2024; Yonghong et al., 2023). Wherein, competitive advantage tends to materialize when digital leadership, a pro-digital culture, and clear digital orientation shift transformation efforts into three supporting channels: leaner operations, sustainability-oriented process innovation, and data-driven planning that aligns with ESG reporting; nevertheless, these payoffs can be made better with cybersecurity and IT-risk management capabilities (Clemente-Almendros et al., 2024; Valaskova et al., 2025; Appiah et al., 2025; Momtaz & Parra, 2025; Zhang et al., 2025; Chotia et al., 2025). Against this backdrop, whether these patterns generalize to SMEs in developing and emerging economies is less clear and highly context-dependent, with recent reviews documenting limited evidence and distinct institutional constraints (Díaz-Arancibia et al., 2024; Das et al., 2020).

Put simply, expected improvements in economic performance from strategic digital transformation often fall short in economies where uneven infrastructure and a lack of digital skills limit what firms can deliver (Brahmana & Kontesa, 2024). In this setting, the antecedents of digital transformation, digital leadership, digital orientation, and digital culture act as firm-level foundations that shape ESG reporting and, in the case of leadership, link directly to economic performance; they also make digital investments observable and measurable for SMEs (Mollah et al., 2024b; Brahmana & Kontesa, 2024). Prior work on strategic approaches highlights several recurrent dimensions: how firms use technology, how they redesign value creation, how they alter structures, and how they manage financial implications, as vital to digital transformation (Nasiri et al., 2022; Escoz Barragan & Becker, 2025; Qiao et al., 2024). Effective transformation extends beyond tools to coordinated shifts in culture and firms' foundational orientation strategy, guided by leadership that digitizes processes and administers data and security risks (Verhoef et al., 2021; Arroyabe et al., 2024).

Within this frame, the digital leadership capability mobilizes resources and orchestrates the initiatives for change empowered by technology, as it can turn digital tools into competitive value by redesigning how the firm operates and competes (Kane et al., 2015; Warner & Wäger, 2019). In this study, we therefore treat digital leadership as the driver that aligns strategy, structure, and investment decisions with digital transformation initiatives, rather than a mere technical skill set confined to the use of digital tools (Kane

et al., 2015; Verhoef et al., 2021). Respectively, changes in value creation led by digital leadership remain a primary driver in digital strategies, as executives reconfigure business models and capabilities to generate new value and measure impact (Warner & Wäger, 2019; Verhoef et al., 2021; Westerman et al., 2014). These shifts are inherently complex and require more than roadmaps or strategy documents to navigate the digital landscape in pursuit of economic and financial growth (Warner & Wäger, 2019). Building on this, a digitally oriented leader drives competitive value by showing day-to-day adaptability to changing conditions and a deliberate expansion of the firm's digitized business activities, because these signals of commitment and openness let technology turn into business value (Khin & Ho, 2019; Kindermann et al., 2021; Saunila et al., 2021).

Such commitment and openness guide the use of technology toward competitive value by enabling new ways of doing business (Khin & Ho, 2019; Saunila et al., 2021). This study views digital orientation through the lens of Kindermann et al. (2021), according to whom digital orientation encompasses four organizational dimensions: scope of digital technology, digital capabilities, digital ecosystem coordination, and digital architecture configuration, all positioning the firm to derive value from digitalization. These dimensions also enhance a broader technological scope that broadens what can be measured; while digital capabilities improve data quality and analysis, ecosystem coordination expands supply chain coverage; and through advanced digital architecture, timely, comparable, and auditable reports can be generated (Rangineni et al., 2023; Fornasiero & Tolio, 2025; Nofel et al., 2024). Put together, digital orientation is a firm's strategic guide to steer where the firm invests and furnishes the data and governance backbone needed for sustainability reporting, helps understanding that these initiatives do not occur in isolation, which supports practical decision-making (Kindermann et al., 2021; Kohli & Melville, 2019; Nambisan et al., 2019).

As a recognized driver of digital transformation, digital culture reflects norms that favor experimentation, evidence-based decision making, and collaboration across functions, turning technology into competitive value by changing everyday work and competitive behavior (Kane et al., 2015; Westerman et al., 2014; Weritz et al., 2020). In this study, digital culture is treated as the organizational climate that allows implementing and ascending of digital initiatives by supporting behavior and routines based on learning, and governance with transformation goals (Verhoef et al., 2021; Warner & Wäger, 2019). To be specific, culture-led shifts in value creation remain a key factor in digital strategy: as cultural expectations evolve, firms reconfigure business models and capabilities to capture new values and accelerate their transformation path (Nambisan et al., 2017; Verhoef et al., 2021). Within such a culture, data systems and analytics brace sustainability reporting by improving how data are collected, integrated, and refreshed, and cross-functional routines convert these progresses into timelier and more comparable ESG disclosures (Münch et al., 2025).

Despite growing interest, evidence on the long-term sustainability value of digital adoption in SMEs remains sparse, leaving leaders with limited decision support for strategy. Accordingly, this study examines four questions: do the three antecedents of digital transformation (digital leadership, orientation, culture) and ESG reporting relate to firms' economic performance? Do digital culture, digital orientation, and digital leadership influence ESG reporting? Does digital leadership shape a firm's digital orientation and digital culture? Does ESG reporting mediate the relationship between the three antecedents of digital transformation (digital leadership, orientation, culture) and economic performance?

1.1. Research Objectives

Guided by these questions, this study sets four objectives.

i. First, it examines whether digital leadership, digital orientation, digital culture, and ESG reporting have a direct impact on firms' economic performance (H1–H4).
ii. Second, it examines whether the three antecedents of digital transformation (digital leadership, digital orientation, and digital culture) improve ESG reporting quality and scope (H5–H7).
iii. Third, it assesses whether digital leadership fosters a digital orientation and culture (H8–H9).
iv. Fourth, it evaluates ESG reporting as a mediator between each firm-level digital factor and economic performance (H10–H12).

The model focuses on the specified digital transformation's antecedents rather than a broad digital transformation basket and treats economic performance as the core outcome. The partial least squares structural equation modeling technique (PLS-SEM) is used to estimate path coefficients, test indirect effects, and identify the links, while SPSS complements this by revealing the descriptive statistics via demographic components analyzed in the study. The paper proceeds as follows: the introduction is followed by a literature review and research hypotheses; Section 3 details research design and methods; Section 4 reports the results of the demographic data and the measurement and structural models assessed using PLS-SEM; Section 5 discusses findings, contribution, and originality of the study, limitations, future research directions, and conclusions.

2. Literature Review

2.1. Digital orientation, digital leadership, digital culture, ESG reporting to economic performance (and digital transformation pathways)

In recent years, the effects of digital transformation and ESG performance on firms' economic performance have garnered significant attention, highlighting how digital advancements can influence sustainable business practices across various industries and geographies. For instance, in view of Chinese firms, digital transformation is not just a technological shift but a foundation for sustainable economic growth, indicating that manufacturers adopting digital tools, particularly labor-intensive and non-state-owned firms, tend to perform better in terms of ESG, suggesting that digitalization helps create a reinforcing cycle where higher profitability supports investments in sustainability (Wang et al., 2023). While research has extensively documented the impact of digital transformation on firms' economic performance, the scholarly focus is still expanding, and the conversation is now integrating the antecedents of digital transformation and how they can help firms improve economically (Nasiri et al., 2022; Weritz et al., 2020; Imran et al., 2025). This can be illustrated across technologically dynamic European contexts, for instance, the notion that digital transformation empowers firms to link profitability with sustainability is consistent with evidence showing that firms with digital orientation, a key determinant of digital transformation, have higher chances to thrive financially, tend to achieve better environmental outcomes and contribute to sustainable development (Nasiri et al., 2022; Nosratabadi et al., 2023).

