Original Research Article

The Strategic Roles of Technology Orientation, Digital Capability, and Economic Orientation in Fostering Innovation Performance via Sustainable Product Design

Abstract

Digital transformation and intensifying global competition compel manufacturing companies to continuously innovate while maintaining operational sustainability. This study aims to analyze how technology orientation, digital capability, and economic orientation collectively drive innovation performance through the mediation of sustainable product design in Indonesian manufacturing companies. Employing a quantitative approach with Partial Least Squares-Structural Equation Modeling methodology, data were collected from 159 respondents working across various manufacturing firms through structured questionnaires using a seven-point Likert scale. The analysis reveals that technology orientation significantly influences digital capability, economic orientation, sustainable product design, and innovation performance. Digital capability substantially enhances both sustainable product design and innovation performance. Economic orientation also contributes positively to sustainable product design and innovation performance. A unique finding indicates that sustainable product design does not directly affect innovation performance, suggesting the necessity for systemic integration with other organizational capabilities. The research model explains 85.2% of innovation performance variance, demonstrating remarkably robust predictive power. This study contributes theoretically by integrating multiple strategic orientations within a comprehensive framework and offers practical implications for manufacturing managers in designing sustainable and competitive innovation strategies.

Keywords: technology orientation; digital capability; sustainable product design; economic orientation; innovation performance

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1. Introduction

The contemporary business landscape undergoes fundamental transformation through digitalization and intensifying global competition, compelling organizations to maintain competitiveness through continuous innovation, operational efficiency, and sustainable practices. The Fourth Industrial Revolution (Industry 4.0) has fundamentally altered business operations by introducing digital technologies, data-driven decision-making, and sophisticated automation, increasing operational complexity and necessitating comprehensive strategic realignment toward technology adoption, economic performance, and sustainability imperatives (Ahmadi-Gh & Bello-Pintado, 2021). Manufacturing companies now stand at a critical juncture where they must simultaneously pursue technological innovation, maintain financial performance, and respond to mounting environmental and social expectations.

The manufacturing sector's transformation is accelerated by evolving market dynamics and international sustainability frameworks demanding integration of technological capabilities with sustainable operations and cost-effective production systems. Manufacturing firms are increasingly required to develop robust technological infrastructures alongside digital competencies that enable them to process information, leverage analytics, and optimize operations in real-time (Al-Abbadi & Abu Rumman, 2023). Innovation performance emerges as a critical indicator of organizational success, reflecting the capacity to transform creative ideas and available resources into tangible, market-ready outputs that generate competitive advantage.

Technology orientation significantly influences an organization's capability to adopt new technologies, pursue creative development initiatives, and achieve superior innovation outputs that contribute substantially to competitive positioning and organizational adaptability in dynamic markets. However, technological sophistication alone proves insufficient for sustaining long-term business viability and market leadership. Organizations must simultaneously maintain a strong economic orientation that emphasizes operational efficiency, profitability optimization, and systematic value creation across all business functions. The traditional paradigm focused primarily on rapid economic growth has evolved to prioritize high-quality, sustainable development that balances financial returns with broader stakeholder interests (Alaskar, 2025).

Digital capability emerges as an increasingly decisive element of organizational achievement, potentially surpassing conventional technological and economic imperatives in strategic importance (Huber et al., 2024). Organizations that develop sophisticated digital capabilities can effectively harness the transformative power of data analytics, intelligent automation, and digital collaboration tools to accelerate innovation processes and enhance strategic decision-making quality. Digital capabilities enable organizations to compress product development cycles, systematically integrate customer feedback into design iterations, and continuously optimize operational processes, thereby simultaneously strengthening both innovation performance and sustainability outcomes (Almodóvar & Nguyen, 2022).

Contemporary manufacturing companies operate under multiple, sometimes conflicting pressures as they strive to maintain strong brand reputations while simultaneously adapting to economic constraints and environmental pressures that increasingly mandate sustainable production methodologies. Traditional cost management approaches primarily focused on expense reduction and profit maximization are proving inadequate in the current business environment. Manufacturing organizations progressively recognize that sustainability must be systematically integrated into cost management strategies as awareness grows regarding resource depletion and environmental degradation (Ardolino et al., 2025)

Sustainable product design (SPD) emerges as a Hossain particularly promising approach for operationalizing sustainability commitments in manufacturing contexts, garnering significant attention from organizations seeking to enhance product sustainability while maintaining innovation momentum (Mengistu et al., 2024). SPD involves systematically incorporating environmental and social considerations throughout the product development process, including the selection of renewable and recyclable materials, implementation of energy-efficient manufacturing processes, and aggressive waste minimization strategies. Manufacturing companies that successfully adopt sustainable product design principles can simultaneously reduce environmental impacts and strengthen competitive positioning through enhanced innovation performance and improved market perception (Ayinaddis, 2023).

Despite extensive research examining sustainable orientation and its effects on innovation performance, economic orientation has received comparatively limited scholarly attention, representing a significant gap in current understanding (Jagani, 2023). This research addresses these gaps by examining how technology orientation influences sustainable product design and innovation performance within manufacturing firms, and how these relationships are moderated by economic orientation and digital capabilities. Building on foundational work by (Ayinaddis, 2023), this study offers substantial theoretical and practical contributions to manufacturing management.

