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Linking entrepreneurial leadership and digital literacy competence to firm performance through business innovation

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ABSTRACT

This study examines the relationships between entrepreneurial leadership, digital literacy competence, and business performance, with business innovation as a mediating mechanism. Previous research has frequently examined leadership or digital capabilities separately. 157 owners or managers of micro, small, and medium enterprises in West Java, Indonesia were selected through non-probability purposive sampling. A seven-point Likert scale was used to gather the data. Structural equation modelling–partial least squares was used for analysis. The findings demonstrate that business performance and innovation are positively affected by entrepreneurial leadership. Digital literacy competence has a beneficial impact on company innovation but has no impact on business performance. Business innovation positively affects business performance and significantly mediates the effects of entrepreneurial leadership and digital literacy competence on business performance. These findings highlight innovation as a key pathway through which leadership and digital capabilities improve performance, underscoring the importance of innovation-oriented leadership development and the strategic deployment of digital capabilities to strengthen the competitiveness of micro, small, and medium enterprises. Theoretically, this study contributes to the development of dynamic capabilities theory by demonstrating how entrepreneurial leadership and digital literacy competence enhance firm performance through innovation as a reconfiguration mechanism. In practice, the findings provide policymakers and micro, small, and medium enterprises development programs with insights to focus on strengthening entrepreneurial leadership and innovation-oriented digital capabilities to improve the competitiveness and sustainability of engineering-sector micro, small, and medium enterprises.

1. Introduction

Micro, small, and medium enterprises (MSMEs) play a crucial role in Indonesia's economic framework, significantly contributing to employment generation, the production of goods and services, and equitable distribution of economic growth (Sinha et al., 2024). However, intensifying competition and rapid technological shifts require MSMEs to pursue digital transformation to sustain competitiveness (Pan, 2024). Digital transformation should

be understood as a strategic and organizational renewal process rather than a mere adoption of digital tools, because value creation emerges when digital technologies are embedded into business processes, routines, and strategic decision-making (Vial, 2021). In this increasingly data-driven and platform-based economy, MSMEs also need adequate digital literacy competence to effectively utilize digital platforms, information technology, and data for market expansion and operational efficiency (Kahveci, 2025). Recent international studies further underline that digital transformation and digital capability are more likely to translate into superior performance when firms build internal mechanisms that channel digital initiatives into innovation and renewal, rather than expecting direct effects from technology usage alone (Merín-Rodrigáñez et al., 2024).

This study's theoretical underpinnings are reinforced by dynamic capabilities theory (DCT), which explains how businesses stay competitive in turbulent environments by developing higher-order capabilities to recognize opportunities and threats, take timely strategic action to seize opportunities, and reorganize resources and routines to support ongoing renewal (Ellström et al., 2022). In the digital transformation literature, dynamic capabilities are frequently positioned as the core logic explaining why some firms can convert technological change into competitive advantage while others fail, because transformation requires systematic capability-building and strategic renewal (Warner & Wäger, 2019; Vial, 2021). Recent peer-reviewed research in the MSMEs sector also demonstrates that dynamic skills support important organizational enablers of digital transformation, like digital leadership and digital culture, which aid businesses in executing change more successfully (Held et al., 2025). Moreover, recent research on MSMEs digital transformation aligns digital literacy and organizational flexibility with a capability-building logic consistent with the dynamic capability framework (Kahveci, 2025).

This condition is increasingly relevant for engineering-sector MSMEs in West Java, Indonesia, whose business scope includes technical services, workshop operations, and component fabrication. West Java is one of Indonesia's major industrial and manufacturing areas, where industrial expansion and the spatial concentration of industrial sites have accelerated competitive intensity and raised performance expectations for local suppliers and partners (Advincula et al., 2022; Telukdarie et al., 2023). Evidence on industrial-site development and suitability in West Java also indicates the region's strong industrial orientation, which reinforces the strategic pressure on MSMEs operating as supporting industries (Chumaidiyah et al., 2023). However, many MSME actors still struggle to implement digital transformation-oriented development strategies due to limitations in adaptive and visionary leadership and uneven practical digital skills (Denmamode & Panchoo, 2024; Singh & Anees, 2025).

These limitations have contributed to suboptimal business performance, including stagnant revenue growth, low operational efficiency, unstable profit margins, and limited long-term competitiveness. Many engineering MSMEs still rely on manual production and marketing practices, have limited customer data management, and have not adopted process automation at scale (Toros, 2024). At the same time, industrial customers increasingly demand consistent quality, shorter service time, and competitive pricing, creating a gap between market expectations and MSMEs' ability to respond through reliable operational performance (Maheshkar & Soni, 2021). Recent international manufacturing-MSMEs research also highlights that technology-enabled quality and process upgrading (often associated with industry 4.0 trajectories) becomes critical for meeting high-precision requirements and performance standards, reinforcing the need for engineering MSMEs to continually upgrade their routines and capabilities (Tanane et al., 2025).

Empirical studies indicate that digital literacy competence influences MSMEs' outcomes (Vieru et al., 2015), while entrepreneurial leadership plays a strategic role in

driving innovation that enhances business performance (Al-Refaei et al., 2024). Business innovation serves as an essential mechanism that links leadership capabilities and digital literacy to business outcomes. Benítez et al. (2022) emphasize that product, process, and business model innovation are crucial for transforming technological adoption and managerial competence into competitive advantage. Recent evidence also supports that digital capabilities improve MSMEs' performance through capability-based mechanisms and mediators, suggesting that digital resources become economically meaningful when converted into opportunity exploitation and innovation-oriented routines (Kim & Jin, 2024).

Empirical studies indicate that digital literacy competence is related to MSMEs performance (Patria et al., 2023), while entrepreneurial leadership plays a strategic role in shaping innovation that contributes to performance improvement (Al-Refaei et al., 2024). Building on DCT, the relationship between these antecedents and business performance can be explained through a capability-conversion mechanism in which business innovation functions as the key transmission path. Entrepreneurial leadership strengthens the firm's ability to sense opportunities and threats (e.g., identifying customer and technology shifts), seize them through strategic initiatives (e.g., allocating resources and prioritizing improvement projects), and reconfigure resources and routines processes that are commonly realized as innovation in products, processes, and business models (Warner & Wäger, 2019; Ellström et al., 2022). In parallel, digital literacy competence enables the recognition of opportunities and the effective deployment of digital tools and information. However, performance gains are more likely when these digital resources are translated into innovation outputs that redesign workflows, enhance value propositions, and renew business models, rather than remaining isolated technology use (Vial, 2021; Benítez et al., 2022). Accordingly, innovation serves as the core mechanism that converts leadership capability and digital competence into competitive advantage and superior performance, because product, process, and business model innovations transform technological adoption and managerial competence into tangible business outcomes (Benítez et al., 2022; Patria et al., 2023).

Although research exploring these relationships exists, studies that test this mediated mechanism in engineering-oriented MSMEs remain limited (Vieru et al., 2015; Al-Refaei et al., 2024). West Java is selected because engineering-sector MSMEs there commonly operate as partners of firms located in industrial estates, where rapid shifts in industrial demand, quality and delivery standards, and technology-driven competition strongly shape performance. These characteristics make West Java a theoretically meaningful case for applying DCT, as firms must continuously sense changes, seize opportunities, and reconfigure routine processes, frequently manifested through business innovation, to sustain performance under persistent turbulence (Ellström et al., 2022). Thus, the objectives of this study are to: assess how entrepreneurial leadership affects the business performance of engineering MSMEs; investigate how digital literacy competency affects business performance; and assess how business innovation mediates these relationships. This study is innovative since it focuses on an industry, incorporates a mediated innovation model, and examines digital literacy and entrepreneurial leadership concurrently inside a single analytical framework.

2. Literature Review and Hypothesis Development

2.1. Theoretical Review

2.1.1. Dynamic Capabilities Theory

Dynamic capabilities theory (DCT) explains how companies maintain competitiveness in a dynamic environment by developing higher-level capabilities to continuously update strategies and reconfigure resources. The foundational work of

10.12928/fokus.v16i1.15070

Teece et al. (1997) formally introduced the concept of dynamic capabilities, defining them as the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. This perspective was further refined by Teece (2007), who conceptualized dynamic capabilities through three core managerial activities: Sensing opportunities and threats, seizing opportunities through strategic investments and decisions, and transforming or reconfiguring organizational assets to sustain competitiveness. These seminal contributions establish DCT as a grand theory explaining how firms achieve and maintain competitive advantage under conditions of uncertainty and technological change.

