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Building Digital Capability in Startups: The Roles of Technology Orientation and Innovation-Oriented Leadership

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ABSTRACT

Purpose: This study examines the roles of technology orientation and innovation-oriented leadership in shaping digital capability in startups. It specifically positions digital capability as a primary strategic outcome and explores how internal strategic factors contribute to its development.

Design/methodology/approach: This study uses a quantitative explanatory design. Data were collected from 105 founders or co-founders of digital startups through a structured questionnaire. The data were analyzed using PLS-SEM with SmartPLS 3 and bootstrapping of 5,000 subsamples. Business age and market segmentation were included as control variables.

Finding/Results – The results show that technology orientation has a significant positive effect on digital capability. Innovation-oriented leadership also significantly influences digital capability and emerges as the strongest direct predictor. In addition, the interaction between technology orientation and innovation-oriented leadership has the largest effect, indicating a strong synergistic relationship in strengthening digital capability. Market segmentation significantly affects digital capability, while business age does not show a significant effect.

Originality/Value – This study highlights digital capability as a key strategic outcome in startup research. It also shows that the combined effect of technology orientation and innovation-oriented leadership is more important than their separate effects. The findings enrich the literature on startups by offering evidence from emerging digital businesses and by showing the relevance of market segmentation in explaining digital capability.

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1. Introduction

The digital economy has fundamentally restructured the sources of competitive advantage for organizations across industries. In this environment, digital capability (DC) defined as the organizational capacity to integrate digital technologies into core business processes, reconfigure resources dynamically, and generate value through digitalization has emerged as a foundational strategic asset (Bharadwaj, 2000; Khin & Ho, 2019). Unlike conventional IT resources, DC is inherently dynamic: it reflects not merely the possession of digital tools, but the organizational competence to deploy those tools in ways that create competitive value (Teece et al., 1997). In the context of digital startups, where the boundary between organizational strategy and technological infrastructure is thin, DC constitutes the primary determinant of whether a firm survives its early years or succumbs to competitive displacement.

Technology orientation (TO), understood as an organization's proactive disposition to seek, adopt, and leverage new technologies as part of its product development, process design, and business model innovation (Gatignon & Xuereb, 1997), has been widely identified as a primary antecedent to digital capability and innovation-related outcomes. Empirical evidence consistently supports the positive relationship between TO and innovation performance: firms with high technology orientation tend to introduce more new products and processes, respond more rapidly to technological shifts, and outperform competitors in innovation-driven markets (Lee et al., 2015; Zahra & Bogner, 2000). More recently, Xi et al. (2025) demonstrated that TO exerts both direct and indirect effects on green process innovation in Chinese manufacturing firms, with DC serving as the mediating mechanism. Khin and Ho (2019) similarly confirmed that digital orientation and digital capability jointly predict digital innovation outcomes among Malaysian IT SMEs.

However, a persistent gap in the literature concerns the mechanism through which TO is converted into DC. Several scholars have noted that technology orientation alone is insufficient to produce digital capability; the conversion requires organizational processes that channel technological ambitions into capability-building investments and behavioral routines (Xi et al., 2025; Hwangbo et al., 2022). This study argues that innovation-oriented leadership (IOL) constitutes that mechanism. IOL characterized by sensitivity to technological change, risk tolerance, a drive for cross-functional collaboration, and behavioral commitment to innovation serves as the organizational agent that translates TO into DC. Engelen et al. (2014), in a cross-cultural study of 954 firms across eight countries, demonstrated that each of the six behaviors comprising transformational leadership positively influenced firm-level innovation orientation a finding that directly supports the premise that leadership mediates the relationship between strategic orientation and capability development. Hwangbo et al. (2022) further confirmed that leadership type significantly moderates the relationship between technological innovation and corporate performance across diverse Korean industries.

Prior research has examined IOL as either an antecedent of innovation orientation (Engelen et al., 2014) or a boundary condition that strengthens the TO–DC relationship (Xi et al., 2025;

Hwangbo et al., 2022). This study advances that latter perspective by demonstrating that IOL does not merely add to TO's effect on DC it fundamentally transforms it. When technology orientation is paired with high innovation-oriented leadership, the resulting digital capability substantially exceeds what either condition independently predicts. The underlying logic is that high-TO environments provide strategic orientation and resource signals (what digital capabilities to invest in and why), while IOL provides the behavioral architecture and institutional commitment to convert those signals into embedded organizational competencies. Neither is sufficient alone; the joint configuration is the capability-generating system.