2. Literature review and hypothesis development

Theoretical background

Technology Orientation

Technology orientation entails to a company's inclination to implement, investigate, and use advance technological capabilities in order to generate innovation, optimise business processes, and preserve a competitive advantage (Borodako et al., 2022). This perspective is distinguished by actions instances such as making investments in advanced technologies, systematically exploring opportunities is technology, and acknowledging technical innovation as an essential aspect of strategies (Nikkhah et al., 2024). According to (Borodako et al., 2022) technology orientation indicates a company's commitment to conduct investigations, advancement of technology, potential for invention examination, and technological forecasting of developments (Borodako et al., 2022).

Empirical research repeatedly emphasize the significance of this perspective. For example, Xi et al. (2025) discovered that technology orientation has a direct and positive effect on green process innovation along with indirectly defining conclusions with the help of the mediating role of digital capabilities, emphasizing the way technology-driven firms reallocate resources regarding sustainable innovation strategies (Xi et al., 2025). Recently, Lee and Trimi (2024) demonstrated the way technological orientation, together with absorptive capability, supports digital innovation and sustainable performance in the digital market, further confirming its critical role in assuring flexibility and competitiveness (Lee & Trimi, 2024). Collectively, these insight underscore that technology orientation should be conceptualized not solely as the utilization of modern technological tools, but rather as a strategic framework through which firms orchestrate resource allocation, cultivate innovative competencies, and secure long- term resilience amidst dynamic market uncertainties.

Digital Capability

Many studies define digital capability as an indicator of dynamic capacities in the digital age, such as capacity to notice technology opportunities (sensing), capture opportunities (seizing), and rearrange organizational resources and procedures (transforming). This model connects digital competence with strategic readiness and organizational flexibility (Zhang et al., 2024). An alternative conceptualization highlight the functional outcomes of digital capability, framing it as the organizational capacity to develop novel products, services, and process through the deployment of digital technologies, while simultaneously reconfiguring business models to enhance performance. Thus, digital capability serves as a critical mechanism linking digital investments to measurable organizational outcomes (Wang et al., 2022).

Scientific studies have emphasized its importance for determining business performance. In this instance, Joensuu-Salo & Matalamäki (2023) discovered that companies that have greater digital capability are more inclined to produce innovative products and services, because these abilities assist them to determine possibilities, allocate resources with greater efficiency, and execute digital solutions which improve their market agility (Joensuu-Salo & Matalamäki, 2023). In synthesis, the findings underscore that digital capability transcends the realm of technical expertise, representing instead a strategic orientation that aligns technology, human resources, and organizational processes, positioning it as indispensable for fostering sustainable product design and enhancing innovation performance within competitive contexts.

Economic Orientation

The foundation of an organization’s primary focus on financial objectives is its economic orientation (Jagani, 2023). According to existing literature, economic orientation is a strategic management technique that promotes the concept that a company's primary responsibility is to prioritize its shareholders' financial interests. Considering the economic factors, rather than corruption, this orientation encompasses revenue growth from long-term investment and strategic production (Busch et al., 2021). It also refers to a company’s strategic preference for long-term financial stability, cost control, and profitability achieved by intentional planning and managerial methods (Zhang et al., 2023). Previous studies has shown that economic orientation provides a critical role in influencing resource allocation and defining behaviour within organizations, especially in dynamic markets where profitability is directly linked to business value and investor trust (Khan et al., 2022). Therefore, in this study, economic orientation is operationalized as the firm’s commitment to sustained revenue growth, strategic cost advantage, clear return-on-investment guidelines, contingency planning, senior management accountability, and communication of financial priorities. In this sense, economic provides a structure for organizations to maintain financial resilience while pursuing larger innovation and sustainability objectives.

Sustainable Product Design

Multiple manufacturing companies, particularly those that have built their operations around producing and marketing technologically advance goods, are currently worried about their prospects for their future growth (Tan et al., 2007). According to previous literature, they also stated that in the categories of price, performance, and design, these businesses are already having difficulty setting themselves apart from the competition. By minimizing product sensitivity to manufacturing and changing environments and optimising performance response through design quality procedures, manufacturers can achieve this goal and drastically reduce their operating expenditures (Shetty, 2016). The procedural aspects of minimising the negative ecological effects of raw materials, assets, and consumption of energy are the key focus of the majority of the available literature on sustainable (Jagani, 2023). Innovative product strategies and marketing efforts generally are seen to benefit significantly from design. According to Shetty (2016), Incorporating sustainability into product design and manufacturing leads to environmental gains while also providing significant business advantages (Shetty, 2016).

Innovation Performance

Innovation is a major factor influencing company success and results (Ayinaddis, 2023). Innovation performance reflects the contribution of innovations in enhancing a company's business performance and securing a competitive edge (Almodóvar & Nguyen, 2022). From an academic perspective, innovation performance denotes the organizational capability to systematically introduce and apply innovations that deliver significant value creation. It encompasses the measurement of a firm's proficiency in conceiving, developing, and executing novel initiatives, highlighting the extent to which innovation activities translate into measurable results and sustainable organizational advancement (Gupta, 2021). Recent studies within the sustainable entrepreneurship domain has demonstrates that firms exhibiting high levels of innovation performance possess greater resilience to external disruptions while simultaneously improving its responsiveness to evolving stakeholder interests (Alaskar, 2025). Taken together, these insights emphasize that innovation performance cannot be reduced solely to the output of research and development or technological expenditures, but rather represents as an integrative construct that unites strategic, operational, and market-oriented perspectives, which is essential for elucidating the mechanisms through which organizations secure competitive positioning and sustain long-term growth.