In the literature on digital transformation, DCT highlights that the ability of organizations to establish routines that enable strategic adjustments and changes in working methods, so that technology truly generates value, is more important for the success of digital transformation than simply adopting technology. For example, Ellström et al. (2022) emphasize the need for specific dynamic capabilities for digital transformation, namely routines that help organizations manage the transformation process from a strategic, organizational, and learning perspective, not just the implementation of digital tools (Ellström et al., 2022).

Three dimensions are commonly used to understand DCT operationally: sensing (identifying opportunities or threats), seizing (taking opportunities through strategic decisions and actions), and reconfiguring or transforming (reconfiguring resources, processes, and structures). In the context of MSMEs, recent research shows that to maximize the benefits of digital transformation, MSMEs need sensing–seizing–reconfiguring capabilities to overcome resource constraints and survive market or technology turbulence (Saeedikiya et al., 2024). The enabling role of DCT is also supported by empirical data, which shows that dynamic capabilities can enhance organizational elements crucial for digital transformation (such as digital leadership and digital culture) to make transformation implementation in MSMEs more successful (Held et al., 2025).

2.1.2. Entrepreneurial Leadership

Entrepreneurial leadership plays a crucial role in navigating dynamic business environments, especially among engineering-sector MSMEs undergoing accelerated digitalization. In an era of intense competition and rapid technological advancement, leaders are required to be visionary, innovative, risk-taking, and capable of driving digital and business transformation (Telukdarie et al., 2023; Denmamode & Panchoo, 2024). This condition indicates that stagnated innovation, low digital readiness, and slow business growth among engineering MSMEs in West Java are due not solely to technological limitations but also to the leadership quality of business actors.

The ability to combine entrepreneurial focus with managerial functions through creativity, long-term vision, environmental adaptability, and the guts to make strategic choices is the conceptual definition of entrepreneurial leadership (Al-Refaei et al., 2024). Leaders with entrepreneurial characteristics do not merely manage daily business operations but also build new opportunities and mobilize resources to support sustainable business growth (Esmer & Dayı, 2017). Within the context of digital transformation, entrepreneurial-oriented leaders act as catalysts for change because more responsive to market opportunities, digital technology, and business innovation strategies (Addy et al., 2024). This aligns with empirical evidence in engineering MSMEs where the adoption of digitalization, product

innovation, and business model improvement remains limited (Maheshkar & Soni, 2021; Toros, 2024).

Furthermore, Subramaniam and Shankar (2020) explained that entrepreneurial leadership strengthens organizational learning and encourages innovative strategies that contribute to business performance. This perspective is reinforced Al-Refaei et al. (2024), who attest to the direct impact of entrepreneurial leadership on company performance and innovation. Therefore, entrepreneurial leadership is positioned as a strategic variable in this research model, as it demonstrates theoretical and empirical relevance in addressing challenges related to digital transformation, innovation development, and performance improvement among engineering-sector MSMEs in West Java, Indonesia.

2.1.3. Digital Literacy Competence

Many people believe that one of the main forces behind MSMEs' digital transformation is their proficiency in digital literacy. When digital capability is limited, enterprises often struggle to adopt technology across core functions such as production, marketing, and customer service. Over time, these constraints can reduce operational responsiveness, weaken competitive positioning, and contribute to stagnant business performance (Denmamode & Panchoo, 2024). In practice, this condition often manifests as low utilization of digital platforms, limited integration of digital tools into workflows, and slow adaptation to customer expectations that are increasingly shifting to digital channels.

From a theoretical standpoint, digital literacy competence can be defined as an individual's capacity to comprehend, utilize, assess, and effectively apply digital technologies to facilitate business operations (Reddy et al., 2020). This includes not only basic operational skills but also the ability to assess the suitability of digital tools for specific business needs and to interpret digital information to support managerial decisions. Petruk and Klescheva (2021) broaden this notion by highlighting additional competencies, including digital communication, data management, and information security. Accordingly, digital literacy competence should be understood not merely as a technical skill set, but as a strategic capability that helps MSMEs manage digital risks, improve process reliability, and sustain performance in a dynamic business environment.

Empirically, Kumar et al. (2025) report that MSME actors with higher digital literacy tend to achieve better outcomes in digital marketing, production efficiency, and data-driven decision-making. This is particularly relevant for engineering-sector MSMEs, which increasingly rely on software, automation systems, and digital platforms to support design, production planning, quality control, and coordination with customers or industrial partners. In a similar vein, Rego et al. (2024) argue that stronger digital literacy competence facilitates product innovation, service improvement, and business model development, as digital skills enable faster experimentation, better capture of customer feedback, and more effective refinement of offerings.

These arguments align with those of Caroline et al. (2025), who emphasize that digital literacy competence yields stronger performance benefits when coupled with the ability to generate value-added innovation. In other words, digital literacy becomes more impactful when it is translated into concrete, innovative actions such as improving processes, enhancing product or service features, or developing new ways to deliver value to customers. Therefore, in this study, digital literacy competence is expected to contribute to business performance not only directly but

10.12928/fokus.v16i1.15070

also indirectly through business innovation as a mediating mechanism, thereby reinforcing competitive advantage.

2.1.3. Business Innovation

An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process) (Eurostat, 2018). This definition clarifies two important points that strengthen the theoretical basis of this study: innovation is not limited to products, and it requires implementation rather than intention. Accordingly, innovation in MSMEs can take the form of product upgrades, process redesign, service improvements, marketing changes, or business model renewal, each of which can generate value by improving quality, speed, reliability, or customer experience (Liu, 2024).

A more robust view also recognizes that innovation is multi-dimensional and multi-stage. Innovation is not only an output (e.g., a new process or offering) but also a process that involves opportunity recognition, idea generation, selection, experimentation, and implementation, often shaped by managerial decisions, organizational learning, and internal routines (Crossan & Apaydin, 2010). This framing helps avoid a simplistic interpretation by explaining why some firms "have ideas" but do not convert them into performance benefits: What matters is the organizational capability to move from exploration to implementation repeatedly. In engineering MSMEs, this conversion is particularly important because innovation often occurs through incremental yet high-impact improvements, such as reducing rework, increasing process precision, shortening turnaround time, and improving service reliability, rather than through the launch of entirely new products (Karlsson & Magnusson, 2019; Bilali, 2022).

In technology-intensive markets, innovation is increasingly digitally enabled, shaping outcomes through how firms use digital platforms, data, and digital work tools to redesign workflows and enhance value creation. Benítez et al. (2022) highlight that technology-related capability strengthens innovation when firms can integrate digital resources into product, process, and business model renewal, while Wu et al. (2025) emphasize that digital sensing, analytics, and orchestration can serve as foundational enablers of continuous innovation. Importantly, this perspective broadens innovation beyond product improvement by positioning innovation as the outcome of combining technological resources with managerial capability and organizational routines (Benítez et al., 2022; Wu et al., 2025). This is highly relevant for engineering MSMEs because digital design tools, automation applications, and platform-based customer interaction can reduce development cycles and improve service accuracy, thereby supporting innovation in both operational and market-facing activities (Liu, 2024).

Finally, the mediating role of business innovation becomes theoretically clearer when anchored in DCT, where innovation represents a concrete manifestation of reconfiguring the firm's ability to renew resources, restructure routines, and redesign how value is created and delivered under environmental turbulence (Ellström et al., 2022). In this sense, entrepreneurial leadership and digital literacy competence function as antecedents that strengthen sensing and seizing behaviors, while business innovation serves as the organizational renewal mechanism through which those capabilities are translated into competitive advantage and performance outcomes (Tidd & Bessant, 2020; Ellström et al., 2022).

This reasoning aligns with the view that dynamic capabilities determine a firm's capacity to develop and reconfigure business models and to drive innovation to maintain long-term competitiveness, particularly in contexts where rapid technological advancements require ongoing strategic and operational adaptation (Teece, 2018).

2.1.4. Business Performance

Achieving optimal business performance is a priority for engineering-sector MSMEs as respond to technological advancements, market demands, and industrial competition. Business performance reflects not only financial outcomes but also process effectiveness, customer satisfaction, and the organization's adaptability to rapid digital transformation. Maheshkar and Soni (2021) describe business performance as an organization's success in managing resources to achieve growth, profitability, and competitive advantage.

Kaplan and Norton (1996) emphasize that business performance includes both financial and non-financial indicators, such as revenue growth, service quality, internal process efficiency, and innovation. This perspective is relevant for engineering MSMEs, which require improvements in operational quality, service responsiveness, and digital integration to strengthen market standing and business sustainability.