The Indonesian digital startup ecosystem provides a particularly relevant empirical context. Indonesia ranks among the top ten nations globally in active startup entities, with over 2,500 registered digital startups operating across fintech, edutech, and e-commerce (Startup Ranking, 2024). Yet data from DSInnovate (2023) and the Ministry of Cooperatives and SMEs (2023) reveal a persistent capability gap: approximately 60% of startups fail within their first three years, and only 17% report embedded digital capability in their core operational processes. This gap is not primarily technological in origin it is organizational and managerial. In the startup context, where decision-making authority is centralized and leadership identity is inseparable from organizational culture (Bass & Riggio, 2006), the founder-leader's innovation orientation is disproportionately consequential in determining whether technology assets are converted into organizational capability.

Two structural characteristics of startups are incorporated as control variables: business age and market segmentation (B2B vs. B2C). Business age captures organizational maturity and accumulated experience, which may independently accelerate DC development regardless of leadership or orientation quality (Lee et al., 2015). Market segmentation reflects the differential digital capability demands imposed by B2B versus B2C operating environments: B2B startups must build complex system integration capabilities, while B2C startups require consumer analytics and platform scalability both structurally distinct DC profiles (Khin & Ho, 2019).

The study makes three contributions to the literature. First, it demonstrates that the synergistic interaction of TO and IOL not either construct alone is the dominant driver of DC in digital startups (interaction $\beta = 0.430$, $f^2 = 0.586$), providing micro-foundational evidence for how sensing (TO) and seizing (IOL) capabilities jointly produce reconfigured organizational competencies within Dynamic Capability Theory (Teece et al., 1997). Second, it repositions DC as a primary strategic outcome worthy of upstream investigation, shifting scholarly attention from what DC produces to how DC is formed in resource-constrained entrepreneurial organizations. Third, it extends TO–IOL–DC theorizing to Indonesian digital startups — a context where leadership centrality and institutional resource scarcity amplify the synergistic effect — and introduces market segmentation (B2B/B2C) as a structural boundary condition, an underexplored dimension in existing DC literature. The remainder of this paper is structured as follows. Section 2 presents the theoretical foundations and hypothesis development. Section 3 describes the research methodology. Section 4 reports the results of the measurement and structural model evaluations. Section 5 discusses the findings, and Section 6 concludes.

2. Literature Review & Hypothesis Development

The theoretical framework of this study integrates Dynamic Capability Theory (Teece et al., 1997) and the Resource-Based View (Barney, 1991) to explain how technology orientation is transformed into digital capability through the synergistic moderating influence of innovation-oriented leadership. Each construct is reviewed in turn, followed by the development of testable hypotheses.

2.1 Technology Orientation (TO)

Technology orientation is defined as a firm's ability and willingness to acquire substantial technological knowledge and deploy it in the development of new products and processes (Gatignon & Xuereb, 1997, p. 78). It reflects the degree to which an organization prioritizes technology acquisition, experimentation with emerging tools, and the systematic integration of technological advancement into its product and process development activities. Firms with high technology orientation invest heavily in R&D, maintain awareness of technological frontiers, and treat technology as a primary driver of organizational renewal (Zahra & Bogner, 2000).

The empirical literature on TO consistently confirms its positive effect on innovation-related outcomes, though with important boundary conditions. Gatignon and Xuereb (1997) established the foundational evidence that technology-oriented firms develop more innovative products, particularly when customer orientation is co-present. Zahra and Bogner (2000) demonstrated that technology orientation toward product upgrades plays a key role in new venture innovation performance. More recently, Lee et al. (2015), in a study of 352 technology-intensive Korean SMEs, confirmed that TO positively predicts innovation performance, with external networks moderating the strength of this relationship. Their findings also revealed that innovation performance mediates the TO–financial performance link, suggesting that TO's effects on firm outcomes operate through intermediate organizational mechanisms — a logic this study extends to the TO–IOL–DC chain.

In the digital context specifically, Khin and Ho (2019) found that digital orientation (an extension of TO applied to digital technologies) exerts a significant positive effect on digital innovation among Malaysian IT SMEs, with digital capability complementing this relationship. Xi et al. (2025) confirmed that TO directly promotes green process innovation in Chinese manufacturing firms, and that digital capability mediates this relationship. Hwangbo et al. (2022) extended the TO literature by demonstrating that market orientation promotes technological innovation, which in turn mediates the market orientation–corporate performance relationship indicating that TO effects are systematically channeled through organizational capabilities before producing performance outcomes.