Hypothesis development

Technology orientation influences digital capability.

Technology orientation influences digital capability. Companies that adopt and operationalize a technological orientation not only shape the ways in which technology is utilized within the organization but also cultivate the internal digital capabilities essential for effectively responding to technological disruptions (Ardolino et al., 2025). According to the dynamic capabilities theory, technology orientation acts as a foundational driver in cultivating digital capabilities, providing companies with the absorptive capacity necessary to identify, capture, and reconfigure technological opportunities into strategic digital competencies (Jang & Lee, 2025). Furthermore, empirical research indicates that technology orientation serves as a critical antecedent in the formation and advancement of organizational digital capabilities, and the accumulated evidence from extant literature highlights that technology orientation constitutes a critical strategic basis for the formation of digital capabilities. Hence, the following hypothesis is proposed:

H1: Technology orientation influences digital capability.

Technology orientation influences sustainable product design.

Technology orientation influences sustainable product design. From a strategic management standpoint, technology orientation amplifies a company's capacity to absorb and assimilate new technological knowledge, foster innovative experimentation, and incorporate emerging technological advancements into product design and manufacturing processes (Nassani et al., 2023). Viewed through the lens of sustainable innovation, technology orientation constitutes a fundamental driver of sustainable product design by embedding ecological, social, and economic considerations into the product innovation and development framework (Zhang et al., 2025). Empirical research shows that technology-oriented companies are more inclined to employ digital and green design technologies, including CAD, simulation technologies, and life cycle assessment frameworks to enhance their capacity for developing environmentally sustainable and energy-efficient products (Popowicz et al., 2025). Based on these results, the following hypothesis can be proposed:

H2. Technology orientation influences sustainable product design.

Technology orientation and economic orientation.

Technology orientation is positively related to economic orientation. According to Yang et al. (2022), technology-oriented companies conceptualize technology as a core determinant of lasting profitability and sustainable competitiveness, influencing not only their innovative capacity but also the configuration of their economic decision-making framework. Drawing on the principles of the Resource-Based View and dynamic capabilities perspectives, technological capabilities are perceived as pivotal intangible assets that support the continuous reconfiguration of resources, leading to enhanced cost effectiveness and greater productivity outcomes (Bertacchini et al., 2025). Encountering technology orientation as a purposeful strategic trajectory enables companies to cultivate stronger internal mechanisms to manage costs, maximize return on investment, and maintain strategic coherence between financial objectives and technology-driven initiatives (Krishnamurthy et al., n.d.). Drawing upon the empirical evidence presented, it can be inferred that a company's technology orientation exhibits a significant relationship with economic orientation. Therefore, the ensuing hypothesis is posited:

H3: Technology orientation is positively related to economic orientation.

Technology orientation and innovation performance.

Companies with a pronounced technology orientation leverage technological learning and experimentation to foster unique capabilities that support differentiation and durable innovation performance (Nassani et al., 2023). From a strategic management perspective, companies characterized by technological orientation develop dynamic capabilities that empower them to detect and respond effectively to technological disruptions through continuous product and process innovation (Pan et al., 2021). Research from He et al. (2020) shows that technology orientation substantially influences the success of new products by encouraging structured technology monitoring and fostering internal research and development collaboration. Insight derived from both theoretical perspectives and empirical findings collectively indicates that technology orientation constitutes a critical antecedent of innovation performance. Thus, the following hypothesis is proposed:

H4: Technology orientation is positively related to innovation performance.

Digital capability and sustainable product design.

Digital capability enables companies to embed environmental and social objectives into their design and manufacturing processes, thereby strengthening Sustainable Product Design (SPD) grounded in eco-efficiency, material recycling, and life-cycle optimization (Zhang & Liu, 2024). Empirical evidence highlights that digitalization improves transparency, traceability, and resource utilization efficiency, all of which are essential for sustainable manufacturing and eco-design outcomes (Chen et al. (2020). By enabling real-time simulation and data-driven decision-making, digital capabilities enhance flexibility in product design and facilitate systematic incorporation of energy efficiency, recyclability, and material optimization (Zhuge et al., 2023). Accordingly, digital capability constitutes a critical foundation for SPD by equipping companies with technological infrastructures and analytical intelligence necessary to embed sustainability principles within product development. Thus, the following hypothesis is proposed:

H5: Digital capability influences sustainable product design.

Digital capability influences and innovation performance.

Digital capability supports innovation performance by strengthening firms' ability to sense market changes, enhance operational efficiency, and coordinate digital resources to enable collaborative and knowledge-intensive innovation ecosystems (Tian et al., 2025). Empirical studies demonstrate a positive relationship between digital capability and multiple dimensions of innovation performance, including product and process innovation, organizational adaptability, and digital-driven efficiency improvements (Wang et al., 2022). Further evidence indicates that digital capability fosters green knowledge development, stimulates sustainable innovation, and enhances both commercial and ecological outcomes (Zhuge et al., 2023). Grounded in the Resource-Based View and Dynamic Capabilities Theory, these insights collectively confirm the essential role of digital capabilities in enabling innovation performance. Thus, the following hypothesis is proposed:

H6: Digital capability influences innovation performance.