Empirical research confirms that improved business performance depends not only on operational effectiveness but also on the organization's ability to utilize technology and generate innovation. Toros (2024) found that MSMEs employing digitalization and innovation strategies achieve superior outcomes, particularly in revenue growth, production efficiency, and market expansion. Vijayakumar and Chandrasekar (2022) further assert that business performance in technical sectors is shaped by organizational capacity in managing industrial customer relationships, adaptability, and innovation aligned with market needs. This directional logic is consistent with DCT, which treats performance as an outcome of prior capability deployment: firms first build the ability to sense changes, seize opportunities, and reconfigure routines, and these capability-driven actions subsequently generate performance improvements (Ellström et al., 2022).

In the engineering sector, MSMEs, entrepreneurial leadership, and digital literacy competence influence how decision-makers interpret industrial requirements, allocate resources, and redesign workflows, thereby affecting delivery reliability, efficiency, and customer retention. By contrast, higher performance may increase available resources but does not automatically create entrepreneurial leadership behaviors or strategic digital competence, which are capability constructs developed through learning and deliberate practice. Therefore, it is theoretically more plausible that independent drives dependent in this setting (Ellström et al., 2022; Vijayakumar & Chandrasekar, 2022). Accordingly, within this research framework, business performance is positioned as the outcome variable influenced by entrepreneurial leadership, digital literacy competence, and business innovation as a strengthening mechanism.

2.2. Hypothesis Development

2.2.1. Positive Effect of Entrepreneurial Leadership on Business Performance

This hypothesis is developed based on the competitive realities faced by engineering-sector MSMEs in West Java, where firms operate in a manufacturing-oriented region that intensifies rivalry and heightens customer demands for service

10.12928/fokus.v16i1.15070

quality, speed, and cost efficiency. In such conditions, business performance is strongly influenced by how effectively MSMEs respond to market turbulence, reconfigure routines, and continuously improve operational reliability. Grounded in DCT by Teece et al. (1997) and Teece (2007), Entrepreneurial leadership is a strategic capability that enhances a company's capacity to recognize changes in the market and consumer needs, take advantage of opportunities by making quick strategic decisions, and adjust operational procedures and resource allocations to stay competitive (Ellström et al., 2022). When leaders demonstrate visionary, innovative, risk-taking orientations, and more likely to direct engineering MSMEs to adapt their service processes, mobilize resources efficiently, and pursue strategic improvements aligned with dynamic market expectations (Telukdarie et al., 2023; Denmamode & Panchoo, 2024).

Empirically, entrepreneurial leadership has been shown to improve business growth, profitability, and sustainability through adaptability and opportunity management, which are critical for MSMEs facing technological change and market pressure (Al-Refaei et al., 2024). In addition, leaders who adopt an entrepreneurial approach tend to create differentiation strategies and strengthen organizational learning, thereby enhancing both operational and market performance outcomes (Subramaniam & Shankar, 2020). Therefore, it is anticipated that entrepreneurial leadership will improve business performance in the context of West Javan MSMEs in the engineering sector because it allows companies to maintain operational and strategic efficacy while responding more proactively to customer-driven performance standards and competitive pressures (Subramaniam & Shankar, 2020; Telukdarie et al., 2023; Al-Refaei et al., 2024; Denmamode & Panchoo, 2024). **H_1: Entrepreneurial Leadership Has a Positive Effect on Business Performance.**

2.2.2. Positive Effect of Digital Literacy Competence on Business Performance

This hypothesis is developed in response to the specific challenges faced by engineering-sector MSMEs in West Java, where firms increasingly operate in a technology-intensive environment characterized by customer demands for higher precision, faster service time, and competitive pricing. In such a setting, many MSMEs still rely on manual operational and marketing practices, while lagging in customer data management and business process digitalization, which can hinder efficiency and weaken competitiveness. Digital literacy competence becomes critical because engineering MSMEs must not only adopt digital tools, but also understand how to operate, evaluate, and strategically utilize digital information and systems to improve decision quality and operational effectiveness (Reddy et al., 2020; Petruk & Klescheva, 2021).

Grounded in DCT by Teece et al. (1997) and Teece (2007), digital literacy competence can be interpreted as an enabling capability that strengthens a firm's ability to sense market and technological changes (e.g., identifying customer requirements and industry trends through digital information), seize opportunities (e.g., implementing digital marketing, digital customer management, and technology-enabled services), and reconfigure operational routines (e.g., process digitalization and automation) to achieve performance improvements. This logic is supported by Kumar et al. (2025), who found that MSMEs with stronger digital literacy are better able to increase revenue through digital marketing, process automation, and customer-driven decision-making using customer data. In addition, Toros (2024) suggests that digital competence enhances an organization's adaptability to technology-driven industrial trends, thereby contributing to superior performance

outcomes. Therefore, within engineering-sector MSMEs in West Java, higher digital literacy competence among owners or managers is expected to translate into improved business performance because it enables efficiency gains, broader market access, and stronger responsiveness to digitally driven competition (Reddy et al., 2020; Petruk & Klescheva, 2021; Patria et al., 2023; Toros, 2024). **H_2: Digital Literacy Competence Has a Positive Effect on Business Performance.**

2.2.3. Positive Effect of Entrepreneurial Leadership on Business Innovation

Engineering-sector MSMEs in West Java face intensifying competition because the region is a major manufacturing hub, heightening market expectations for product or service quality, faster turnaround times, and increasingly complex operational requirements. Under these pressures, innovation is not merely optional. However, it becomes a strategic necessity to close the gap between industrial customers' expectations and MSMEs' internal limitations, particularly when many firms still rely on manual routines and have limited automation and digitalization in their business processes (Maheshkar & Soni, 2021; Advincula et al., 2022; Telukdarie et al., 2023; Toros, 2024). Consistent with DCT by Teece et al. (1997) and Teece (2007), innovation can be viewed as the result of a firm's advanced capability to identify opportunities and threats, capitalize on them through prompt strategic decisions, and realign its resources and operational processes to navigate environmental uncertainty; in MSMEs settings, these adaptive processes are strongly shaped by leadership quality because leaders determine how quickly the organization learns, commits resources, and implements change (Ellström et al., 2022; Held et al., 2025).

Entrepreneurial leadership becomes a key driver of business innovation because entrepreneurial-oriented leaders tend to encourage technological exploration, resource optimization, and disciplined experimentation, behaviors particularly relevant for engineering MSMEs seeking to improve service processes, output quality, and value creation under resource constraints. Such leaders not only manage day-to-day operations but also actively initiate renewal by promoting opportunity recognition and supporting initiatives that translate new ideas into implementable changes (Esmer & Dayı, 2017; Addy et al., 2024). Empirical evidence further supports this mechanism: entrepreneurial leadership has been shown to directly stimulate innovation through product transformation and business model development, reinforcing the argument that stronger entrepreneurial leadership increases the likelihood of sustained innovation as a strategic response to competitive and technological pressures (Al-Refaei et al., 2024). **H_3: Entrepreneurial Leadership Has a Positive Effect on Business Innovation.**

2.2.4. Positive Effect of Digital Literacy Competence on Business Innovation

For MSMEs in the engineering sector in West Java, innovation is increasingly shaped by their capacity to leverage digital technologies to redefine value creation and delivery, particularly as competition becomes more digitally oriented and customers expect superior quality, faster service, and greater operational efficiency. In this setting, digital literacy competence should be understood not only as an operational skill but as a strategic capability that enables MSME actors to identify digital-enabled opportunities, interpret market information, and connect technology use with innovation outcomes in products, services, and business models (Rego et al., 2024). From a DCT perspective (Teece et al., 1997; Teece, 2007), digital literacy supports innovation by strengthening sensing (e.g., recognizing customer needs and

10.12928/fokus.v16i1.15070

industry trends through digital information), seizing (e.g., using platforms and tools to act on opportunities), and reconfiguring (e.g., updating routines and processes through digital integration), which are essential for sustaining innovation under environmental turbulence (Ellström et al., 2022; Kahveci, 2025).