Within the Resource-Based View (Barney, 1991), TO constitutes a strategic resource a source of competitive heterogeneity that, when properly leveraged, generates sustained advantage. However, RBV stipulates that resources alone are insufficient for value creation; they must be mobilized through organizational capabilities (Teece et al., 1997). This distinction is particularly consequential for digital startups, where the proximity between strategic intent and operational execution is compressed: a startup may possess high TO at the founder level, yet fail to convert this orientation into embedded digital processes if the organizational mechanisms for capability development are absent. This study identifies IOL as that mechanism.

2.2 Innovation-Oriented Leadership (IOL)

Innovation-oriented leadership denotes a leadership style characterized by a strong propensity to encourage novelty, experimentation, and creative problem-solving within the organization (Stock et al., 2014; as cited in Xi et al., 2025). IOL leaders exhibit heightened sensitivity to technological and market change, actively promote risk-taking and learning from failure, support cross-functional knowledge sharing, and provide psychological safety for experimentation (Damanpour & Schneider, 2006). The construct is distinct from transformational leadership though related in that it is specifically calibrated to the innovation-enabling functions of leadership, rather than to the relational dynamics between leader and follower more broadly (Engelen et al., 2014).

Engelen et al. (2014) provided foundational multi-country evidence for the link between leadership and innovation orientation, examining 954 firms across eight national cultures. Their study demonstrated that all six transformational-leader behaviors positively influence firm-level innovation orientation, with the strongest effect attributed to "articulating a vision" (standardized $\beta = .334$, $p < .01$) and "accepting group goals" ($\beta = .218$, $p < .01$). Critically, two behaviors — providing an appropriate model and accepting group goals were found to be culturally independent in their positive effects on innovation orientation, suggesting that the leadership-innovation orientation link has universal applicability. While their study examined leadership as an antecedent of innovation orientation, this study extends the logic to argue that IOL constitutes the moderating mechanism through which TO is amplified into DC with high IOL conditions enabling a synergistic effect that substantially exceeds additive prediction.

Hwangbo et al. (2022) added complementary evidence by demonstrating that both transformational and transactional leadership significantly moderate the relationship between technological innovation and corporate performance in Korean firms. Their analysis of 414 respondents across diverse industries found that transformational leadership moderated the innovation–performance link for both financial and non-financial outcomes, while its moderating effect on market orientation was significant only for non-financial performance. These findings suggest that leadership's influence is particularly potent in converting technological assets and orientations into organizational outcomes which is the precise function attributed to IOL in the present model.

In the startup context, the centrality of the founder-leader in shaping organizational behavior amplifies the significance of IOL. Startups lack the institutional structures, formal processes, and middle-management layers of established firms; consequently, the leader's own innovation orientation directly determines the organization's capability investment decisions, talent development priorities, and openness to digital transformation (Bass & Riggio, 2006). Xi et al. (2025) confirmed this premise empirically, showing that innovation-oriented leadership significantly strengthens the effect of TO on digital capability in Chinese manufacturing firms (interaction term $\beta = 0.222$, $p < .001$). In the present study, IOL is examined as a synergistic moderator a contextual amplifier whose co-presence with high TO produces digital capability outcomes that neither construct independently achieves.

2.3 Technology Orientation and Digital Capability: H1

The first hypothesis concerns the direct effect of technology orientation on digital capability. Organizations with high technology orientation invest heavily in R&D, systematically scan technological frontiers, and treat technology as a primary driver of organizational renewal. This sustained technological engagement directly builds digital capability by creating the organizational conditions — knowledge assets, experimentation routines, and digital infrastructure — that underpin embedded digital competence. Firms that proactively seek and adopt new technologies develop richer repositories of digital tools, data systems, and process integration routines than firms that lag in technology adoption (Gatignon & Xuereb, 1997).

This argument draws on Dynamic Capability Theory's sensing micro-foundation (Teece et al., 1997): technology orientation activates organizational sensing mechanisms, directing managerial and employee attention toward digital opportunities and threats. This sustained engagement generates experiential learning that directly builds digital capability. Xi et al. (2025) confirm that TO exerts both direct and indirect effects on capability outcomes in digital contexts. Khin and Ho (2019) demonstrated a significant positive relationship between digital orientation and digital capability among Malaysian IT SMEs. Within the RBV (Barney, 1991), TO constitutes a strategic resource that creates the knowledge stocks and routinized digital processes necessary for capability formation.