Sustainable Product Design and Innovation Performance

Sustainable Product Design (SPD) integrates ecological considerations, resource efficiency, and life-cycle assessments into product development, including the use of recyclable materials, reduced energy consumption, and design for recovery (Mengistu et al. (2024); Wu et al. (2025)). Studies shows that embedding environmental criteria at the design stage shifts firms from incremental improvements toward systemic eco-innovation, reshaping product characteristics and production processes to generate new forms of competitive value (Lu et al., 2011). SPD also strengthens firms' absorptive capacity by generating codified knowledge applicable across product and process domains, thereby enhancing innovation capability (Forés & Fernández-Yáñez, 2024). Collectively, prior findings support a positive and meaningful relationship between sustainable product design and innovation outcomes. Thus, the following hypothesis is proposed:

H7: Sustainable product design has a positive impact on innovation performance.

Economic Orientation and Sustainable Product Design

A firm's economic orientation reflects a strategic prioritization of cost efficiency, revenue growth, and long-term financial returns (Jagani, 2023). Within the triple-bottom-line framework, economic considerations complement ecological requirements in advancing Sustainable Product Design (SPD), which enhances product longevity while reducing environmental impact (Gao et al., 2023). Prior research shows that aligning economic ambitions with environmental imperatives promotes material and energy efficiency, reduces waste, and strengthens SPD practices (Dangelico & Pujari, 2010). Economic pressures to reduce costs, shorten cycle times, and improve quality further motivate organizations to explore innovative redesigns aligned with sustainability goals (Jagani, 2023). Thus, economic orientation meaningfully shapes the strategic adoption of SPD. Thus, the following hypothesis is proposed:

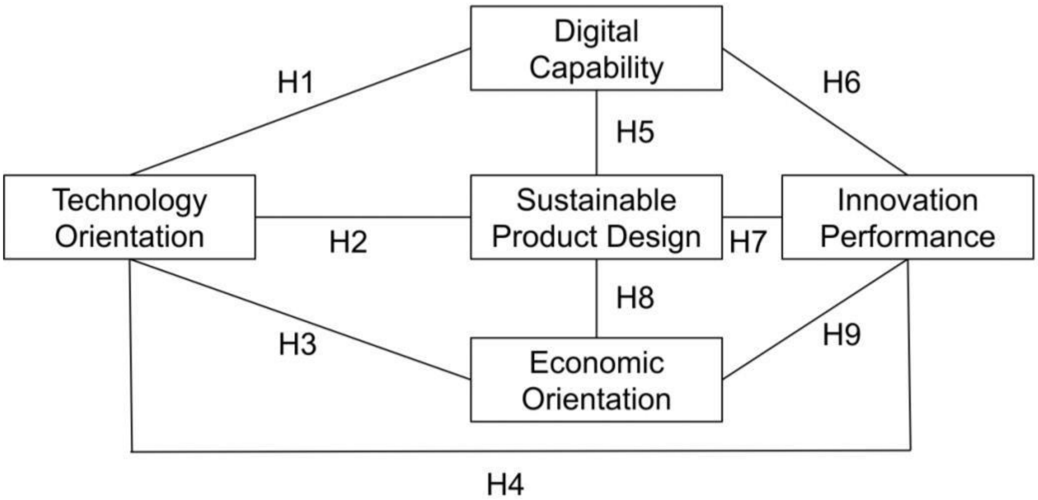
H8: Economic orientation influences sustainable product design.

Economic Orientation and Innovation Performance

A firm's economic orientation also shapes its innovation performance by prioritizing revenue expansion, operational efficiency, and maximization of investment returns, thereby directing innovation activities toward outcomes that enhance financial performance and competitive strength (Jagani, 2023). Firms with strong economic orientations adopt financial discipline to structure innovation processes, accelerate time-to-market, and improve operational efficiency, contributing to strategic differentiation and sustainable growth. Additionally, economic orientation drives systematic reinvestment of resources into innovation, supporting continuous technological advancement and profitability enhancement (Simone et al., 2024). Empirical and theoretical evidence collectively indicates that economic orientation positively affects innovation performance by tightly coupling financial imperatives with innovation strategies.

H9: Economic orientation influences innovation performance.

The conceptual framework in Figure 1 illustrates the hypothesized causal relationships among the key variables, detailing how technology orientation, digital capability, economic orientation, and sustainable product design collectively influence innovation performance.



Source: adapted from (Jagani, 2023) and (Xi et al., 2025)

Figure 1 Research framework

2. Methods

This research investigates strategic orientation and digital capability as drivers of innovation performance in manufacturing companies through a quantitative approach. The selection of this design aligns with the need to empirically test nine hypotheses concerning relationships among strategic orientation dimensions, digital capabilities, sustainable product design, and innovation performance. A quantitative framework enables systematic measurement of variables, objective assessment of causal relationships, and generation of generalizable findings through statistical analysis, consistent with positivist epistemology that prioritizes precision and replicability (Ayinaddis, 2023).