Empirically, digital literacy competence is associated with stronger innovation capacity because digitally capable MSME actors can combine technology with market opportunities to generate value-added innovations rather than merely adopting tools for routine tasks (Rego et al., 2024). This logic is reinforced by evidence that technology-driven innovation accelerates organizational transformation through the integration of engineering software, cloud systems, and digital platform elements, particularly relevant to engineering MSMEs that rely on technical workflows and service delivery precision (Benítez et al., 2022). Accordingly, higher digital literacy competence is expected to increase the likelihood and intensity of business innovation among engineering-sector MSMEs in West Java because it enables firms to translate digital resources into new offerings, improved processes, and more adaptive business models in the digital era (Benítez et al., 2022; Rego et al., 2024). **H_4: Digital Literacy Competence Has a Positive Effect on Business Innovation.**

2.2.5. Positive Effect of Business Innovation on Business Performance

In engineering-sector MSMEs in West Java, business performance is increasingly shaped by the firm's ability to respond to industrial customers' expectations for consistent quality, faster service completion, and competitive pricing requirements that are difficult to meet when firms rely on manual routines and limited process standardization. In this setting, business innovation serves as a vital mechanism for bridging the gap between market demands and internal operational limitations by generating new value through enhanced products, services, processes, and business models. Prior literature emphasizes that innovation supports growth, efficiency, and sustained competitive advantage because it enables firms to enhance productivity, differentiate offerings, and strengthen customer value propositions in dynamic markets (Liu, 2024).

From the perspective of DCT by Teece et al. (1997) and Teece (2007), business innovation reflects the firm's reconfiguring capability, through which organizations renew resources, restructure routines, and redesign value creation mechanisms in order to sustain competitive advantage under changing environmental conditions. Empirical findings further reinforce the performance implications of innovation. Businesses that innovate consistently tend to achieve higher sales, improved customer satisfaction, and stronger long-term sustainability, indicating that innovation contributes directly to both market and operational outcomes (Bilali, 2022). This logic is particularly relevant for engineering MSMEs, where process and service innovations can translate into shorter lead times, higher quality reliability, and better cost control, all of which are closely associated with performance improvement. Moreover, MSMEs that integrate technological innovation have been shown to attain superior operational and financial results compared to more conventional enterprises, suggesting that innovation-driven approaches are better aligned with today's technology-intensive competitive environment (Toros, 2024). Therefore, business innovation can be positioned as a direct determinant of improved business performance among engineering-sector MSMEs in West Java (Bilali, 2022; Toros, 2024). **H_5: Business Innovation Has a Positive Effect on Business Performance.**

2.2.6. The Effect of Entrepreneurial Leadership on Business Performance through Business Innovation

In engineering-sector MSMEs in West Java, entrepreneurial leadership is often insufficient to improve business performance if it remains at the level of day-to-day managerial control and does not translate into concrete organizational renewal. The region's intensified manufacturing competition and rising expectations from industrial customers require MSMEs to continuously adjust service processes, quality standards, and value delivery, making innovation a key pathway for leadership to deliver measurable performance gains. Anchored in DCT by Teece et al. (1997) and Teece (2007), entrepreneurial leadership can be viewed as a capability that enhances a firm's capacity to identify opportunities and threats, capitalize on them through prompt strategic actions, and realign resources and organizational routines accordingly; this reconfiguration is typically manifested in the form of business innovation (Ellström et al., 2022). In MSMEs settings, the enabling role of dynamic capabilities is also evidenced in how capability-building supports transformation outcomes by strengthening organizational conditions that make change executable and value creating (Held et al., 2025). Therefore, under the dynamic capability logic, leadership contributes more strongly to performance when it activates innovation as a reconfiguration mechanism rather than relying solely on direct effects (Subramaniam & Shankar, 2020; Patria et al., 2023).

Empirically and conceptually, entrepreneurial leaders tend to create innovation-supportive environments by encouraging experimentation, learning, and opportunity-driven initiatives that reshape products, processes, and business models, thereby generating new value propositions that can improve business performance (Karlsson & Magnusson, 2019). This argument aligns with evidence that leadership contributes to business outcomes by influencing innovation, indicating that performance improvements are more likely when leadership capabilities translate into implementable innovations rather than remain as strategic intent (Subramaniam & Shankar, 2020). Accordingly, business innovation functions as the key mechanism that translates entrepreneurial leadership into superior business performance, consistent with DCT's emphasis on renewal through sensing, seizing, and reconfiguring as the basis for sustained competitiveness in turbulent environments (Teece et al., 1997; Teece, 2007; Ellström et al., 2022; Held et al., 2025). **H_6: Business Innovation Mediates the Effect of Entrepreneurial Leadership on Business Performance.**

2.2.7. The Effect of Digital Literacy Competence on Business Performance through Business Innovation

For engineering-sector MSMEs in West Java, digital literacy competence does not automatically translate into higher business performance, especially when firms remain dependent on manual routines and have limited integration of digital tools into core operations. In a manufacturing-oriented region with increasingly demanding industrial customers, performance improvements require MSMEs to go beyond basic digital tool usage and instead embed digital resources into new ways of working, delivering services, and managing value creation. Grounded in DCT by Teece et al. (1997) and Teece (2007), digital literacy competence can be positioned as an enabling capability that strengthens the firm's capacity to sense market needs and technological opportunities through digital information, seize opportunities by deploying appropriate digital solutions, and reconfigure routines and processes so that technology use becomes operationally and strategically meaningful (Ellström et

10.12928/fokus.v16i1.15070

al., 2022). Under this grand-theory logic, the pathway from digital literacy to performance is strengthened when digital competence triggers organizational reconfiguration, typically realized through business innovation (Held et al., 2025).

This mechanism is consistent with empirical evidence indicating that technology-driven innovation is the primary channel through which digital resources create competitive advantage and performance gains. Benítez et al. (2022) emphasize that digital technologies contribute to competitiveness when translated into innovation outcomes, such as product, process, or business model innovation, rather than remaining isolated technology adoption. Similarly, research on digitally enabled innovation highlights that capabilities such as digital sensing, analytics, and orchestration shape firms' strategic innovation in turbulent environments (Wu et al., 2025). Importantly, Mancha and Shankaranarayanan (2021) show that the effect of digital literacy on performance is stronger when mediated by innovation, because digital transformation demands implementing tangible innovations that create business value, rather than merely using digital tools. Therefore, business innovation serves as the core mechanism that converts digital literacy competence into improved business performance among engineering-sector MSMEs in West Java, consistent with the dynamic capabilities emphasis on performance gains through sensing, seizing, and reconfiguring capabilities (Teece et al., 1997; Teece, 2007; Ellström et al., 2022; Benítez et al., 2022). **H_7: Business Innovation Mediates the Effect of Digital Literacy Competence on Business Performance.**

2.3. Research Framework

Based on Figure 1, the research framework illustrates the structural relationships among entrepreneurial leadership, digital literacy competence, business innovation, and business performance in engineering-sector MSMEs in West Java, Indonesia. Entrepreneurial leadership and digital literacy competence are positioned as key antecedent variables that directly influence business performance and exert indirect effects through business innovation, which serves as a mediating variable. This model reflects a capability-based perspective in which leadership and digital competence function as strategic enablers that shape how firms identify opportunities, allocate resources, and respond to technological and market changes. Entrepreneurial leadership encourages proactive decision-making, experimentation, and adaptive resource mobilization, thereby directly enhancing operational effectiveness and market responsiveness while fostering innovation in products, processes, and business models. Similarly, digital literacy competence enables MSMEs actors to effectively utilize digital tools, interpret information, and integrate technology into workflows, thereby improving efficiency and decision quality; however, its impact on performance becomes stronger when digital capabilities are translated into concrete innovation outcomes. Business innovation, therefore, serves as the central mechanism that converts leadership capability and digital competence into measurable performance improvements, such as higher efficiency, improved service quality, stronger customer satisfaction, and enhanced competitiveness. Through this integrated structure, the framework explains that superior business performance is achieved not only through the possession of strategic capabilities but through their transformation into innovation-driven organizational renewal.

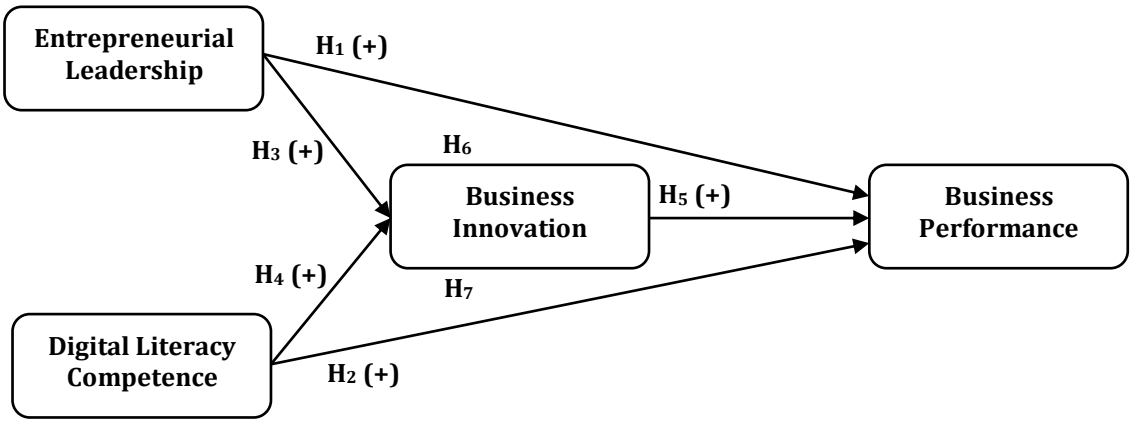

Figure 1. Research Framework

3. Research Methods

3.1. Population and Sampling Method

This study uses a quantitative, survey-based approach to assess the associations among variables. Engineering-sector MSMEs in West Java, Indonesia, are the subject of the study. These businesses provide technical services, operate workshops, and fabricate components. The unit of analysis is MSMEs, and the respondents are owners, managers, or individuals responsible for decision-making with direct knowledge of business operations.