Owing to these benefits, leaders have a crucial role in improving environmental and competitive performance by inducing digital readiness, showing that digital transformation serves as a bridge between economic and sustainability goals (Bendig et

al., 2023). Digital transformation is not an automatic process; it is, in fact, inherently human-driven, with leadership appearing as a necessary handler, and without leadership intervention, it may also fail to launch. Research reinforces that leadership quality also determines the depth of digital adoption and the extent to which digital transformation generates sustainable value. Such that a leader's characteristics are vital to steer and sustain a firm's journey toward ESG and economic performance (Latham, 2013). For instance, leaders' level of education and knowledge reinforce the positive influence of digital transformation on ESG performance, suggesting that well-educated digital leaders can interpret complex technological and sustainability demands, make informed risk-taking decisions, and align digital initiatives with long-term ESG goals (Sang et al., 2024). This offers a clearer picture, from the standpoint of the upper echelon's theory, the personal characteristics of upper management or senior leaders play an important role in directing a firm toward success.

These characteristics may include, but are not limited to, their cognitive focus and complexity, and deeply ingrained value systems, which alter and develop through professional experience, collectively guide strategic decisions, and influence financial and economic outcomes (Cristofaro et al., 2023; Cho & Hambrick, 2006). Simultaneously, research in contexts like India's high-tech SME sector reveals that the mechanism linking digital transformation to sustainable performance takes a different but complementary form. Firms with digital business capabilities can turn their digital orientation into higher innovation performance, particularly in volatile or dynamic markets, implying that the effectiveness of digital transformation relies on a firm's strategic commitment to digitalization as well as its ability to deploy digital tools flexibly in changing environments, reinforcing an argument that digital readiness and capability to adapt in changing environments together withstand long-term economic growth (Ranjan, 2024). Taken together, these studies suggest a logic that is multilayered, which becomes apparent when viewed through different theoretical perspectives. In the dynamic capabilities perspective, sensing, seizing, and reconfiguring skills of the firm convert resources into outcomes when conditions change (Teece, 2023). Digital business capability is a concrete expression of this reconfiguration logic, translating digital orientation into innovation outputs (Ranjan, 2024).

On the other hand, the stakeholder theory explains why digitalization often corresponds with mature ESG practices; digital tools improve monitoring, information disclosure, and responsiveness to relevant stakeholders, making ESG actions more credible and elastic. However, where stakeholder priorities are politically driven, as in some state-owned enterprises (SOEs), the conversion from digitalization to ESG reporting weakens, consistent with agency and misalignment frictions (Wang et al., 2023). And from the standpoint of the upper echelon's theory, the personal characteristics of leaders play an important role in directing a firm toward success. These characteristics may include, but are not limited to, their cognitive focus and complexity, and deeply ingrained value systems, which alter and develop through professional experience, collectively guide strategic decisions, and influence financial and economic outcomes (Cristofaro et al., 2023; Cho & Hambrick, 2006), most importantly impacting the results while dominating and addressing the concurrent challenges (Firk et al., 2022).

Grounded in three perspectives, this reasoning corresponds to the common understanding of digital transformation as an organizational change that prioritizes sustainable value creation and economic growth through capabilities (Hanelt et al., 2021; Teece, 2023; Talan et al., 2024). Across the literature, digital transformation influences

ESG performance through three repeatable channels. First, pollution prevention: broader digital technology scope and stronger digital capabilities enable better monitoring and process control, reducing emissions and waste (Bendig et al., 2023). Second, product stewardship: although digital devices consume energy and materials, digital orientation supports efficiency tools like smart metering that cut energy use and water loss, improving stewardship at scale (Bendig et al., 2023). Third, sustainable development: cloud infrastructures and analytics improve information flows that feed green R&D and product innovation (Bendig et al., 2023). Payoffs, on the other hand, are conditional. The digital transformation to ESG link is stronger in labor-intensive firms, in more developed regions, and among non-SOEs; it is weaker or insignificant in SOEs, where non-market objectives may dominate (Wang et al., 2023).

Despite the growing recognition of digital transformation's potential, countless businesses, particularly in the sphere of SMEs in emerging economies, continue to fall short in converting it into economic improvements. This suggests that there is a need for a deeper understanding of the construct and its mechanisms to uncover the economic benefits gained through it (Nasiri et al., 2022; Sousa-Zomer et al., 2020). Existing research still lacks clarity on which strategic pathways allow businesses to extract the most value from digital transformation initiatives (Zhang et al., 2025; Singh et al., 2020). This study draws on digital transformation and sustainability literature to explore how firms need to utilize the key antecedents of digital transformation to achieve both sustainability and economic success. The study has identified three major antecedents, digital leadership, digital orientation, and digital culture, as core to effective digital transformation (Nasiri et al., 2022; Weritz et al., 2020). The study seeks to understand how these interrelated factors drive firms' ability to convert digital investments into long-term growth. While prior research has examined these antecedents either in isolation or in different contexts through bilateral relationships, evidence suggests that their synchronized interaction offers a more complete understanding of digital transformation's impact (Warner & Wager, 2019; Nasiri et al., 2022; Weritz et al., 2020; Firican, 2023; Imran et al., 2025). Digital transformation itself can be viewed through multiple lenses, such as the adoption of disruptive technologies or the organizational renewal of structures, processes, and capabilities (Nadkarni & Prugl, 2021). In this study, the focus is on SMEs, recognizing their resource constraints, limited digital infrastructure, and shortage of digital talent, conditions that make navigating the digital era challenging but fundamental for survival and competitiveness.

2.2. Dynamic Capabilities Theory, Upper Echelon Theory, Stakeholder Theory

Grounded in dynamic capabilities theory, this study explains how leaders sense, seize, and reconfigure these resources into capabilities that keep pace with technological and institutional change, which is why leadership is modeled to shape both digital orientation and digital culture and, in turn, a firm's economic performance (Teece, 2023). Consistent with this, recent evidence links digital leadership to stronger competitive outcomes in conjunction with culture and strategy alignment and shows that a clear digital orientation supports value creation and performance under turbulent conditions (Brahmana & Kontesa, 2024; Mollah et al., 2024a). Stakeholder theory clarifies the ESG mechanism in the model: ESG reporting is a disclosure capability that aligns firm behavior with salient stakeholder expectations, reduces information risk, and improves access to resources, thereby supporting economic performance. Contemporary synthesis and meta-analytic work find that higher ESG disclosure or ESG performance is, on average, associated with better accounting and market outcomes, providing a strong rationale for the mediating

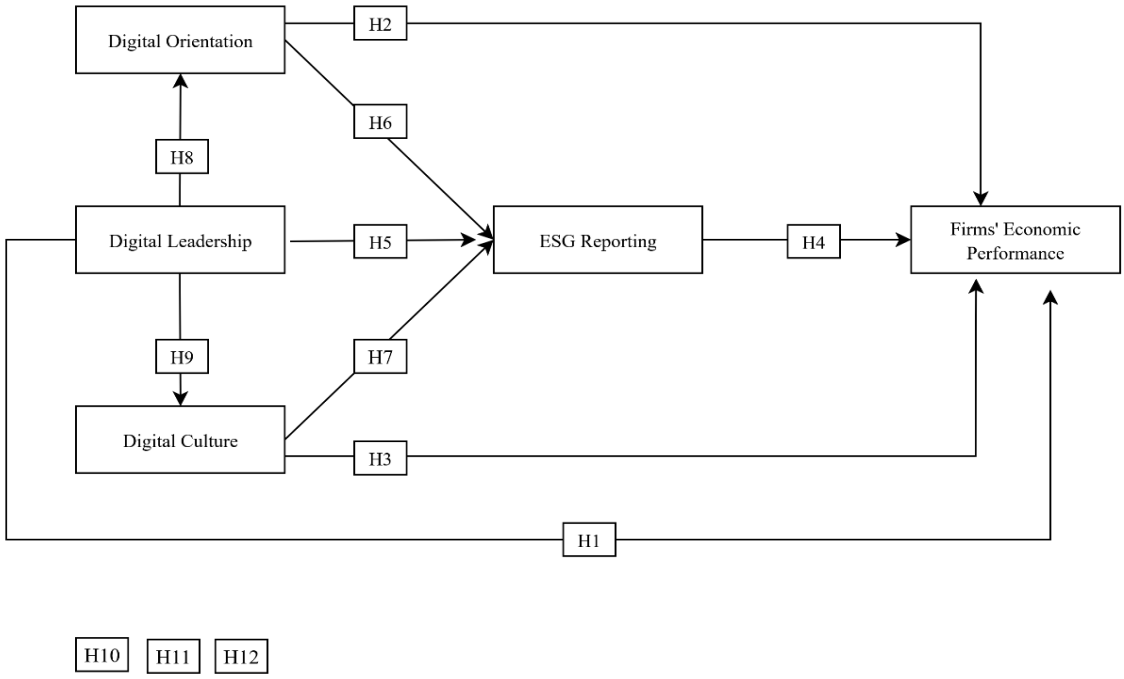
role specified (Wang et al., 2025; Shobhwani, 2024). Digital orientation and culture are also expected to lift ESG reporting quality and breadth because digitalized data governance, analytics, and cross-functional routines lower the cost of producing decision-useful ESG information; recent studies show digital transformation improves firms' ESG performance and that corporate culture is a robust predictor of ESG outcomes (Xie et al., 2024; Bai et al., 2024).