H1: Technology Orientation has a significant positive effect on Digital Capability in digital startups.

2.4 Innovation-Oriented Leadership and Digital Capability: H2

The second hypothesis concerns the effect of IOL on DC. Innovation-oriented leaders create the organizational conditions under which digital capability can be systematically constructed. By fostering experimentation, allocating resources to digital skill development, encouraging data-driven decision-making, and modeling openness to new technologies, IOL leaders directly enable the accumulation and integration of digital competencies across the organization (Damanpour & Schneider, 2006; Xi et al., 2025).

Khin and Ho (2019) provide direct empirical support for the capability-building function of leadership-oriented digital commitment. Their study demonstrated that digital capability positively predicts digital innovation (path coefficient $\beta = 0.416$, $p < .01$) among Malaysian IT SMEs, and that this relationship is facilitated by the firm's orientation toward digital technology. While their model does not isolate leadership specifically, the underlying logic is consistent with the present argument: that the organizational commitment and behavioral routines associated with innovation orientation are prerequisite conditions for DC development. Xi et al. (2025) made this mechanism explicit, confirming that innovation-oriented leadership significantly amplifies the TO–DC pathway, with high IOL increasing the effect of TO on DC nearly tenfold relative to low IOL conditions (0.410 vs. 0.044).

The theoretical mechanism operates through three channels. First, IOL institutionalizes technology-oriented behavior by reconstructing the strategic framework: leaders embed digital capability development into corporate goals, design architecture linking data assets to capability components, and ensure strategic coherence (Xi et al., 2025). Second, IOL enhances structural flexibility through cross-boundary experimentation and organizational restructuring, breaking down departmental silos that impede digital system integration (Hwangbo et al., 2022). Third, IOL improves behavioral engagement by translating abstract strategic goals into actionable guidance through vision-building and value reinforcement, thereby increasing employees' participation in capability transformation (Engelen et al., 2014). These three channels collectively explain why IOL constitutes a powerful moderating mechanism in the TO–DC relationship: it is the organizational infrastructure through which technology orientation is amplified into embedded digital competence.

H2: Innovation-Oriented Leadership has a significant positive effect on Digital Capability in digital startups.

2.5 The Moderating Role of Innovation-Oriented Leadership: H3

The third hypothesis concerns the interactive effect of TO and IOL on DC. Rather than acting as a sequential step between TO and DC, IOL functions as a synergistic moderator: when leaders exhibit high innovation-oriented behaviors, the organizational signals embedded in technology orientation are more effectively converted into systematic capability investments, structured learning routines, and cross-functional digital integration. Conversely, when IOL is low, even a high-TO environment fails to generate embedded digital capability, because the leadership behaviors necessary to translate technological aspiration into organizational action are absent.

The moderation logic draws on Dynamic Capability Theory's sensing–seizing–reconfiguring framework (Teece et al., 1997). Technology orientation activates the sensing function: it directs organizational attention toward digital opportunities and competitive technological threats. IOL operationalizes the seizing function: innovation-oriented leaders convert sensed opportunities into organizational commitments, resource allocations, and behavioral routines. Digital capability represents the reconfiguring outcome: the accumulated and integrated digital competencies resulting from sustained IOL-driven investment and learning. Crucially, when IOL is high, the conversion from TO to DC is substantially amplified; when IOL is low, high TO alone produces limited capability formation.

This moderation logic implies that the impact of TO on DC varies significantly depending on the level of IOL. A startup with high TO but low IOL will accumulate technology awareness without translating it into embedded digital processes, because the behavioral mechanisms for systematic capability investment are absent. Xi et al. (2025) provide the most directly relevant empirical support, demonstrating that IOL significantly moderates the TO–DC pathway, with high-IOL conditions amplifying the TO–DC effect nearly tenfold relative to low-IOL conditions (0.410 vs. 0.044, $p < .001$). Hwangbo et al. (2022) offer complementary evidence that leadership type significantly moderates technology–performance relationships across diverse Korean industries.