The conceptual model draws upon strategic orientation theory and dynamic capabilities framework, positioning economic orientation, technology orientation, and digital capability as determinants that simultaneously exert direct and indirect influences on innovation performance through sustainable product design mediation. This theoretical positioning receives empirical support from recent investigations examining innovation-sustainability linkages in manufacturing contexts (Bertacchini et al., 2025). Technology Orientation serves as the independent variable, representing strategic and technological drivers. Digital Capability, Sustainable Product Design, and Economic Orientation function as mediating variables that transmit effects to the dependent variable, Innovation Performance, which constitutes the ultimate organizational outcome measure.

Data collection employed a structured online questionnaire distributed via Google Forms, utilizing a seven-point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (7). This psychometric instrument facilitates nuanced measurement of latent constructs such as organizational orientations and innovation outcomes, with the seven-point scale offering enhanced reliability and sensitivity for social science applications. The questionnaire comprised 23 measurement items across five constructs, adapted from validated instruments in prior literature. Economic Orientation was operationalized through four indicators measuring revenue growth planning, cost leadership implementation, return-on-investment standards, and management accountability for economic performance, as detailed in Table 1.

Table 1. Measurement of the variables

Variabel	**Code**	**Indicator**	**References**
Economic Orientation	EO1	Our company has a shared plan to continuously increase revenue.	Jagani (2023)
	EO2	Our company is implementing long-term steps to achieve cost leadership.	
	EO3	Our company has clear rules regarding return-on-investment targets for key projects.	
	EO4	Our company assigns senior management responsibility for achieving economic performance.	
Technology Orientation	TO1	Our company uses modern technology to create new products.	Xi et al. (2025)
	TO2	Every new product we produce always incorporates the latest technology.	
	TO3	Our company continuously seeks out and develops new products with modern technology.	
	TO4	The results of technical innovation are easily implemented in this company.	

Digital Capability	DC1	Our company is capable of acquiring key digital technologies.	Xi et al. (2025)
	DC2	Our company is capable of recognizing and capitalizing on new digital opportunities.	
	DC3	Our company adapts quickly to digital change.	
	DC4	Our company is proficient in the latest digital technologies.	
	DC5	Our company is capable of creating new products, services, or processes using digital technologies.	
Sustainable Product Design	SPD1	Our company's final products are made using recycled materials.	Jagani (2023)
	SPD2	Our company's final products are made with minimal raw materials.	
	SPD3	Our company's final products are designed to require minimal energy during adoption.	
	SPD4	Our company's final products are reusable after use.	
	SPD5	Our company's production process uses energy more efficiently than competitors.	
Innovation Performance	IP1	Our company demonstrated an increase in new product launches to the market.	Jagani (2023)
	IP2	Our company reported excellent results from process innovation.	
	IP3	Our company demonstrated improved new features for existing products.	
	IP4	Our company was able to reduce the time required to launch products to the market.	
	IP5	Our company demonstrated an increase in the number of new products.	

3. Results

Data analysis utilized Partial Least Squares-Structural Equation Modeling (PLS-SEM) via SmartPLS software, appropriate for complex models with smaller samples and non-normal distributions. The measurement model evaluation assessed indicator reliability, convergent validity, and discriminant validity before structural model testing. The structural model examination included collinearity assessment through Variance Inflation Factor (VIF) values below 5.0, coefficient of determination (R^2) to evaluate explanatory power, and path coefficient significance testing via bootstrapping procedures with 5,000 resamples.

Discriminant Validity Test

Based on Table 2, the square root of the AVE values for each construct is Technology Orientation (TO) = 0.826, Digital Capability (DC) = 0.849, Economic Orientation (EO) = 0.859, Sustainable Product Design (SPD) = 0.801, and Innovation Performance (IP) = 0.835. Each of these values is greater than any correlation value in the corresponding row and column. This pattern holds consistently for all constructs. Therefore, the results of this study confirm that each construct in the model is empirically distinct and measures a unique concept. Thus, the results in this table meet the Fornell-Larcker criteria, indicating that the model has achieved acceptable discriminant validity.

Table 2. Discriminant Validity Results (Fornell-Larcker)

	DC	EO	IP	SPD	TO
DC	0,849				
EO	0,334	0,859			
IP	0,688	0,708	0,835		
SPD	0,593	0,613	0,772	0,801	
TO	0,363	0,375	0,692	0,617	0,826

Based on the test results displayed in the Table 3, the Heterotrait-Monotrait correlation ratio (HTMT) values between constructs show relatively low results and are all below the threshold of 0.90. Specifically, the relationship between Digital Capability (DC) and other constructs has an HTMT value of 0.370 with Economic Orientation (EO), 0.768 with Innovation Performance (IP), 0.668 with Sustainable Product Design (SPD), and 0.411 with Technology Orientation (TO). Furthermore, the relationship between Economic Orientation (EO) and Innovation Performance (IP) is 0.797, with Sustainable Product Design (SPD) is 0.700, and with Technology Orientation (TO) is 0.434. The highest HTMT value is found in the relationship between Sustainable Product Design (SPD) and Innovation Performance (IP) at 0.879, but is still below the recommended maximum limit of 0.90. According to Henseler et al., a value below 0.90 indicates good discriminant validity for models with similar contexts. However, a stricter value (below 0.85) is used for closely related constructs to avoid overlap (Henseler et al., 2016)

Table 3. Discriminant Validity Results (HTMT)

	DC	**EO**	**IP**	**SPD**	**TO**
DC					
EO	0,370				
IP	0,768	0,797			
SPD	0,668	0,700	0,879		
TO	0,411	0,434	0,797	0,722	

Reliability Test

The reliability of the measurement instrument was evaluated through the application of Cronbach's Alpha, with the objective of enhancing result credibility in the quantitative analysis. Reliability is deemed acceptable when the Cronbach's Alpha coefficient exceeds the recommended value greater than 0.70 denotes adequate internal consistency. The corresponding results are displayed in Table 4 below.