From the standpoint of the upper echelon's theory, the personal characteristics of leaders play a central role in steering a firm toward economic success. These characteristics include their attentional focus, cognitive complexity, and deeply rooted value systems, all shaped through professional experience, which collectively guide strategic decisions and influence financial and economic outcomes (Li et al., 2025a; Cristofaro et al., 2023; Cho & Hambrick, 2006). Leaders with digital expertise are more likely to enhance their environmental awareness and understanding of technology adoption, in part through perceived usefulness; to the extent that their choice reflects how attention is allocated, these competencies likely shape decision priorities, consistent with attention-based accounts (Nakandala et al., 2024). Leaders equipped with digital skills tend to foster a stronger digital culture and orientation, which accelerates digital transformation and sustainable development, thereby improving firms' inclination toward ESG reporting (Cheng et al., 2025). Such leaders can identify external opportunities, take risks associated with digital growth, leverage their understanding of skill allocation to attract investors, increase capital inflows, and enhance investment appeal (Eberl & Drews, 2021; Kane et al., 2017; Kwiotkowska et al., 2021; Sousa & Rocha, 2019; Tagscherer & Carbon, 2023). Consequently, leaders who strengthen ESG reporting standards elevate ethical conduct and social responsibility across the organization, emphasizing meeting stakeholder needs and expectations (Chen et al., 2015).

Under digitally skilled and ESG-conscious leadership, firms are in a better position to adopt proactive sustainability measures, mitigate environmental harm, improve employee well-being, and deliver higher-quality products and services, actions that reinforce stakeholder trust, corporate reputation, and brand equity. However, ESG practices often bring challenges such as high resource requirements, long payback periods, and significant implementation costs, particularly for firms with limited resources (Zhang et al., 2023). In this context, leaders with advanced digital and ESG expertise can use their social networks and human capital to bridge resource gaps and integrate external support. Through their influence, digital leaders reduce information asymmetry, increase the visibility and credibility of firms' ESG strategies in capital markets, and open access to diverse financing channels, thereby lowering external financing costs and constraints (Deng et al., 2024). Furthermore, these leaders possess a keen awareness of shifting regulatory dynamics, enabling their firms to anticipate emerging opportunities and respond effectively to environmental challenges.

Figure 1, a conceptual framework developed by the authors, presents a model that serves as a foundation of this study. It illustrates the hypothesized relationships among the key constructs exhibited in the model. The model incorporates insights from dynamic capabilities theory and the social embeddedness perspective to explain how these constructs interact to contribute to firms' economic performance.

Figure 1: Conceptual Model



Note: H10, H11, and H12 are proposed but not displayed in the research model

Source: Created by Authors

2.3. Research Hypotheses

2.3.1. Digital leadership, digital orientation, digital culture, ESG reporting, and firms' economic performance

Leadership research highlights digital leadership as a key driver for navigating technological change and achieving superior organizational and financial outcomes (Mollah et al., 2023). Grounded in dynamic capabilities theory, which centers on a firm's capacity to integrate, build, and reconfigure resources in response to environmental shifts (Teece, 2023), digital leadership can be seen as a strategic capability that aligns technology adoption with market agility to strengthen firms' economic performance. Digital leaders possess digital fluency, strategic intuition, and the ability to stimulate innovation and workplace collaboration (Abbu et al., 2022). To manage complex internal and external dynamics, they harness these capabilities, which convert digital investments into operational efficiency, value creation, and profit growth. Broadly, digital leadership merges technological competence with strategic management to improve firms' competitive positioning and financial resilience (Rudito & Sinaga, 2017). When organizations transition from traditional systems to digitally integrated structures under capable leadership, they experience cultural transformation and advanced innovation outcomes to facilitate economic performance (Gunawan et al., 2023; Senadjki et al., 2024).

Existing research consistently highlights the role of digital orientation in driving firms' economic growth. In practical terms, digital orientation represents a firm's deliberate use of digital technologies through a structured roadmap that incorporates digital strategies into its business model (Brahmana & Kontesa, 2024). This strategic integration enhances

operational efficiency, reduces costs, and promotes a culture of innovation (Kindermann et al., 2021; Kohtamäki et al., 2020; Lee et al., 2015; Li et al., 2022). Firms that embed digital orientation across their managerial and operational processes are better positioned to capitalize on digital resources and strengthen their competitiveness. From a dynamic capabilities perspective, a firm's technological infrastructure constitutes capabilities that equip firms to sense, seize, and reconfigure opportunities in dynamic environments (Teece, 2023; Warner & Wäger, 2019). Such capabilities transform digital assets into sustained value creation (Matarazzo et al., 2021), allowing digitally oriented firms to achieve superior financial results. Empirical evidence supports this view: You and Brahmana (2024) demonstrate that digital orientation enhances innovation and internationalization by improving firms' operational efficiency and helping them expand through new ventures abroad.

In the digital era, digital culture has become a central pillar in understanding the means through which firms enhance economic performance (Martínez-Caro et al., 2020). It represents a firm's collective mindset and behavioral orientation toward experimentation, data-driven decision-making, and collaboration (Jewapatarakul & Ueasangkomsate, 2024). With the advancement of digital technologies, businesses that have adapted digital culture have both lowered firms' and individuals' financing costs and expanded access to information channels among financial stakeholders, improving transparency and connectivity across the funding network (Cortina Lorente & Schmukler, 2018). The rise of digital culture has lifted many of the traditional barriers faced by the manufacturing industry, fostering new avenues for growth. Externally, it helps reduce information asymmetry, enhances resource allocation, increases access to credit, and drives enterprise value creation. Internally, digital culture enables firms to adapt to evolving markets, refine organizational structures, strengthen management capabilities, and ultimately improve economic performance (Jewapatarakul & Ueasangkomsate, 2024). A strong digital culture facilitates manufacturing firms to expand their customer base and strengthen business-to-business (B2B) interactions (Saunila et al., 2021). By stimulating responsiveness, which is driven by data and innovation that is customer-focused, firms better anticipate and meet evolving market demands. Firms committed to digital culture adapt continuously to market and policy shifts, which in turn allows employees to embrace and engage in technological change, align with innovation goals (Verhoef et al., 2021; Warner & Wäger, 2019). Such engagement and operational efficiency improve business performance and generate positive economic results.

ESG is built upon the foundations of corporate social responsibility (CSR) and socially responsible investment (SRI). However, the influence of the disclosure of ESG-related information on firms' economic performance remains contested in the research community (Chen & Xie, 2022). Stakeholder theory provides the foundation for linking ESG reporting with economic growth by positing that firms accountable to their stakeholders achieve sustainable development (Qureshi et al., 2020; Chen & Xie, 2022). Stakeholders include internal groups like shareholders, managers, and employees, as well as external ones like customers, suppliers, communities, and governments (Parmar et al., 2010). Stakeholder theory pinpoints two essential dimensions of corporate operations, ethical and social, suggesting that during market downturns or external shocks, ethical capital safeguards firms committed to environmental and social responsibility (Olofsson et al., 2021). It further posits that ESG practices increase business value. Extant research also confirms that social responsibility and ESG reporting contribute positively to business development (Abdi et al., 2022; Krueger et al., 2021; Mohammad & Wasiuzzaman, 2021; Wong et al., 2021). While past studies indicate that transparent and

verifiable environmental performance or ESG reporting lowers firms' cost of capital (Eichholtz et al., 2019), reduces financing risk (Atif & Ali, 2021; Banerjee et al., 2020; Feng & Wu, 2023), and stabilizes stock price volatility (Bofinger et al., 2022; Shakil, 2021). On capital market asymmetry, while consumers increasingly favor environmentally responsible products (Austmann & Vigne, 2021), high-quality ESG disclosure strengthens stakeholder confidence via less perceived risks, as it aligns them with risk-averse investment preferences (Frydman & Wang, 2020). Institutional investors, as key stakeholders, prioritize information on policy direction, social responsibility, and public welfare that supports sustainable development. Conversely, firms focused solely on short-term gains and avoid reporting ESG often face investor backlash (Shakil, 2021). Firms that openly report ESG information minimize information asymmetry with stakeholders, which helps them avoid negative media attention and lawsuits and secure greater access to state support (Jackson et al., 2020).
Therefore, we propose the following:

H1: Digital leadership positively influences a firm's economic performance.
H2: Digital orientation positively influences a firm's economic performance.
H3: Digital culture positively influences a firm's economic performance.
H4: ESG Reporting positively influences a firm's economic performance.