Data from the Department of Industry and Trade of West Java in 2025 show that 258 engineering-sector MSMEs operate as business partners to companies located in industrial estates. From this population, data were collected from 157 respondents. Purposive sampling, a non-probability sampling approach, is used in this study to make sure that participants fit the following requirements: The MSMEs operate in the engineering sector in West Java and are a partner of an industrial-estate company, and the respondent is an owner or manager or key decision-maker who understands business operations and strategic decisions.

3.2. Data Collecting Method

Data was gathered using a closed-ended questionnaire using a Likert scale ranging from 1 to 7. A Likert scale with 1 representing strongly disagree and 7 representing strongly agree was used to measure each item, which was modified for the engineering-sector MSMEs. The operationalization of the constructs used in this study, including their dimensions and measurement indicators, was adapted to the MSMEs context. Entrepreneurial leadership (EL), adapted from Esmer and Faruk (2017), is measured through four dimensions: Innovation, long-term vision, risk-taking, and influence and motivation. The innovation dimension captures the firm's tendency to generate new ideas, apply new technologies or methods, and actively seek innovative solutions to business problems. The long-term vision dimension reflects the ability to anticipate future trends, formulate long-term strategies, and consistently act in alignment with the business vision and mission. The risk-taking dimension assesses willingness to face uncertainty, take calculated risks in pursuing opportunities, and effectively identify, evaluate, and manage business risks. Meanwhile, the influence and motivation dimension measures the leader's ability to inspire team members, create motivating work conditions, and communicate goals clearly and persuasively.

Digital literacy competence (DLC), adapted from Martínez-Bravo et al. (2022),

10.12928/fokus.v16i1.15070

consists of six dimensions: critical, cognitive, social, operational, emotional, and proactive. The critical dimension evaluates the ability to assess the credibility and relevance of digital information before use. The cognitive dimension measures understanding of social and ethical implications, digital security issues, and the effective use of digital technologies to support business activities. The social dimension reflects the capability to collaborate and interact effectively through online or digital platforms. The operational dimension assesses the practical use of digital technologies in work and daily business operations. The emotional dimension captures the ability to manage emotions and maintain well-being when using digital technologies. Finally, the proactive dimension measures the extent to which individuals create and innovate responsibly using digital technologies.

Business innovation (BI), as defined by Pang et al. (2019), is measured through indicators that reflect value creation and strategic renewal. These include the firm's ability to create superior customer value through innovation, to coordinate internal and external resources synergistically to support innovation, to encourage investment in research and development (R&D), and to build barriers that make innovations difficult for competitors to imitate. Business performance (BP), adapted from Kaplan and Norton (1996), is assessed using financial and customer dimensions. The financial dimension measures perceived financial growth over the past few years, while the customer dimension evaluates customer satisfaction with the firm's products or services.

3.3. Data Analysis Method

The structural equation modelling–partial least squares (SEM-PLS) approach, which is suitable for predictive models with latent variables and mediation effects and does not require stringent assumptions about data distribution, was used to analyse the data. Hair (2014) states that SEM-PLS is appropriate for investigations with intermediate sample sizes and predictive aims, which aligns with this. There were two phases to the SEM-PLS analysis. First, convergent validity (loading factor ≥ 0.7; AVE ≥ 0.5) and reliability (Cronbach's alpha ≥ 0.7; composite reliability ≥ 0.7) were assessed for the outer model. The significance of the structural path coefficients (β) obtained in the SEM-PLS inner model serves as the basis for hypothesis testing in this investigation. Following the guidelines for inference testing in SEM-PLS, the significance of the direct and indirect correlations was evaluated using a nonparametric bootstrap approach with 2.000 subsamples, as SEM-PLS does not assume multivariate normality (Hair, 2014; Henseler et al., 2016). The decision rule for hypothesis support is based on two-tailed testing at the 5% significance level: a relationship is considered significant when $p < 0.05$ (equivalently, t-value > 1.96).

In addition to statistical significance, the direction (sign) and magnitude of β are interpreted to evaluate whether the empirical evidence aligns with the theoretical expectations. The mediating role of business innovation is evaluated by testing the bootstrapped indirect effect (e.g., independent → mediation → dependent). When the indirect effect is significant based on bootstrapping ($p < 0.05$), indicating that the predictor affects business performance through business innovation, mediation is validated (Hair, 2014; Henseler et al., 2016). To interpret the type of mediation, the direct effect (independent → dependent) and the indirect effect are examined simultaneously: the mediation is considered partial if both are significant, and full if the indirect effect is substantial while the direct effect becomes non-significant. This approach provides a clear basis for evaluating both direct relationships and mediated mechanisms within the proposed model.

4. Results and Discussion

4.1. Characteristics of Respondent

The respondent data in this study were collected through questionnaires distributed to owners, leaders, and managers of engineering-sector MSMEs in West Java, Indonesia. The characteristics of the respondents provide important contextual information that supports a more comprehensive interpretation of the data and the resulting analysis. The analyzed characteristics include gender, age, education level, and length of work experience. The detailed distribution of respondent characteristics is presented in the following Table 1.

Table 1. Characteristics of Respondent

Classification	Description	Frequency	Percentage
Gender	Male	126	80.3%
	Female	31	19.7%
Age	≤ 40 years	58	36.9%
	≥ 41 years	99	63.1%
Education Level	≤ Associate Degree or Diploma	105	66.9%
	≥ Bachelor's Degree	52	33.1%
Work Experience	≤ 15 Years	82	52.2%
	≥ 16 Years	75	47.8%

According to Table 1, the majority of respondents are male (126 or 80.3%), while 31 are female (19.7%). This indicates that the engineering industry remains predominantly male-dominated. In terms of age, most respondents are over 40, accounting for 63.1%, while only 36.9% are under 40. This suggests that the majority of MSMEs in this sector belong to older age groups and possess substantial work experience. Regarding education level, most respondents have ≤ Associate Degree or Diploma (66.9%), while those with at least a bachelor's degree account for 33.1%. These findings suggest that higher formal education is not yet a primary requirement for running a business in the engineering sector, although technical competence and work experience remain essential factors. Based on work experience, respondents with ≤ 15 years of service represent 52.2%, slightly higher than those with ≥ 16 years of experience at 47.8%. This demonstrates that the respondents possess a relatively balanced range of professional experience. Overall, the respondent profile indicates that the engineering-based MSME sector is dominated by experienced male actors with diverse educational backgrounds, who are primarily concentrated in a productive age group with substantial professional experience.

4.2. Validity Test

To ensure each research variable can reliably measure the intended construct, a validity test was conducted. This study's validity assessment used outer loadings; according to Hair et al. (2021), an indicator is deemed valid if its loading is ≥ 0.7. The following displays the findings of the outer loading test for each research variable and the output of the research model.

Table 2. Validity Test Result

Indicator	Entrepreneurial Leadership	Digital Literacy Competence	Business Innovation	Business Performance
EL1	0.850			
EL2	0.797			
EL3	0.781			

10.12928/fokus.v16i1.15070

Indicator	Entrepreneurial Leadership	Digital Literacy Competence	Business Innovation	Business Performance
EL4	0.792			
EL5	0.790			
EL6	0.823			
EL7	0.803			
EL8	0.802			
EL9	0.770			
EL10	0.782			
EL11	0.796			
EL12	0.799			
DLC1		0.865		
DLC2		0.885		
DLC3		0.866		
DLC4		0.866		
DLC5		0.875		
DLC6		0.856		
DLC7		0.857		
BI1			0.926	
BI2			0.924	
BI3			0.932	
BI4			0.922	
BP1				0.920
BP2				0.911

Based on Table 2, all indicators for the entrepreneurial leadership, digital literacy competence, business innovation, and business performance have outer loadings above 0.70. As a result, every sign in this study is regarded as legitimate and appropriate for use in the analytical stage that follows.