This interactive model carries theoretical significance beyond prior research. Hwangbo et al. (2022) and Xi et al. (2025) confirmed that leadership moderates technology–performance relationships but treated this as a simple amplification effect. This study demonstrates that the synergy is dominant the interaction effect ($f^2 = 0.586$) exceeds both individual direct effects indicating that TO and IOL constitute a capability-generating system rather than additive inputs. This is consistent with Dynamic Capability Theory's emphasis on complementarity among capability-building mechanisms (Teece et al., 1997), and with resource bundling logic (Sirmon et al., 2007): TO provides the technological resource signals, while IOL provides the organizational architecture to combine, deploy, and integrate those investments into coherent digital competencies. The bundle, not either component alone, generates capability.

H3: Innovation-Oriented Leadership moderates the relationship between Technology Orientation and Digital Capability in digital startups, such that the positive effect of TO on DC is significantly stronger when IOL is high.

2.6 Control Variables

Two organizational characteristics are included as control variables directed toward the dependent variable (DC), to ensure that the primary TO–IOL–DC relationships are estimated free from systematic structural variance.

Business Age. Older startups have navigated more technology adoption cycles, accumulated greater organizational learning, and developed more mature routines for integrating digital tools into operational processes independent of their current TO or IOL quality. Lee et al. (2015) controlled for firm age in their technology-intensive SME study, noting its potential independent effect on innovation-related outcomes. Controlling for business age ensures that capability advantages attributable to organizational maturity are not conflated with the effects of TO and IOL.

Market Segmentation (B2B/B2C). The nature of a startup's target market imposes differential demands on its digital capability profile. B2B startups typically require complex system integration, enterprise-grade security infrastructure, and interoperability with client IT architectures structural requirements that drive DC development independently of internal orientation or leadership. B2C startups, by contrast, prioritize consumer analytics, platform scalability, and user experience optimization. Khin and Ho (2019) note that the specific digital capabilities required vary systematically by market context; controlling for B2B/B2C segmentation accounts for this structural heterogeneity.

2.7 Research Model

Figure 1 presents the proposed research model, integrating the three primary constructs and two control variables. Technology Orientation (X) directly influences Digital Capability (Y), with this relationship moderated by Innovation-Oriented Leadership (W) represented as the TO×IOL interaction term. Business age and market segmentation (B2B/B2C) are directed to

DC as control variables. The model is tested using PLS-SEM with bootstrapping (5,000 subsamples) for interaction effect estimation.

Table 1. Summary of Research Hypotheses and Supporting Literature

H	Hypothesis	Key Supporting References
H1	Technology Orientation (+) → Digital Capability	Gatignon & Xuereb (1997); Khin & Ho (2019); Xi et al. (2025)
H2	Innovation-Oriented Leadership (+) → Digital Capability	Damanpour & Schneider (2006); Khin & Ho (2019); Xi et al. (2025); Hwangbo et al. (2022)
H3	IOL moderates TO → DC (TO×IOL interaction effect, $f^2 = 0.586$)	Teece et al. (1997); Lee et al. (2015); Xi et al. (2025)

3. Research Methodology

This study employed a quantitative explanatory design using Partial Least Squares Structural Equation Modeling (PLS-SEM), implemented via SmartPLS 3 (Ringle, Wende, & Becker, 2015). PLS-SEM was selected given its suitability for predictive, theory-building research contexts and its robustness with small-to-medium samples (Hair et al., 2019). The population comprised all active digital startups in Malang, Indonesia. Data were collected from 105 founders or co-founders of digital startups using a purposive sampling approach. Inclusion criteria required respondents to be the primary decision-maker (founder or co-founder), and that the startup had been operating for at least six months in a digital business domain (fintech, edutech, e-commerce, or tech-enabled services). Respondents were predominantly male (61%), aged 22–35 years (78%) and led startups with 1–10 employees (84%). Of the total, 57% operated B2B models and 43% B2C models. Business age ranged from 6 months to 7 years (mean = 2.3 years). Technology Orientation (TO) was operationalized using four items adapted from Gatignon and Xuereb (1997); Innovation-Oriented Leadership (IOL) was measured with five items drawn from Stock et al. (2014) as cited in Xi et al. (2025); and Digital Capability (DC) was assessed using five items adapted from Khin and Ho (2019). All reflective constructs were measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The moderating variable (Moderating Effect 1) was constructed as the product of TO and IOL standardized scores using the consistent PLS interaction approach. Two control variables — market segmentation (B2B/B2C, dummy-coded: 0 = B2C, 1 = B2B) and business age (continuous, in years) — were directed to DC. Bootstrapping with 5,000 subsamples was employed to obtain t-statistics and confidence intervals for hypothesis testing.