2.3.2. Digital leadership, digital orientation, digital culture, and ESG reporting

First, as a driver of technological change, digital leaders make ethical and stakeholder-oriented decisions while leveraging emerging technologies to enhance renewable energy use, reduce emissions, and promote sustainability in innovation (Li et al., 2023; Tian et al., 2025; Zhu et al., 2023). Second, they advance social responsibility by stimulating learning, empowering employees, and anticipating market trends through a transformative and inclusive vision (Chatterjee et al., 2023; Kane et al., 2019). Through digital and social media tools, such leaders improve communication and information sharing with stakeholders, which enhances both social engagement and performance (Borah et al., 2022; Park & Wallace, 2020). Finally, digital leadership strengthens governance by using technology to increase transparency, reduce self-serving behaviors, and ensure accountability through public information disclosure and social media monitoring (Gu & Kurov, 2020; Jia et al., 2020). Guided by the upper echelon's theory, this relationship suggests that leaders' individual characteristics, cognitive orientations, and values shape their approach to ESG governance. Digitally competent and ethically visionary leaders influence how technology is used to align ESG reporting with economic performance (Qiao et al., 2025). Their strategic mindset surrounds transparency and innovation within everyday routines and transforms leadership intent into measurable ESG outcomes and improvement in economic performance (Hambrick & Mason, 1984; Hambrick, 2007).

Nevertheless, digital leadership alone cannot fix the firms' digital sustainability transformation. The firm's broader digital orientation, its collective intent, and strategic inclination toward digital adoption institutionalize these leadership impulses across all functions. Firms led by individuals who understand the scope of digital technologies, possess digital capabilities, and can coordinate digital ecosystems and configure digital architectures are better positioned to harness the value of digitalization (Kindermann et al., 2021). Such leadership enables organizations to capitalize on digital infrastructures and leverage data-driven decision-making systems (Kindermann et al., 2021). Following this style, they can elevate the quality, timeliness, and transparency of ESG reporting (Seele, 2016). Such firms embed sustainability within their digital innovation pipelines,

where environmental and social metrics, as part of their reputation, become integral to performance dashboards rather than marginal disclosures.

Digital culture reflects norms that favor experimentation, evidence-based decision making, and collaboration across functions, turning technology into competitive value by changing everyday work and competitive behavior (Kane et al., 2015; Westerman et al., 2014; Weritz et al., 2020). A day-to-day environment where integrating digital technologies, across all areas of business, fundamentally reshapes operations, value creation, and customer engagement (de bem Machado et al., 2025). Beyond technology adoption, it represents a deep shift in the organization's conduct and processes that emphasizes agility, continuous learning, and innovation. When aligned with ESG objectives, digital culture strengthens sustainability by enabling transparency, accountability, and efficiency through data analytics and automation. In manufacturing, for instance, the day-to-day operations based on digital culture can enhance product innovation and reduce emissions, while in energy and finance, it promotes cleaner operations, better governance, and social inclusion (de bem Machado et al., 2025). Ultimately, digitalization of the processes allows for setting ESG principles into organizational practices, improving performance, competitiveness, and stakeholder trust. Therefore, we propose the following:

H5: Digital leadership positively impacts ESG reporting.
H6: Digital orientation positively impacts ESG reporting.
H7: Digital culture positively impacts ESG reporting.

2.3.3. Digital leadership, digital orientation, and digital culture

The relationship between digital leadership and digital orientation can also be explained through the upper echelon's theory (Hambrick & Mason, 1984), which argues that organizational outcomes reflect the values, cognition, and experiences of top leaders. In the context of digital transformation, this means that leaders with digital literacy, visionary thinking, and openness to innovation shape the firm's orientation toward digital technologies. As Hambrick (2007) noted, leaders' interpretations of their environment influence strategic choices, and in today's environment, those choices increasingly involve how technology is sensed, prioritized, and embedded across business functions. Digital leaders, through their vision and technological insight, guide how firms develop and execute digital strategies that align with the firm's vision and mission (Wang et al., 2022a). Leaders with staunch digital mindsets encourage a culture that values agility, experimentation, and data-driven decision-making (Wasono & Furinto, 2018; Kane et al., 2019). This mindset reinforces digital orientation, which reflects that a firm is proactively inclined toward integrating digital technologies into its business model (Kindermann et al., 2021). Upper echelons theory views digital leadership as a top-down mechanism through which firms develop digital orientation. Leaders influence the scope, scale, and speed of digital initiatives (Bharadwaj et al., 2013), including technological vision to formulating strategy and allocating resources. They also encourage the intelligent use of digital tools across departments to improve efficiency, collaboration, and responsiveness, ultimately translating leadership vision into organizational routines that sustain their course (Martins, 2019; Warner & Wäger, 2019).

The development of a digital culture is inseparable from the presence of digital leaders with strategic foresight and an ability to harness emerging technologies to create new business opportunities and customer value (Shin et al., 2023; Bharadwaj et al., 2013). As

Sacavém et al. (2025) note, effective digital leaders inspire and influence others, allowing for the creation of a digital culture that supports innovation, adaptability, and sustainability in a rapidly evolving environment. Digital culture, in this context, represents how technology shapes communication, collaboration, and decision-making across organizations, transforming how people think and work (Kane et al., 2019). Drawing on the upper echelon's theory (Hambrick & Mason, 1984), digital leadership is viewed as a determinant of organizational culture and behavior, where leaders' digital competencies and mindsets shape how firms adjust to technological change. Leaders, first, set the tone for cultural transformation by embedding digital values, such as agility, openness, and innovation, into organizational routines (Hambrick, 2007; Wasono & Furinto, 2018). In doing so, they align and abridge digital capabilities and culture, nurturing employee creativity and innovation that drive sustainable performance (Kohli & Melville, 2019; Warner & Wäger, 2019). This alignment strengthens the digital culture, enhances competitiveness, and enables long-term organizational sustainability.
Therefore, we propose the following:

H8: Digital leadership positively impacts digital orientation.
H9: Digital leadership positively impacts digital culture.

2.3.4. Mediating Role of ESG Reporting

a) Digital leadership, digital orientation, digital culture, and firms' economic performance

When digital leaders invest in better data systems and transparency processes, ESG performance improves, reinforcing reporting accuracy and corporate accountability (Dhaliwal et al., 2011; Christensen et al., 2019). Higher ESG standards also discourage earnings manipulation and promote ethical financial behavior, helping firms build investor confidence and reduce financing costs (Albuquerque et al., 2019; Wang et al., 2022b; Maiyarni et al., 2024). Through this mechanism, ESG enables digital leadership to turn technological progress into sustainable value creation and economic growth. Contrarywise, when firms engage in emblematic ESG or "greenwashing," these benefits weaken, and reporting credibility is compromised (Arrfelt et al., 2015). Hence, ESG efficiency serves as a bridge to connect digital leadership with economic growth (Arshi et al., 2025).