4.3. Reliability Test

To ensure that the constructs in this study exhibit adequate internal consistency, a reliability test was conducted. This assessment utilized indicators including Cronbach's alpha, composite reliability, rho_A, and average variance extracted (AVE). A construct is deemed reliable when the Cronbach's alpha and composite reliability values are greater than 0.7 (Hair et al., 2021). The outcomes of the reliability analysis are displayed in Table 3.

Table 3. Reliability Test Result

Variable	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted
Entrepreneurial Leadership	0.948	0.952	0.955	0.638
Digital Literacy Competence	0.945	0.946	0.955	0.752
Business Innovation	0.945	0.945	0.960	0.858
Business Performance	0.808	0.809	0.912	0.839

Referring to Table 3, all constructs analyzed in this study satisfy the established reliability standards and are therefore appropriate for subsequent analysis. Each variable exhibits Cronbach's alpha and composite reliability values above 0.7, while the AVE values exceed the 0.5 threshold. These findings suggest that the indicators for each

construct have substantial explanatory power in accounting for the variance of their respective latent variables.

4.4. Coefficient of Determination (R^2)

The explanatory capacity of the structural (inner) model was evaluated using the coefficient of determination (R^2). R^2 is a measure of how much of an endogenous construct's variance can be accounted for by its predictors. Higher R^2 values in PLS-SEM indicate that the model is more predictive. Table 4 displays the R^2 and corrected R^2 values for the study's endogenous variables.

Table 4. R Square Results

Endogenous Variable	R Square	R Square Adjusted
Business Innovation	0.318	0.309
Business Performance	0.733	0.728

Table 4 shows that the model accounts for 31.8% of the variation in business innovation through entrepreneurial leadership and digital literacy competency. Additionally, the approach accounts for 73.3% of the variation in business performance through business innovation, digital literacy competency, and entrepreneurial leadership. According to these results, the suggested model has a low explanatory power for business innovation but a significant explanatory power for business performance.

4.5. Hypothesis Test

To determine how each independent variable influences the dependent variable and the mediating variable, both partial and direct hypothesis tests were conducted. The evaluation was carried out using these statistical criteria, which are predicated on the idea that a hypothesis is accepted when the T-value is at least 1.96 and the p-value is less than or equal to 0.05.

Table 5. Hypothesis Test Result

Hypothesis	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
Entrepreneurial Leadership → Business Performance	0.119	0.117	0.060	1.985	0.047
Digital Literacy Competence → Business Performance	0.068	0.061	0.059	1.142	0.253
Entrepreneurial Leadership → Business Innovation	0.270	0.276	0.070	3.862	0.000
Digital Literacy Competence → Business Innovation	0.360	0.360	0.072	4.977	0.000
Business Innovation → Business Performance	0.752	0.759	0.118	6.391	0.000
Entrepreneurial Leadership → Business Innovation → Business Performance	0.203	0.211	0.069	2.950	0.003
Digital Literacy Competence → Business Innovation → Business Performance	0.270	0.275	0.076	3.559	0.000

Table 5 shows that the variable entrepreneurial leadership significantly affects business performance (the first hypothesis is accepted). This suggests that MSMEs in West Java's engineering industry can perform better with more entrepreneurial

10.12928/fokus.v16i1.15070

leadership. On the other hand, business performance is not significantly impacted by the variable digital literacy competence (second hypothesis rejected). The findings in the mediation pathway indicate that entrepreneurial leadership and digital literacy competence both significantly affect business innovation (third and fourth hypotheses are accepted). These results show a substantial correlation between the two factors that drive innovation in MSMEs. Business innovation significantly influences business performance (fifth hypothesis accepted). This suggests that enhancing corporate performance requires business innovation. The purpose of the mediation hypothesis test was to determine whether business innovation mediated the relationship between digital literacy competency and entrepreneurial leadership and business performance (sixth and seventh hypothesis accepted).

4.6. Discussion

4.6.1. The Effect of Entrepreneurial Leadership on Business Performance

The results indicate that entrepreneurial leadership has a positive and significant effect on business performance among engineering-sector MSMEs in West Java, Indonesia. This suggests that when owners or managers demonstrate entrepreneurial leadership behaviors such as long-term vision, calculated risk-taking, creativity, adaptability, and opportunity orientation, engineering MSMEs are more likely to achieve higher performance outcomes (e.g., revenue growth, operational efficiency, and market expansion). This pattern is particularly relevant in West Java's manufacturing ecosystem, where engineering MSMEs must continuously meet industrial customers' expectations for speed, quality, and cost competitiveness while responding to technology-driven competition (Telukdarie et al., 2023; Denmamode & Panchoo, 2024).

This finding can be strengthened through DCT by Teece et al. (1997) and Teece (2007), which explains that superior performance in turbulent environments is achieved when firms develop higher-order capabilities to sense shifts in markets and technology, seize opportunities through timely strategic action, and reconfigure resources and routines to sustain competitiveness (Ellström et al., 2022). In engineering MSMEs, entrepreneurial leaders serve as key micro foundations of these capabilities: interpret external signals (e.g., changing technical specifications, digital procurement practices, or customer service expectations), allocate resources toward improvement priorities, and drive operational adjustments that translate uncertainty into performance gains. Recent international evidence also aligns with this logic: A meta-analysis reports that entrepreneurial leadership is generally effective across levels and outcomes, reinforcing the view that it is associated with stronger organizational results rather than being context-specific or incidental (Lin & Yi, 2025).

Empirically, the present result is consistent with prior work highlighting that entrepreneurial leadership contributes to performance through growth-oriented strategies and proactive opportunity management (Al-Refaei et al., 2024). It also supports the argument that entrepreneurial-oriented leaders build differentiation and learning-oriented approaches that ultimately enhance operational and market performance (Subramaniam & Shankar, 2020). Importantly, international MSMEs research has begun to model entrepreneurial leadership together with dynamic capabilities to explain performance outcomes, suggesting that entrepreneurial leadership is particularly impactful when it helps firms renew competencies and adjust configurations under uncertainty.

In practical terms, field conditions in engineering MSMEs help explain why leadership matters for performance: firms led by entrepreneurial leaders are more likely to pursue rapid adaptation such as using digital design tools, adopting online marketing or business to business platforms, and improving workflow discipline through technology-supported routines thereby improving delivery reliability and customer satisfaction in industrial markets (Telukdarie et al., 2023; Denmamode & Panchoo, 2024). This aligns with DCT's emphasis that performance improvements emerge when leaders convert external change into internal renewal (Ellström et al., 2022). Therefore, entrepreneurial leadership should be interpreted not only as a managerial approach but as a strategic capability that strengthens MSMEs' dynamic adaptation and, consequently, their performance.

Practically, these results imply that performance enhancement programs for engineering-sector MSMEs in West Java should not focus solely on technical upgrading but also on developing leadership competencies that enable sensing–seizing–reconfiguring behaviors. Capacity-building initiatives such as entrepreneurial leadership training, digital leadership development, and industry-based mentoring are recommended to help MSMEs leaders strengthen strategic responsiveness and sustain performance improvement in a highly competitive industrial environment (Telukdarie et al., 2023; Denmamode & Panchoo, 2024).

4.6.2. The Effect of Digital Literacy Competence on Business Performance

The results indicate that digital literacy competence does not have a significant direct effect on business performance among engineering-sector MSMEs in West Java. In other words, having basic digital skills such as accessing information, operating common applications, and using simple digital tools has not yet translated into measurable improvements in revenue growth, operational efficiency, or overall competitiveness. This finding suggests that digital competence in the studied MSMEs may remain functional and fragmented rather than strategically embedded in core business processes. This interpretation is consistent with the argument that digital competence contributes to performance only when it becomes productive and integrated into operational and market routines (Martínez-Caro et al., 2020).

Several mechanisms may explain why the direct relationship is not significant in this context. First, the observed digital literacy competence among engineering MSMEs actors may remain at a basic level (communication apps, social media, and office software) rather than advanced competencies such as data analytics, digital marketing optimization, enterprise resource planning usage, customer data management, and business process automation. In technical and business-to-business-oriented sectors, performance gains typically materialize when digitalization is embedded in process execution and inter-organizational workflows, rather than merely used as supporting tools. This aligns with evidence that digitalization improves performance more strongly when integrated into supply chain processes and external integration routines (Jing & Fan, 2024). International studies also show that digitalization affects performance through operational integration mechanisms (e.g., supply chain external integration as a mediator), reinforcing that process-level embedding is crucial for performance outcomes rather than standalone tool use.