Table 4. Cronbach's Alpha dan Composite Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DC	0,902	0,906	0,928	0,720
EO	0,881	0,883	0,918	0,738
IP	0,891	0,893	0,920	0,697
SPD	0,860	0,865	0,899	0,642
TO	0,845	0,847	0,896	0,683

Source: Processed Questionnaire Data

Structural Model Testing (Inner Model)

In assessing the structural model, researchers focus on examining the interrelationships between latent constructs while also determining the model's ability to explain and predict outcomes. The evaluation relies on several indicators, including collinearity statistics, R-Square values, and path coefficients obtained through bootstrapping analysis (Hair & Alamer, 2022).

Collinearity Test

Effect estimates can only be considered reliable when collinearity among predictor constructs is adequately assessed and controlled. As an initial step in structural model assessment, the Variance Inflation Factor (VIF) values are examined for predictor constructs entering each endogenous construct. High collinearity among predictors can distort the precision of path estimates and increase standard errors. Based on existing literature, a VIF threshold of less than 5 indicates acceptable levels of collinearity, while values exceeding this threshold denote critical issues that should be corrected. Therefore, the results indicate that multicollinearity does not pose a significant concern, ensuring that the interpretation of the following structural path analysis remains valid and reliable, as shown in Table 5.

Table 5. Collinearity Test

	DC	EO	IP	SPD	TO
DC			1,546	1,215	
EO			1,605	1,228	
IP					
SPD			2,826		
TO	1,000	1,000	1,614	1,257	

Coefficient of Determination (R-Square)

The proportion of variance in an endogenous construct that is explained by its predictor constructs is reflected in the coefficient of determination (R^2) within the structural, or inner, model. The maximization of the R^2 value for the target construct is a primary objective in variance-based structural equation modeling (PLS-SEM), as it reflects the model's substantive predictive power. The interpretation of R^2 values commonly follows benchmark thresholds, where values of 0.75 or higher indicate substantial explanatory power, those between 0.50 and 0.75 suggest moderate strength, and values near 0.25 reflect weak explanatory capability.

Table 6. R-Square Results

	R-square	R-square adjusted
DC	0,132	0,126
EO	0,141	0,135
IP	0,852	0,848
SPD	0,646	0,639

Based on the test results in the Table 6, the Digital Capability (DC) construct has an R^2 value of 0.132 and an Adjusted R^2 of 0.126, indicating that approximately 13.2% of the variation in DC can be explained by the exogenous variables influencing it, while the remainder is explained by factors outside the model. The Economic Orientation (EO) construct has an R^2 value of 0.141 and an Adjusted R^2 of 0.135, indicating that approximately 14.1% of the variation in EO can be explained by the predictor variables in the model. Both values indicate a weak level of explanation, but are still acceptable in social research involving organizational behavior. Furthermore, the Innovation Performance (IP) construct has an R^2 value of 0.852 and an Adjusted R^2 of 0.848, indicating that 85.2% of the variation in IP can be explained by the constructs influencing it. These values are considered strong (substantial), indicating that the model has high predictive ability for innovation performance. Meanwhile, the Sustainable Product Design (SPD) construct has an R^2 value of 0.646 and an Adjusted R^2 of 0.639, indicating that 64.6% of the variation in SPD can be explained by exogenous variables in the model. This value is in the moderate or quite strong category (Hair Jr et al., 2021).

Path Coefficient Test

In Partial Least Squares-Structural Equation Modeling (PLS-SEM), path coefficients indicate the estimated strength and direction of the relationships linking the model's constructs. The bootstrapping procedure in PLS-SEM is employed to assess the statistical significance of path coefficients by estimating standard errors and corresponding t-values used in hypothesis evaluation. Significance at the 5% level is established when the computed t-value surpasses 1.96 and the p-value is under 0.05, confirming empirical support for the hypothesized relationship (Hair & Alamer, 2022). The data is shown in Table 7 and depicted in Figure 2.

Table 7. Path Coefficient Results

	Original sample (O)	Sample mean (M)	Standarddevi-ation (STDEV)	T statistics (|O/STDEV|)	P values	Conclusion
DC -> IP	0,375	0,376	0,040	9,346	0,000	H6 is supported
DC -> SPD	0,342	0,340	0,051	6,682	0,000	H5 is supported
EO -> IP	0,395	0,395	0,042	9,468	0,000	H9 is supported
EO -> SPD	0,365	0,362	0,049	7,443	0,000	H8 is supported
SPD -> IP	0,091	0,090	0,053	1,715	0,086	H7 is not supported
TO -> DC	0,363	0,356	0,105	3,440	0,001	H1 is supported
TO -> EO	0,375	0,367	0,097	3,847	0,000	H3 is supported
TO -> IP	0,352	0,358	0,048	7,290	0,000	H4 is supported
TO -> SPD	0,355	0,356	0,058	6,182	0,000	H2 is supported