The relationship between digital orientation and firms' economic performance is also facilitated by ESG reporting. When firms with a digital orientation build data systems, analytics, and integrated processes that make ESG reporting accurate, timely, and credible (Kindermann et al., 2021; Matarazzo et al., 2021). Firms with better ESG practices and reporting then contribute to profitability by reducing risk, attracting responsible investors, and boosting operational efficiency (Friede et al., 2015; Velte, 2022). Extant research also suggests that firms excelling in ESG, especially in environmental innovation, tend to outperform their peers economically (Gull et al., 2022). This process reflects both the dynamic capabilities theory and the stakeholder theory, where digital orientation equips firms to adapt and reconfigure around sustainability opportunities like investor appeal and government subsidies. ESG performance transforms digital capabilities into value and competitive advantage (Teece, 2023; Warner & Wäger, 2019).

In examining the relationship between digital culture and firms' ecnomic performance, ESG reporting is proposed to play a facilitator's role to increase transparency and stakeholder engagement. By providing insights into a firm's environmental policies and

practices, ESG reporting increases trust among investors and consumers, which can lead to increased investment and improved market positioning (Amel-Zadeh & Serafeim, 2018). The information supplied through ESG reporting helps stakeholders assess a company's commitment to sustainability, ultimately influencing their financial decisions (Dhaliwal et al., 2011). This connection is vital, as firms often struggle to interrelate economic outcomes to arise due to the digitalization of the processes, keeping in view their multilayered nature (Eller et al., 2020). Thus, ESG reporting facilitates an understanding of a firm's environmental initiatives and reinforces the link between digital culture and economic performance, enhancing overall organizational performance (Nkgowe et al., 2025).
Therefore, we propose the following:

H10: ESG reporting mediates the relationship between digital leadership and firms' economic performance.
H11: ESG reporting mediates the relationship between digital orientation and firms' economic performance.
H12: ESG reporting mediates the relationship between digital culture and firms' economic performance.

3. Methods

3.1. Research Design

The study followed a positivist paradigm and employed a quantitative research design, using a cross-sectional survey to allow for objective measurement and statistical testing of hypothesized relationships. A quantitative, cross-sectional survey design is appropriate as it facilitates testing hypothesized relationships among variables using standardized measures across a broad sample at a single point in time (Barroga & Matanguihan, 2022). This approach ensured objectivity, statistical generalizability, and efficient data collection while capturing the organizational phenomena (Maier et al., 2023; Saunders et al., 2009). Furthermore, a cross-sectional survey captures diverse perspectives at a single point in time, making it suitable for hypothesis-driven studies in organizational research.

3.2. Research Population and Sample

We retrieved the study's population from the Federation of Malaysian Manufacturers (FMM) directory, which is frequently cited in earlier and contemporary research for its reliability (Yusuff, 2004; Hanaysha & Alzoubi, 2022; Rashid et al., 2025). The target population comprised the total registered Malaysian manufacturing SMEs listed on the FMM website during 2023. The research was conducted across eight Malaysian states to reflect the regional diversity of the country's manufacturing sector in terms of both industry and development. Nonetheless, Selangor, Johor, and Penang, being the industrial hubs, have the highest manufacturing firms with the highest responses in comparison to other states (Yasin et al., 2021). This approach allowed a balanced and generalizable understanding of SMEs' performance and strategic behavior.

That said, the sample size was determined using Yamane's (1973) formula, which provides a statistically reliable method for calculating a suitable sample from a finite population, ensuring a 95% confidence level and 5% precision. In this study, all surveys were self-administered to improve comprehension and minimize non-response bias. As a firm serves as the primary unit of analysis in this research, a survey was forwarded to

managerial-level employees, one representative from each firm, as they play a key role in shaping the firm's strategic behavior and are best positioned to evaluate the strategic factors influencing their firms' economic performance (Van Gils, 2005; Kim & Nguyen, 2024). The study utilized the stratified proportionate sampling method as it allows for an impartial representation of the manufacturing firms across Malaysia's eight selected states, warranting that the sample accurately reflects the geographic, economic, and industrial diversity within the sector. The number of surveys distributed in each state corresponded to the proportion of firms identified in the FMM directory.

As highlighted earlier, a larger proportion of surveys was allocated to Selangor, Johor, and Penang, reflecting their dominant share of manufacturing activity in Malaysia (Yasin et al., 2021). This sampling approach guarantees proportional representation of each state in line with its true population size. By dividing the population into strata according to state boundaries and assigning sample sizes in proportion to the number of firms in each stratum, the approach minimizes regional bias, enhances external validity, and captures variations in firm behavior and performance linked to local development contexts (Teddlie & Yu, 2007; Howell et al., 2020). Within each stratum, simple random sampling was employed to select participating firms. This multi-stage approach ensured that both highly industrialized and developing regions were adequately represented in proportion to the number of existing firms in selected states, improving external validity and minimizing selection bias (Yasin et al., 2021; Teddlie & Yu, 2007; Howell et al., 2020).

3.3. Data Collection

To ensure broad coverage, we collected data through both online and in-person surveys. Google Forms were disseminated electronically, while printed surveys were distributed during in-person visits. Following the exclusion of incomplete hard-copy responses, a total of 360 valid questionnaires were retained for final analysis, denoting a 40.49% response rate. We surveyed managerial-level employees as key informants and applied a stratified sampling technique by sector, size, and state to ensure representativeness. A combination of online and face-to-face surveys, as online surveys offer significant advantages in research due to their speed, low cost, automation, and broad reach, especially when distributed via email or social media (Ball, 2019). They enable respondents to complete questionnaires at their convenience, improving response rates, while automation minimizes data entry errors and reduces researcher bias (Callegaro et al., 2015; Alessi & Martin, 2010). Online. Online surveys also minimize data loss by needing complete responses and automated data collection, improving integrity (Jaeger & Cardello, 2022). The survey process maintained respondent anonymity. Before carrying out the final survey, we conducted a pretest with 15 firms, followed by a pilot test with 40 firms in Perak to evaluate the clarity and feasibility of the questionnaire. We reviewed and integrated any relevant suggestions to enhance the usability of the instrument (Hashim et al., 2022; Wadood et al., 2021).

3.4. Data Analysis

We used variance-based structural equation modeling (SEM) to develop and test the proposed model. A variance-based SEM approach was most appropriate, given the study's predictive orientation and focus on explaining variance in the study's dependent variable, firms' economic performance (Hair Jr et al., 2021). We employed SmartPLS version 4.1.1 for the analysis because Partial Least Squares (PLS) is widely used when the primary goal is theory development rather than confirmation and when constructs are modeled as

latent variables measured through multiple indicators (Hair & Alamer, 2022; Sarstedt et al., 2024). In parallel, to examine the demographic characteristics of the respondents and data quality and validity assessment through common method bias (CMB) and non-response bias, we used the Statistical Package for Social Sciences (SPSS). Meanwhile, the primary analysis began with data screening and preparation to ensure completeness, reliability, and suitability for SEM. Subsequently, we estimated both the measurement model (outer model), which links observed indicators to their corresponding latent constructs, and the structural model (inner model), which defines hypothesized relationships among constructs. Model parameters were computed in three sequential stages following Henseler et al. (2009): first, the iterative estimation of latent variable scores; second, the computation of outer weights, loadings, and path coefficients through multivariate regression; and finally, the estimation of location parameters to complete the model.

All constructs were modeled reflectively, and the PLS algorithm was carried out using a path-weighting scheme with standard settings (300 maximum iterations, stop criterion of 10^{-7}, and initial outer weights of +1). This approach maximized the explained variance (R^2) of the endogenous variables, aligning with the study's aim to assess the determinants of firms' economic performance. For mediation testing, the bootstrapping method (5,000 subsamples) was applied to evaluate the indirect effects, following the guidelines of Hair Jr et al. (2021). In sum, the data analysis employed a systematic, multi-stage PLS-SEM procedure using SmartPLS software to ensure methodological rigor, model robustness, and statistical validity. Before proceeding with the main analysis, we performed several diagnostic tests to ensure the dataset's validity and reliability. To begin with, we assessed CMB to determine whether the observed correlations among variables were due to measurement bias rather than genuine relationships between constructs. We applied Harman's single-factor test, conducting an unrotated exploratory factor analysis (EFA) on all measurement items. The results showed that the first factor explained 43.62% of the total variance, which falls below the 50% threshold, confirming that CMB was not a major concern (Aguirre-Urreta & Hu, 2019). Following this, we assessed non-response bias by comparing early and late respondents following the procedure recommended by Armstrong and Overton (1977). No significant differences were observed across the main constructs, dependent, independent, firm size, and industry, indicating the absence of systematic response bias in the data.