Second, engineering MSMEs often rely heavily on relationship-based selling (personal networks, referrals, and long-term industrial relationships), which can reduce the immediate marginal contribution of digital tools to sales and profitability unless digitalization is redesigned to support the entire value creation logic (e.g.,

10.12928/fokus.v16i1.15070

service workflow control, quality assurance documentation, scheduling, procurement, and customer technical reporting). From a DCT by Teece et al. (1997) and Teece (2007), this is a crucial point: DCT emphasizes that performance improvements in turbulent environments arise not from possessing tools or basic skills, but from higher-order capabilities to sense opportunities or threats, seize opportunities through strategic action, and reconfigure resources and routines so that digital initiatives become value-creating (Ellström et al., 2022). Thus, digital literacy competence may function as an enabling condition. However, its direct impact on performance will remain limited if the firm does not reconfigure routines and processes to operationalize digital transformation. This logic is supported by MSMEs-focused research showing that MSMEs require sensing–seizing–reconfiguring capabilities to fully realize performance benefits from digital transformation (Saeedikiya et al., 2024).

Importantly, the non-significant direct effect does not diminish the strategic importance of digital literacy. Instead, it implies that the influence of digital competence is likely indirect, operating through transformation mechanisms such as innovation, operational renewal, or business model adaptation. This interpretation is consistent with your model results, which show that digital literacy competence significantly predicts business innovation and that the indirect effect on business performance is significant. Such a pattern aligns with international evidence that digital capability often enhances performance through intervening mechanisms (e.g., digital business transformation or capability-based mediators) rather than via a simple direct pathway. It also supports the argument that technology-related competencies create business value primarily when translated into innovation and transformation outcomes (Benítez et al., 2022; Al-Refaei et al., 2024).

Therefore, these findings imply that engineering-sector MSMEs in West Java may need to shift from "basic digital usage" to strategic digital capability development, including digital process integration, data-driven decision-making routines, and structured adoption planning, supported by mentoring and access to resources, to unlock stronger performance impacts (Jing et al., 2023). Viewed through DCT, such initiatives should explicitly aim to strengthen MSMEs' ability to sense relevant market or technology signals, seize opportunities through targeted digital investments, and reconfigure operational routines so digital competence becomes a measurable driver of performance improvement (Ellström et al., 2022).

4.6.3. The Effect of Entrepreneurial Leadership on Business Innovation

The findings show that entrepreneurial leadership has a positive and significant effect on business innovation among engineering-sector MSMEs in West Java. This indicates that when owners or managers demonstrate stronger entrepreneurial leadership characteristics such as opportunity orientation, calculated risk-taking, long-term vision, creativity, and the ability to inspire change, MSMEs are more likely to generate and implement innovations in products, services, processes, and business models. This result is consistent with the argument that entrepreneurial leaders promote experimentation, process flexibility, and readiness for uncertainty, which are essential for innovation under competitive pressure (Benítez et al., 2022).

DCT by Teece et al. (1997) and Teece (2007) provides a more thorough explanation of this relationship. According to DCT, businesses may remain competitive in volatile times by cultivating higher-order skills to recognize opportunities and dangers, take prompt strategic action to capitalize on them, and

reorganize routines and resources to revitalize the company. Innovation becomes a key manifestation of the reconfiguring process, in which firms redesign workflows, offerings, and value-delivery mechanisms to remain relevant. In the digital transformation, dynamic capabilities are reflected in routines that help organizations scan digital opportunities, formulate digital strategies, and restructure processes to enable change. Within engineering MSMEs, entrepreneurial leaders often serve as the micro foundations of these routines by recognizing market or technology shifts, prioritizing innovation initiatives, and mobilizing limited resources to implement improvements.

Empirical evidence from international studies supports the role of entrepreneurial leadership in stimulating innovation through organizational mechanisms. Research shows that entrepreneurial leadership can strengthen innovative outcomes by shaping a supportive innovation climate and enabling employees' innovative behavior, suggesting that leadership affects innovation not only through directives but also by creating conditions that encourage exploration and idea implementation. This aligns with the engineering MSMEs context, where leaders' proactive efforts, such as redesigning products, improving production methods, adopting automation or design software, and expanding digital-based business approaches, can accelerate the implementation of innovation. The finding also resonates with the view that technical-sector organizations are more innovative when decision-makers are entrepreneurially oriented and actively drive renewal (Subramaniam & Shankar, 2020).

Overall, these results imply that innovation among engineering-sector MSMEs is multidimensional, extending beyond product changes to encompass process improvements, service enhancements, and business model adjustments. From a practical standpoint, the findings highlight that strengthening MSMEs innovation requires leadership-focused interventions, such as entrepreneurial leadership development, business coaching, and structured innovation support (e.g., mentoring and technical assistance) to help leaders convert opportunities into implementable innovation outputs (Benítez et al., 2022).

4.6.4. The Effect of Digital Literacy Competence on Business Innovation

The results demonstrate that among West Java MSMEs in the engineering sector, digital literacy proficiency has a favorable and noteworthy impact on company innovation. This suggests that MSME actors with higher levels of digital literacy and technological competence have greater capacity for innovation, especially in creating and implementing innovations across goods, services, procedures, and business models. This result is consistent with the view that digital literacy lays the foundation for innovation, as it enables firms to leverage technology to develop new solutions, refine workflows, and enhance the effectiveness of output (Benítez et al., 2022). It also aligns with the argument that strong digital capability increases organizational responsiveness to technological advancements and digital market opportunities, thereby supporting the emergence and implementation of innovation (Al-Refaei et al., 2024).

DCT by Teece et al. (1997) and Teece (2007) provides a clearer explanation of this link. Innovation is not just a function of technology ownership in dynamic, tech-driven environments; it also involves the firm's ability to recognize digital opportunities and customer needs, take strategic action and investments to seize them, and reorganize processes and resources to transform digital tools into new mechanisms for creating value (Ellström et al., 2022; Kahveci, 2025). In engineering

10.12928/fokus.v16i1.15070

MSMEs, digital literacy competence strengthens these dynamic capability processes by enabling actors to access up-to-date technical knowledge, adopt digital work tools (e.g., design software and automation applications), coordinate supply chain activities more effectively, and experiment with digitally enabled market entry and service delivery. This mechanism is consistent with the international digital transformation literature, which emphasizes that digital technologies drive innovation when embedded in organizational routines and enable new ways of creating and delivering value, rather than when remain isolated tools (Warner & Wäger, 2019; Vial, 2021).

In practice, this finding suggests that engineering MSMEs with stronger digital literacy are better positioned to generate relevant innovations by combining technological resources with market opportunities and translating them into tangible changes, such as faster design iterations, more efficient production or service processes, and digitally enabled business models. This aligns with evidence that technology-enabled innovation accelerates transformation when digital systems (e.g., platforms, cloud-based tools, and specialized software) are used to support experimentation and improvement activities rather than solely basic operational tasks (Benítez et al., 2022). It also supports the argument that stronger digital competence accelerates business adaptation and experimentation, which are essential for sustained innovation in competitive industrial ecosystems (Mancha & Shankaranarayanan, 2021). Therefore, digital literacy competence should be viewed not merely as an operational skill, but as a strategic catalyst that strengthens innovation capability among engineering-sector MSMEs in West Java (Ellström et al., 2022; Al-Refaei et al., 2024).

In terms of implications, the results highlight the importance of targeted interventions that move beyond basic digital skills toward innovation-oriented digital capability building, including mentoring in the use of relevant engineering software, digitalization and automation of processes, data-based decision-making routines, and structured experimentation for new offerings and service improvements. Such initiatives are consistent with DCT because help MSMEs institutionalize sensing–seizing–reconfiguring behaviors, enabling digital literacy to consistently generate innovation outputs that support competitiveness in the digital era (Ellström et al., 2022; Kahveci, 2025).

4.6.5. The Effect of Business Innovation on Business Performance

The results indicate that business innovation has a positive and significant effect on business performance among engineering-sector MSMEs in West Java. This finding suggests that stronger innovation capability, reflected in new or improved products, process upgrades, service enhancements, and business model renewal, contributes to better performance through higher productivity, improved cost efficiency, stronger customer value, and enhanced competitiveness. This result supports the view that innovation is central to sustaining competitive advantage in technology-intensive and fast-changing environments (Benítez et al., 2022). It also reinforces the argument that innovation extends beyond product novelty and strengthens value creation by improving operations and market-facing activities, ultimately elevating performance outcomes (Bustamante, 2020).