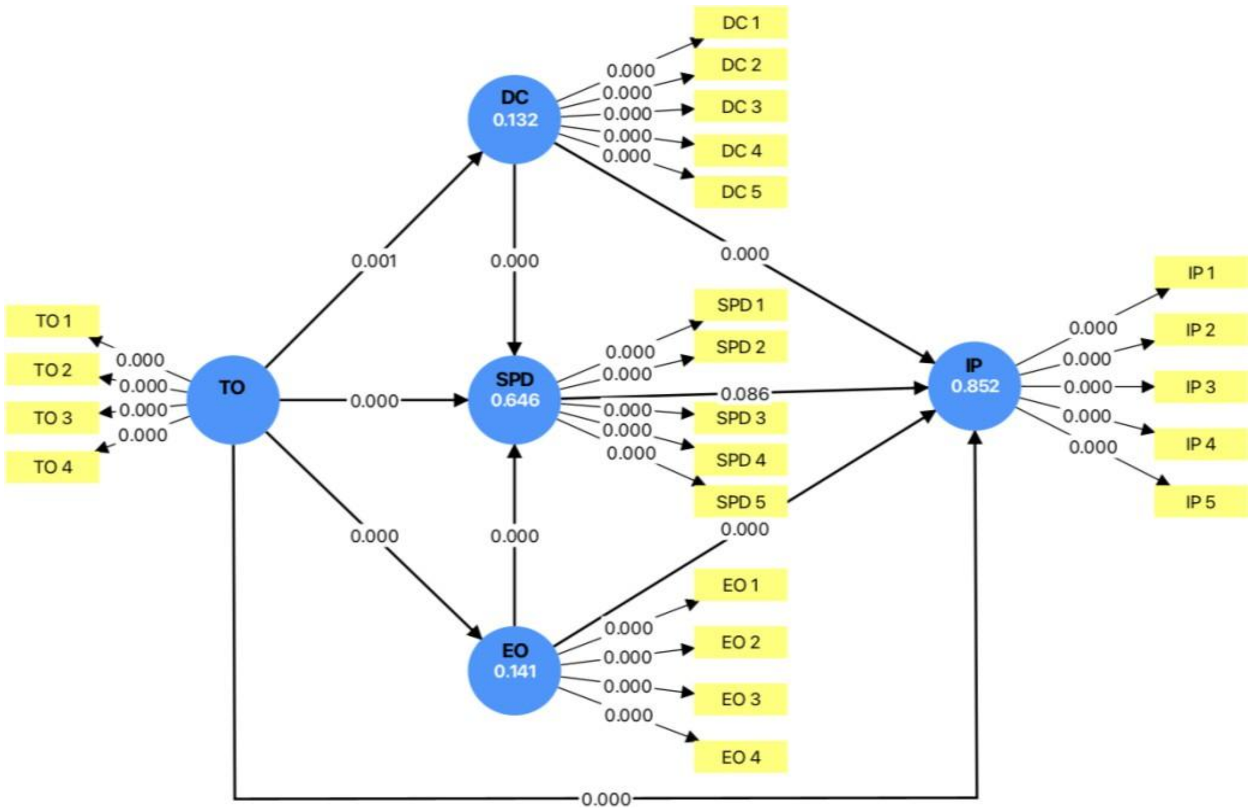


Figure 2 Path Coefficient Results

4. Discussion

This study investigates the relationships between technology orientation, digital capability, sustainable product design, economic orientation, and innovation performance within manufacturing companies. The analysis reveals several significant pathways that collectively illuminate how strategic orientations and digital capabilities function as critical drivers of innovation outcomes in contemporary manufacturing contexts. The empirical evidence demonstrates that technology orientation exerts a substantial positive influence on digital capability ($\beta = 0.363$, $T = 3.440$, $p = 0.001$). This finding suggests that organizations actively pursuing technological advancement and innovation develop stronger digital competencies across infrastructure, integration, and operational dimensions. The result resonates with (Yu et al., 2022), who documented that technology-oriented firms build robust digital capabilities that enhance organizational agility and transformation readiness. Similarly, (Yu et al., 2022) confirmed that technology orientation strengthens digital transformation capabilities in sensing, organizing, and restructuring processes, ultimately improving innovation capacity and market competitiveness. These findings underscore that strategic emphasis on technology serves as a foundational element for developing comprehensive digital capabilities that enable firms to navigate increasingly complex and digitalized business environments (Joensuu-Salo, 2021).

Technology orientation also significantly shapes sustainable product design ($\beta = 0.355$, $T = 6.182$, $p = 0.000$). Firms demonstrating stronger technological commitment are better positioned to integrate environmental considerations into product development processes, optimize resource utilization, and minimize ecological footprints throughout product lifecycles. This relationship aligns with, who established that digital technology integration enhances environmental performance by enabling more efficient resource management and fostering environmental consciousness across organizational practices. further substantiated that digital technology incorporation promotes knowledge accumulation and innovation outcomes that strengthen sustainable product development performance (Yaqub & Alsabban, 2023). These insights reveal that technological advancement not only drives operational efficiency but also facilitates environmentally responsible design and manufacturing practices (Yaqub & Alsabban, 2023).