3.5 Measures

The measurement of constructs in this study followed established scales drawn from prior literature, using a five-point Likert scale across all items. We evaluated firms' economic performance through four key indicators commonly applied in organizational performance research. Return on assets (ROA), defined as the ratio of pre-tax profits to total assets, reflects how efficiently firms utilize their resources (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013). Return on investment (ROI) captures the ability to translate total investment outlay into profit (Koller et al., 2010; Jabbour et al., 2020; Ch'ng et al., 2021). Return on equity (ROE) gauges profitability generated from shareholders' equity (Penman, 2021), while net profit margin expresses net income as a proportion of total revenue, indicative of operational profitability (Palepu et al., 2020). We verified the construct's reliability through Cronbach's alpha, which produced a satisfactory coefficient of 0.79, indicating strong internal reliability and coherence among the measurement items.

Next, we measured digital culture using four items adapted from studies on organizational digitalization and innovation culture. The construct captures shared values and practices that embed digital technologies into daily operations and strategic decision-making (Hanelt et al., 2021; Bharadwaj et al., 2013). We derived the items for digital culture from the works of Martínez-Caro et al. (2020), Hadi and Baskaran (2021), Trainor et al. (2014), and Wamba et al. (2017). Cronbach's alpha was 0.814, confirming internal consistency. Following Murphy et al.'s (2015) approach to refine the survey procedure and question clarity, items were slightly adjusted during pretesting to reflect the digital culture context of Malaysian manufacturing SMEs. Next, we measured digital orientation using four items adapted from studies on digital technology orientation and strategic digital posture. Digital Orientation is a firm's proactive stance and direction toward pursuing opportunities enabled by digital technology for performance improvement and gaining a competitive advantage (Kindermann et al., 2021). We drew measurement items for digital orientation from Teng et al. (2022) and Kindermann et al. (2024). Cronbach's alpha was 0.883, confirming internal consistency. Following Murphy et al. (2015), we refined the items during pretesting to fit the operational realities of Malaysian manufacturing SMEs.

Followed by this, we measured digital leadership using four items capturing how top managers communicate digital strategy based on the challenges arising in the face of digital transformation (Weber et al., 2022), support training, and drive technology adoption. The items were based on constructs from Oktaysoy et al. (2023). The original items assess leadership behaviors that facilitate digital transformation through communication, empowerment, and capability building. Cronbach's alpha was 0.831, confirming internal consistency. We slightly revised the items during pretesting to adapt to the leadership structures of Malaysian manufacturing SMEs (Murphy et al., 2015). Finally, ESG reporting was measured using five items adapted from prior research on sustainability disclosure and corporate governance. The construct assesses how firms integrate, resource, and manage ESG information within decision-making and stakeholder communication. Measurement items were drawn from Van Duuren et al. (2016), Amel-Zadeh and Serafeim (2018). Cronbach's alpha was 0.911, confirming internal consistency. We somewhat modified the items during pretesting to fit the ESG disclosure practices prevalent among Malaysian manufacturing SMEs (Murphy et al., 2015).

4. Results

4.1. Demographic Profile of Respondents

The respondent profile, summarized in Table 1, shows that 45% of participants were female and 55% male. Most respondents held mid-level management positions, with 22.8% serving as supervisors, 22.2% as managers, and 17.5% as assistant managers. A smaller share were owners or entrepreneurs (14.7%), while only 2.8% were CEOs.

About one quarter of firms had operated for more than 20 years, followed by 20 percent aged three to five years. Most firms were small enterprises (38.3%) or micro (21.1%), while medium and large firms represented 22.2% and 18.3%, respectively. Geographically, the majority were located in Selangor (38.1%), followed by Johor (16.4%), Penang (13.1%), and Perak (9.2%), with smaller proportions across other Malaysian states.

Table 1: Respondents' profile (n = 360)

Firm Characteristics	Category	Number	Percentage (%)
Gender	Female	162	45.0
	Male	198	55.0
Position in the Company	Owner/Entrepreneur	53	14.7
	CEO	10	2.8
	Managing Director	18	5.0
	Manager	80	22.2
	Assistant Manager	63	17.5
	Supervisor	82	22.8
	Other	54	15.0
Firm age	Less than 2 years	34	9.4
	3 - 5 years old	72	20.0
	6 - 10 years old	47	13.1
	11 - 15 years old	56	15.6
	16 - 20 years old	54	15.0
	More than 20 years old	92	25.6
	Other	5	1.4
Firm size	Micro = Less than 5 employees	76	21.1
	Small = 5 - 74 employees	138	38.3
	Medium = 75 - 199 employees	80	22.2
	Large = 200 or above employees	66	18.3
State	Federal Territory Kuala Lumpur	27	7.5
	Selangor	137	38.1
	Perak	33	9.2
	Johor	59	16.4
	Penang	47	13.1
	Kedah	11	3.1
	Negeri Sembilan	12	3.3
	Melaka	13	3.6
	Other States, including Sabah, Sarawak, and Perlis	21	5.8

Note: The Authors' computation, based on empirical data analyzed in SPSS

4.2. Measurement Model Evaluation

Table 2 presents the results of the measurement model's reliability and validity assessment. Cronbach's alpha and composite reliability (CR) were first examined to evaluate internal consistency, with all values surpassing the 0.70 benchmark, confirming satisfactory reliability. Convergent validity was then established, as indicated by average variance extracted (AVE) values exceeding 0.50 (Hair Jr et al., 2021).

To further verify construct distinctiveness, discriminant validity was assessed using both the Fornell–Larcker criterion (Table 3) and HTMT ratios, all below 0.85. Moreover, factor loadings demonstrated that each item loaded higher on its respective construct than on any other, reinforcing the measurement model's validity and robustness.

Table 2: Reliability, Convergent Validity, and Multicollinearity Assessment

Constructs	Items	Cronbach's alpha	CR (rho_a)	CR (rho_c)	AVE	VIF
		0.810	0.813	0.888	0.725	
	DC_1					1.892
	DC_3					1.711
DC	DC_4					1.739
DL		0.851	0.854	0.909	0.770	
	DL_1					1.924
	DL_2					2.556
	DL_3					2.077
DO		0.884	0.886	0.920	0.743	
	DO_1					2.775
	DO_2					2.815
	DO_3					2.113
	DO_4					2.461
ESGR		0.909	0.909	0.936	0.785	
	ESGR_2					2.669
	ESGR_3					2.841
	ESGR_4					2.945
	ESGR_5					2.460
FEP		0.798	0.808	0.881	0.713	
	FEP_2					1.550
	FEP_3					1.921
	FEP_4					1.780

Note: Digital Culture (DC), Digital Orientation (DO), ESG Reporting (ESGR), Firms' Economic Performance (FEP) (Applies to all the subsequent tables)

Table 3: Discriminant Validity

Measures	DC	DL	DO	ESGR	FEP
DC	0.851				
DL	0.764	0.877			
DO	0.818	0.770	0.862		
ESGR	0.574	0.465	0.541	0.886	
FEP	0.479	0.455	0.446	0.430	0.844

Note: Diagonal values correspond to the square root of AVE for each construct

4.3. Structural Model and Hypothesis Testing

We assessed the structural model using 5,000 bootstrap samples to test the significance of each path. Table 4 shows that the results support hypotheses H1, H4, H6, H7, H8, H9, H11, and H12. Digital leadership and ESG reporting both improve firms' economic performance, while digital orientation and digital culture reinforce ESG reporting. Digital leadership also enhances digital orientation and digital culture. In contrast, hypotheses H2, H3, H5, and H10 received no support, showing that digital orientation and digital culture have no direct effect on economic performance and that ESG reporting does not mediate the link between digital leadership and economic performance.

4.4. Multicollinearity and Model Fit

All Variance Inflation Factor (VIF) values for the indicators and structural paths remained well below the critical threshold (Table 4), with the highest value recorded at 3.733, confirming the absence of multicollinearity (Hair Jr et al., 2021). We also evaluated model fit using the Standardized Root Mean Square Residual (SRMR), which yielded values of 0.065 for the saturated model and 0.083 for the estimated model. Both fall within the acceptable range of 0.08 to 0.10, indicating that the model demonstrates a satisfactory fit (Shi et al., 2018).