From the perspective of DCT by Teece et al. (1997) and Teece (2007), the positive innovation–performance relationship is theoretically expected because innovation represents a core manifestation of reconfiguring the firm's ability to renew routines, redesign processes, and recombine resources to remain aligned with

market and technological change (Ellström et al., 2022). In engineering MSMEs, where industrial customers demand consistent quality, short lead times, and competitive pricing, innovation becomes a concrete mechanism for transforming adaptive responses into measurable results. This interpretation is consistent with international evidence that digital transformation initiatives improve MSMEs performance, especially when accompanied by business model or process innovation, suggesting that innovation is the pathway through which firms convert technological change into business value.

Empirically, the present findings reflect the increasing adaptive capacity of engineering MSMEs to respond to technological and market demands. Firms that engage in continuous product refinement, improve service delivery, restructure workflows, and introduce more efficient production practices tend to achieve superior outcomes in sales growth, customer engagement, and long-term competitiveness. This logic aligns with international MSME studies showing that consistent innovation supports market success and sustainability by enhancing customer satisfaction and competitive positioning (Bilali, 2022; Toros, 2024). Moreover, innovation-based renewal is particularly valuable in engineering contexts because incremental improvements in process reliability, precision, and turnaround time can directly affect customer retention and contract continuity in B2B relationships (Maheshkar & Soni, 2021).

Overall, these results strengthen the conclusion that business innovation is a primary determinant of performance improvement among engineering-sector MSMEs in West Java. The higher the innovation capability, the greater the firm's capacity to adapt to turbulence and maintain competitive strength consistent with DCT's emphasis that performance gains are realized when firms translate environmental change into sustained renewal through sensing, seizing, and reconfiguring routines (Benítez et al., 2022; Ellström et al., 2022).

4.6.6. The Mediating Role of Business Innovation in the Relationship Between Entrepreneurial Leadership and Business Performance

The results indicate that business innovation significantly mediates the influence of entrepreneurial leadership on business performance among engineering-sector MSMEs in West Java. This means that entrepreneurial leadership generates stronger business outcomes when it is translated into innovative outputs such as improved products, streamlined processes, enhanced services, or revised business models rather than operating only through direct managerial control. This pattern is consistent with prior evidence that leadership contributes to superior organizational outcomes through innovation as a strategic pathway and with the argument that leadership impact becomes more substantial when accompanied by innovation-driven practices that reshape value creation (Benítez et al., 2022).

This mediation effect can be theoretically strengthened using DCT, as proposed by Teece et al. (1997) and Teece (2007). Business innovation is a tangible example of this reconfiguration process. DCT explains that in turbulent environments, performance gains rely on higher-order capabilities to detect opportunities and threats, seize opportunities through timely strategic action, and reconfigure resources and routines to sustain competitiveness (Ellström et al., 2022). Within engineering MSMEs, entrepreneurial leaders function as micro foundations of dynamic capabilities because more likely to recognize changes in industrial demand and technology, commit resources to improvement priorities, and drive organizational renewal through innovation initiatives. This is consistent with data

10.12928/fokus.v16i1.15070

from around the world indicating that entrepreneurial leadership affects MSMEs' performance not only directly but also through internal mechanisms such as innovation-related and dynamic capacities.

Empirically, the mediating role of innovation is also consistent with the broader international literature, indicating that innovation is positively associated with organizational performance, supporting the logic that leadership-driven innovation becomes a key route to performance improvement. For engineering-sector MSMEs, this mechanism is particularly relevant because performance is closely tied to operational reliability, service speed, cost control, and consistent quality, all of which are commonly improved through process and service innovation. Therefore, the findings imply that entrepreneurial leadership contributes most strongly to business performance when it activates innovation as an organizational renewal mechanism, consistent with DCT's emphasis that competitiveness and performance are achieved through sensing–seizing–reconfiguring routines rather than through leadership presence alone (Benítez et al., 2022; Ellström et al., 2022).

4.6.7. The Mediating Role of Business Innovation in the Relationship Between Digital Literacy Competence and Business Performance

The findings indicate that among engineering-sector MSMEs in West Java, business innovation substantially mediates the link between digital literacy competency and business performance. This implies that digital literacy competence, by itself, does not automatically improve performance unless it is converted into innovation outcomes that change how value is created and delivered. In other words, using digital tools for communication, marketing, customer service, or operational support becomes economically meaningful only when the result in tangible innovations such as faster, more reliable service delivery, improved production precision, better workflow coordination, or new business models. This finding aligns with the argument that digital capability influences performance primarily through innovation pathways, rather than through a straightforward direct effect (Benítez et al., 2022).

The DCT by Teece et al. (1997) and Teece (2007), which explains that businesses achieve better results in turbulent environments when recognize opportunities and threats, take strategic action to seize opportunities, and adjust resources and routines to maintain competitiveness, can reinforce this mediated mechanism. Within this framework, digital literacy competence functions as an enabling capability that supports sensing and seizing (e.g., identifying customer requirements through digital information, adopting appropriate digital tools, and responding to market signals). At the same time, business innovation serves as a mechanism that translates digital competence into improved operational and market outcomes (Ellström et al., 2022). This logic is consistent with international digital transformation research, which emphasizes that performance benefits arise when digital initiatives are embedded in organizational change and new value creation rather than remaining isolated technology use (Warner & Wäger, 2019; Vial, 2021).

In the engineering MSMEs context, this mediation effect is particularly reasonable because performance depends heavily on measurable improvements in quality consistency, turnaround time, cost control, and customer trust outcomes that typically require process and service innovation rather than basic digital adoption. MSMEs that use digital platforms, modern production systems, technical software, and technology-enabled marketing are more likely to generate innovations such as workflow redesign, preventive maintenance scheduling, documentation

standardization, customer data-based service customization, or faster prototyping, which directly enhance efficiency, service quality, and competitiveness. Thus, business innovation acts as a "bridge" that translates digital literacy competence into performance gains, confirming that digital competence is valuable when applied strategically to drive innovation (Benítez et al., 2022).

In practice, these findings imply that policy and capacity-building programs should move beyond general digital training and focus on innovation-oriented digital capability development, such as mentoring to integrate digital tools into core engineering workflows, automation readiness, data-based decision-making routines, and structured experimentation for product or process improvement. This approach reflects DCT's emphasis that competitiveness is achieved when firms build the capability to continuously reconfigure routines, meaning that raising digital literacy should be paired with innovation support to ensure that digital competence reliably yields performance outcomes (Benítez et al., 2022; Ellström et al., 2022).

5. Conclusion

This study examined the influence of entrepreneurial leadership and digital literacy competence on the business performance of engineering-sector MSMEs in West Java, with business innovation as a mediating variable, drawing on the DCT perspective. The findings reveal several important results. First, entrepreneurial leadership has a positive and significant direct effect on business performance, indicating that leaders who demonstrate vision, proactivity, calculated risk-taking, and an opportunity orientation can strengthen MSMEs' competitiveness and performance. Second, digital literacy competence does not have a significant direct impact on business performance. This suggests that digital skills across many engineering MSMEs remain basic and have not yet been strategically integrated into core operational and market processes. However, digital literacy competence significantly influences business innovation, and business innovation significantly improves business performance.

Furthermore, the results confirm that business innovation plays a significant mediating role in the relationship between entrepreneurial leadership, digital literacy competence, and business performance. This indicates that leadership capability and digital competence contribute to improved performance when translated into innovation activities, such as product development, process improvement, service enhancement, and business model renewal. These findings highlight innovation as a key pathway through which leadership and digital capabilities improve MSMEs' performance.

From a theoretical perspective, this study contributes to the development of DCT by demonstrating that entrepreneurial leadership and digital literacy competence function as enabling capabilities that enhance business performance through innovation as a reconfiguration mechanism. From a practical perspective, the findings suggest that programs aimed at improving MSMEs' performance should focus not only on technical upgrading but also on strengthening entrepreneurial leadership and developing innovation-oriented digital capabilities through mentoring, training, and integrating digital tools into operational processes.

Despite its contributions, this study has several limitations. First, the research focuses only on engineering-sector MSMEs in West Java, which may limit the generalizability of the findings to other sectors or regions. Second, the study relies on cross-sectional data collected through questionnaires, which may not fully capture the dynamic nature of leadership, digital capability development, and innovation processes over time.

Future research is recommended to expand the scope of analysis by including MSMEs from different industrial sectors or geographic regions to enhance generalizability.

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Longitudinal studies may also provide deeper insights into how entrepreneurial leadership, digital capabilities, and innovation evolve and influence performance over time. In addition, future studies may incorporate other relevant variables such as organizational learning, technological adoption, or collaborative networks to explain MSME performance in dynamic industrial environments further.

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