The relationship between technology orientation and economic orientation ($\beta = 0.375$, $T = 3.847$, $p = 0.000$) indicates that technologically progressive firms exhibit stronger economic performance focus (Zhang et al., 2024). Illustrated how technology and innovation empower firms to overcome challenges and achieve financial growth through resilience, adaptability, and continuous innovation (Zhang et al., 2024). These findings collectively suggest that technological orientation functions as a cornerstone for sustainable and competitive business development by enabling efficiency improvements, productivity enhancements, and resource optimization (Zhang et al., 2024).

Furthermore, technology orientation significantly enhances innovation performance ($\beta = 0.352$, $T = 7.290$, $p = 0.000$). Organizations with strong technological commitment demonstrate superior capacity for product and process innovation, accelerated idea development, and competitive advantage creation (Zhang et al., 2024). Confirmed that technology orientation substantially boosts organizational innovation performance by enabling firms to leverage digital transformation as a strategic tool for enhancing innovation capability. These findings reinforce that technological prioritization enables organizations to innovate more effectively and maintain long-term competitive positioning.

Digital capability emerges as another critical determinant of sustainable product design (β = 0.342, T = 6.682, p = 0.000). Companies possessing advanced digital capabilities including sophisticated data analytics, IoT integration, and digital design tools are substantially better equipped to implement sustainability-oriented practices such as material optimization, energy efficiency enhancement, and lifecycle management improvement (Zhang et al., 2024). Corroborated that digital capabilities strengthen environmentally conscious sustainability practices by leveraging data-driven insights throughout design and manufacturing processes (Zhang et al., 2023). highlighted that digital capabilities facilitate opportunity recognition and exploitation for sustainable product and process development. These studies collectively demonstrate that digital capability drives sustainable product design through innovative approaches and reinforced organizational commitment to environmental responsibility.

The positive relationship between digital capability and innovation performance (β = 0.375, T = 9.346, p = 0.000) confirms that digitally competent organizations achieve superior innovation outcomes across products, services, and processes (Zhang et al., 2023). established that digital capabilities encompassing perception, operation, and resource coordination substantially increase innovation efficiency across development, enhancement, and market responsiveness dimensions (Zhang et al., 2023). Further emphasized that sustained investment in digital capabilities aimed at environmental outcomes, product innovation, and operational processes significantly improves innovation performance through digital transformation initiatives, analytics technologies adoption, and deep operational integration with digital systems. These findings indicate that enhanced digital capability contributes to improved innovation outcomes through effective application of digital technologies that stimulate creativity, organizational agility, and continuous enhancement.

Interestingly, the analysis reveals that sustainable product design does not significantly influence innovation performance (β = 0.091, T = 1.715, p = 0.086). This unexpected finding suggests that mere adoption of sustainable design practices does not automatically translate into measurable innovation performance improvements. (Gonzalez et al., 2021) provided supporting evidence that eco-innovation implementation does not necessarily contribute to sustainability when economic performance overshadows social or environmental objectives, highlighting the need for more systemic assessment approaches. (Gonzalez et al., 2021) similarly found that sustainable practices did not directly affect new product development success. The absence of direct effects may reflect potential negative implications including increased production costs, process complexity, overconsumption, and restricted innovation when sustainability is pursued too rigidly. These findings suggest that sustainable product design requires complementary organizational capabilities and contextual factors to effectively translate into innovation performance improvements.

Economic orientation demonstrates significant positive effects on both sustainable product design (β = 0.365, T = 7.443, p = 0.000) and innovation performance (β = 0.395, T = 9.468, p = 0.000). Firms emphasizing cost efficiency, return on investment targets, and financial planning are more likely to incorporate sustainability principles into product design while simultaneously achieving superior innovation outcomes. (Huber et al., 2024) confirmed that economically oriented firms establish clear strategic direction for achieving stable financial gains that foster sustainable product design and improve innovation outcomes. (He et al., 2020) indicated that integrating economic dimensions such as product reliability, durability, and maintainability within design stages is fundamental to achieving sustainable product performance and enhancing resource efficiency (Hussain et al., 2025) emphasized that financial resource accessibility and cost management critically shape innovation performance, positioning economically focused companies to enhance innovation outcomes. These findings collectively demonstrate that economic orientation drives strategic investments and managerial priorities that result in both sustainability adoption and innovation performance enhancement through targeted technology and innovation-driven strategies aimed at achieving competitive advantage.

5. Conclusions

This research successfully unravels the complex dynamics between strategic orientations and digital capabilities in driving innovation performance within manufacturing companies. The findings demonstrate that technology orientation plays a central role as the primary driver that significantly influences the development of digital capabilities, implementation of sustainable product design, strengthening of economic orientation, and enhancement of innovation performance. Digital capability proves to be a crucial factor that not only reinforces sustainable design practices but also directly elevates organizational innovation achievements. Economic orientation also demonstrates substantial contribution in promoting the adoption of sustainable product design and achieving superior innovation performance. An intriguing finding from this study is the absence of significant influence of sustainable product design on innovation performance, indicating that sustainability practices require systemic integration with other organizational capabilities to transform into innovative advantages. With an R-square value of 85.2% for innovation performance, this research model demonstrates remarkably strong predictive power, proving that the combination of technology orientation, digital capability, and economic orientation collectively forms a strategic ecosystem that drives innovation success in modern manufacturing contexts.

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