Table 4: Direct and Mediation Effects

	Effects	Path Coefficient	T statistics (|O/STDEV|)	P-value	VIF (Inner Model)	VAF (Indirect Effects)	Sig.
Direct Effects	H1: DL -> FEP	0.189	2.114	0.035	2.839	-	Yes
	H2: DO -> FEP	0.035	0.373	0.709	3.641	-	No
	H3: DC -> FEP	0.179	1.871	0.061	3.733	-	No
	H4: ESGR -> FEP	0.220	2.941	0.003	1.527	-	Yes
	H5: DL -> ESG_R	-0.013	0.177	0.860	2.839	-	No
	H6:DO -> ESGR	0.222	2.353	0.019	3.565	-	Yes
	H7: DC -> ESGR	0.402	4.224	0.000	3.485	-	Yes
	H8: DL -> DO	0.770	26.823	0.000	1.000	-	Yes
	H9: DL -> DC	0.764	27.232	0.000	1.000	-	Yes
Indirect Effects	H10: DL-> ESGR -> FEP	-0.003	0.163	0.870	-	0.65%	NM
	H11: DO -> ESGR -> FEP	0.049	1.869	0.062	-	58.33%	PM
	H12: DC -> ESGR -> FEP	0.089	2.188	0.029	-	33.33%	PM

Note: NM (No Mediation), PM (Partial Mediation)

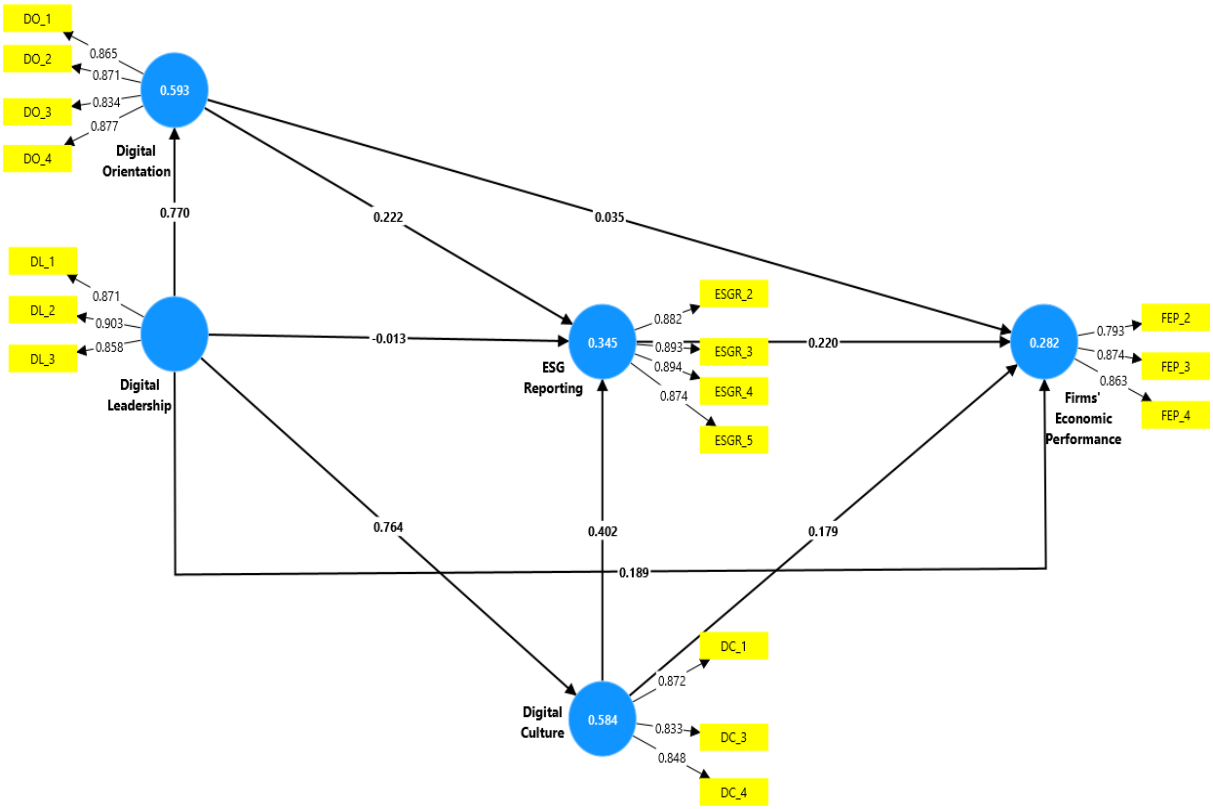
4.5. Predictive Strength and Additional Fit Indices

The results of the structural model evaluation, as highlighted in Figure 2, indicate that digital culture and digital orientation exhibit strong explanatory power, with R^2 values exceeding 0.50, while ESG reporting (0.345) and firms' economic performance (0.282) demonstrate moderate levels of prediction accuracy (Hair Jr et al., 2021). According to Hair Jr et al. (2021), R^2 benchmarks of 0.75, 0.50, and 0.25 typically correspond to high, medium, and low predictive strength, respectively. The model's Q^2 values also surpassed the minimum acceptable limit, further confirming its predictive relevance. Complementary fit statistics, including d_ULS (0.637), d_G (0.353), and Chi-square (χ^2 = 754.868), reflected a close fit between the hypothesized model and observed data (Sathyanarayana & Mohanasundaram, 2024). Additionally, an NFI score of 0.825 supported the model's goodness-of-fit. Collectively, these reliability, validity, and fit indicators uphold the robustness and explanatory capability of the proposed framework.

4.6. Assessment of the Mediation Effects

Following Sarstedt et al. (2024), we applied a nonparametric bootstrapping procedure to examine how ESG reporting mediates the relationships among digital leadership, digital orientation, digital culture, and firms' economic performance (Preacher & Hayes, 2008; Hayes, 2017). Figure 2 offers a detailed visual representation of the test results, path coefficients, and outer loadings. Besides, four items across four constructs, except digital orientation, were excluded due to low factor loading (Hair Jr et al., 2021). Table 4 highlights the results of the twelve hypotheses assessed via the bootstrapping technique, the interpretations of which are discussed in detail in the preceding section, showing different levels of direct and mediating effects across the proposed links.

Figure 2: PLS-SEM Algorithm results



4.7. Summary of the Findings

The results show that six out of nine direct relationships were statistically significant, while three did not demonstrate a significant effect. Regarding mediation, two of the three effects suggest partial mediation. This implies that ESG reporting serves as a partial rather than a full mediator in the relationships between digital orientation and a firm's economic performance and digital culture and a firm's economic performance.

5. Discussion and Conclusions

5.1. Synthesis of the Findings and Theoretical Implications

Digital transformation has emerged as both an opportunity and a challenge for SMEs, particularly in developing contexts like Malaysia, where adoption in the country's

manufacturing industry remains fragmented and exploratory (Tay et al., 2021). While digitalization enables firms to enhance competitiveness, sustainability, and resilience (Nasiri et al., 2022; Li et al., 2025b), businesses classified as small and medium-sized still struggle to manifest these efforts into measurable results due to a lack of supporting infrastructure, literacy, digital skills, and institutional support (Brahmana & Kontesa, 2024). The findings of this study provide empirical evidence that efficiency improvements can indeed coexist with sustainability improvements, meaning that firms can achieve both efficiency and sustainability when digital initiatives are supported by effective ESG reporting through synergy and balance rather than trade-off (Kesidou et al., 2025). In this study, ESG reporting acted as a bridge linking digital culture and orientation with economic gains. It shows that technology-driven efficiency and responsible practices are not conflicting goals but mutually reinforcing once aligned deliberately. This study addressed this lacuna by empirically examining how digital leadership, orientation, and culture interact with ESG reporting to influence firms' economic performance, providing evidence from Malaysian manufacturing SMEs. The findings reaffirm that digital transformation alone is insufficient; economic success depends on a leadership style that aligns digital culture, digital orientation, and ESG practices with strategic goals (Verhoef et al., 2021; Warner & Wäger, 2019). If not aligned, transformation efforts risk becoming fragmented and failing to improve either sustainability or economic performance.

The results of the analysis were conducted using SmartPLS version 4.1.1. lend support to eight out of twelve proposed relationships, reflecting the theoretical grounding in dynamic capabilities theory, the upper echelon's theory, and stakeholder theory. Unlike earlier studies that examined digital transformation, sustainability, innovation, or ESG performance as separate domains (Nasiri et al., 2022; Chen et al., 2021; Sousa-Zomer et al., 2020; Amel-Zadeh & Serafeim, 2018; Dhaliwal et al., 2011), this study integrates the key antecedents of digital transformation, digital leadership, digital orientation, and digital culture, through the lens of dynamic capabilities theory (Verhoef et al., 2021; Warner & Wäger, 2019; Nambisan et al., 2019; Kane et al., 2015; Kindermann et al., 2021). Besides, it also assessed the role of ESG reporting in understanding the antecedents of digital transformation through the upper echelon's theory and the stakeholder theory. Thus, the study extends and contributes to the three widely studied theories in social science research.

First, the results indicate that digital leadership significantly influences firms' economic performance (H1, Path DL→FEP = 0.189, $p < 0.05$). This supports the view that digitally led firms are better placed to build strategic decision-making and digital culture, which collectively enhance firms' economic performance (Gunawan et al., 2023; Senadjki et al., 2024). Second, ESG reporting positively affects economic performance (H4, Path ESGR→FEP = 0.220, $p > 0.05$), highlighting its role in enhancing transparency, accountability, and investor confidence. This finding reinforces stakeholder theory, positioning ESG as a calculated tool to reinforce the firm's credibility and attract sustainable investment (Moats & DeNicola, 2021; Rose, 2020). Third, the study identifies a positive relationship between digital orientation and ESG reporting (H6, Path DO→ESGR = 0.222, $p > 0.05$). Grounded in dynamic capabilities theory, this implies that digitally oriented firms can more effectively reconfigure competencies to address sustainability challenges. Technologies like AI, blockchain, and big data improve ESG reporting by ensuring accuracy and immediate data sharing (Olanrewaju et al., 2024), stimulating firms to proactively align with sustainability goals rather than react to regulatory pressure (Trittin-Ulbrich et al., 2021). Fourth, digital culture significantly influences ESG reporting (H7; Path DC→ESGR = 0.402, $p > 0.05$). This aligns with the evidence that

cultures stressing experimentation, informed decisions, and cross-functional collaboration infuse digital solutions into everyday work environments, allowing for a transparent, accountable, and efficient ESG data practice that enhances disclosure quality (Kane et al., 2015; Westerman et al., 2014; Weritz et al., 2020; de bem Machado et al., 2025).

Digital leadership strongly influences both digital orientation (H8, Path DL→DO = 0.770, p > 0.05) and digital culture (H9, Path DL→DC = 0.764, p > 0.05), reinforcing its foundational role in shaping a firm's digital trajectory. Leaders with digital skills can stimulate digital innovation, develop dynamic capabilities, and drive business model transformation (Mihardjo & Rukmana, 2018; Senadjki et al., 2024). Regarding mediation effects, ESG reporting partially mediates the relationship between digital orientation and firms' economic performance (Table 4, H11, VAF = 58.33%) (Ahmed & Shafiq, 2022; Yang et al., 2024). ESG thus evolves from a compliance obligation to a value-adding strategic resource. Likewise, ESG reporting partially mediates the effect of digital culture on economic performance (Table 4, H12, VAF = 33.33%). This partial mediation indicates that while digital culture has its own direct influence on firms' economic success, a substantial part of its impact operates indirectly through ESG reporting, which indicates that firms with stronger digital cultures achieve higher financial outcomes when they effectively render their digital values into credible, transparent, and stakeholder-oriented ESG practices (Akhtar et al., 2025).

5.2. Practical implications

The study provides important insights for policymakers, practitioners, and institutional facilitators, particularly in the context of digital transformation and sustainability in manufacturing SMEs. The findings highlight that digital leadership directly influences firms' economic performance and shapes both digital orientation and digital culture, signifying its foundational role. The study confirms ESG reporting as a partial mediator in the firms' economic performance link with digital orientation and digital culture, elevating ESG from merely a compliance function to a capability that can help firms generate value in the long run. From a practical standpoint, digital leadership raises a digitally oriented culture that embeds ESG integration into core business strategies, enhancing firm competitiveness and investment appeal.

Policymakers can draw on these findings to formulate targeted, evidence-based interventions that promote digital transformation and sustainability practices among the Malaysian SMEs. By aligning incentives with policies such as Industry4WRD and Malaysian Digital Economy Blueprint (MyDigital), policy efforts should prioritize digital leadership development programs, capacity-building initiatives, and accessible ESG reporting frameworks for SMEs, keeping in view their size and resource constraints. Financial subsidies, tax incentives, and digital upskilling grants can aid SMEs to overcome persistent resource and talent shortages, allowing them to embrace and operationalize advanced technologies, and compete in a digital and sustainability-oriented economy.

For practitioners, particularly SME managers, the findings highlight the need to cultivate digital leadership that embeds ESG thinking into daily operations. Gradual adoption of emerging technologies like AI for production optimization and blockchain for traceable, transparent supply chains can improve reporting credibility, stakeholder trust, and confidence, and create long-term value for them. Such integration reinforces firms' market position and contributes to Malaysia's broader transition toward a digitally driven

and sustainable industrial ecosystem. Equally important, universities, professional bodies, and focal institutions such as the SME Corp. and the Federation of Malaysian Manufacturers, as leading associations representing Malaysian manufacturing and industrial service enterprises, can act as crucial intermediaries, by offering continuous training, digital literacy programs, and ESG-reporting workshops, these institutions can bridge knowledge gaps between policy and implementation, ensuring that digital and sustainability initiatives reach SMEs of varying scales and technological maturity.

5.3. Limitations and Future Research Directions

Despite these contributions, the study is not without limitations. Firstly, data collection was confined to the manufacturing SMEs listed in the FMM directory, which restricts the scope of analysis. Future research could expand data sources beyond the FMM database to include firms from other sectors such as services, construction, agriculture, mining, and quarrying, allowing for broader comparative insights across industries. Second, the study was cross-sectional in design and assessed the data through SEM; future research could complement these results with longitudinal studies to examine ESG reporting's long-term impact on economic performance. Third, external factors such as regulatory shift, industry volatility, and cultural difference may impact ESG adoption and its economic ramifications, necessitating further probing into the mechanism. The study also opens avenues for exploring the role of emerging technologies, such as generative AI and the Internet of Things (IoT), in enhancing ESG reporting and sustainability outcomes. Examining how these technologies interplay with digital leadership and culture could offer actionable insights for firms aiming to stay ahead in the digital and sustainability race. Future research should explore how emerging technologies, such as AI-driven ESG analytics, interact with digital leadership, also examining cross-sector differences**.** Additionally, integrating other theories like institutional theory and the triple-bottom-line framework could offer a more profound understanding of how government regulations and investor expectations shape ESG strategies in emerging economies. Finally, future research could explore how firms, small and medium-sized, can balance the high costs of digital transformation with ESG-driven financial returns.

6. Conclusion

The study established that digital leadership and ESG reporting positively impact firms' economic performance. It also established that digital orientation and digital culture positively influence ESG reporting. Digital leadership positively influences digital orientation and digital culture. Likewise, the study revealed a partial mediation, observing that the relationship between digital orientation and digital culture with firms' economic performance occurs partly through the mediating effect of ESG reporting. Based on these results, the authors offered theoretical, practical, and policy implications to guide manufacturing SMEs in enhancing their competitive edge and economic performance and driving ESG disclosure activities. By incorporating these strategic recommendations, SMEs can better capitalize on digital initiatives to attain sustainable growth and strategic economic success.

Ethics Approval and Consent to Participate

The study involved human participants and adhered to the ethical standards delineated by the university's research ethics guidelines. Prior to the commencement of the data

collection, ethical approval was formally requested and subsequently granted by Universiti Tunku Abdul Rahman (UTAR) Ethics Review Board (Approval No. U/SERC/110/2023). All participants were informed about the purpose of the study, and informed consent was obtained to warrant voluntary participation and confidentiality throughout the study.

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Conflict of Interest

The authors declare there are no conflicts of interest.

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