4. Results and Discussion

4.1 Measurement Model Evaluation

The measurement model was assessed for indicator reliability, internal consistency, convergent validity, and discriminant validity prior to structural model evaluation.

Indicator Reliability and Outer Loadings. All indicator outer loadings exceeded the recommended threshold of 0.70 (Hair et al., 2019). For the Technology Orientation (TO) construct, loadings ranged from 0.767 (TO4) to 0.846 (TO1). For Innovation-Oriented Leadership (IOL), loadings ranged from 0.722 (IOL3) to 0.825 (IOL1). For Digital Capability (DC), loadings ranged from 0.764 (DC3) to 0.861 (DC4). The single-item control variables (Lama Usaha and Segmentasi Pasar) each had loadings of 1.000, as expected. All outer VIF values remained below 3.3 (range: 1.546–2.772), indicating no multicollinearity concerns among indicators.

Internal Consistency and Convergent Validity. Cronbach's Alpha values were 0.833 (TO), 0.852 (IOL), and 0.887 (DC), all exceeding the 0.70 threshold. Composite reliability (CR) values were 0.888 (TO), 0.894 (IOL), and 0.917 (DC), surpassing the 0.70 benchmark. Average Variance Extracted (AVE) values were 0.666 (TO), 0.629 (IOL), and 0.690 (DC), all above the recommended 0.50 threshold, confirming convergent validity. Rho_A values (TO = 0.843; IOL = 0.856; DC = 0.894) further confirmed construct reliability (see Table 2).

Table 2. Construct Reliability and Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE	rho_A
TO	0.833	0.888	0.666	0.843
IOL	0.852	0.894	0.629	0.856
DC	0.887	0.917	0.690	0.894

Discriminant Validity. Discriminant validity was assessed using both the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The Fornell-Larcker criterion was satisfied: each construct's square root of AVE (TO = 0.816; IOL = 0.793; DC = 0.830) exceeded all inter-construct correlations. The HTMT ratios between the primary constructs remained well below the conservative 0.85 threshold (TO–IOL = 0.227; TO–DC = 0.562; IOL–DC = 0.626), confirming that the three constructs are empirically distinct. Cross-loadings were inspected and each indicator loaded highest on its respective construct. Inner VIF values for all predictors in the structural model ranged from 1.035 to 1.112, indicating no multicollinearity concerns.

4.2 Structural Model Evaluation and Hypothesis Testing

Explanatory Power. The structural model demonstrated strong explanatory power. The coefficient of determination for Digital Capability was $R^2 = 0.669$ (adjusted $R^2 = 0.664$), indicating that the combination of TO, IOL, Moderating Effect 1 (TO×IOL), Segmentasi Pasar, and Lama Usaha explains approximately 66.9% of the variance in DC. This is classified as a substantial effect according to Hair et al. (2019) guidelines.

H1 — Technology Orientation → Digital Capability. The direct path from TO to DC yielded a path coefficient of $\beta = 0.382$ ($T = 8.529$, $p < 0.001$; 95% CI [0.298, 0.473]), indicating a significant positive relationship. The effect size $f^2 = 0.398$ is classified as large. H1 is therefore supported. This finding confirms that technology orientation is a robust antecedent of digital capability in Indonesian digital startups, consistent with Xi et al. (2025) and Khin and Ho (2019).

H2 — Innovation-Oriented Leadership → Digital Capability. The direct path from IOL to DC was $\beta = 0.407$ ($T = 9.057$, $p < 0.001$; 95% CI [0.319, 0.495]), with a large effect size ($f^2 = 0.471$). H2 is supported. IOL demonstrates the strongest individual effect among the primary constructs, underscoring the central role of leader behaviors in accumulating digital competencies within startup organizations.

H3 — Moderating Effect of IOL on TO→DC (TO×IOL Interaction). The interaction term (Moderating Effect 1 = TO × IOL) exhibited the largest path coefficient in the model: $\beta = 0.430$ ($T = 10.451$, $p < 0.001$; 95% CI [0.341, 0.505]), with the largest effect size ($f^2 = 0.586$). H3 is supported. The positive and significant interaction effect indicates that the impact of Technology Orientation on Digital Capability is substantially amplified when Innovation-Oriented Leadership is high. This synergistic effect represents the central theoretical contribution of the study, demonstrating that TO and IOL jointly rather than independently determine the level of digital capability achieved by digital startups.

Control Variables. Market Segmentation (Segmentasi Pasar) exerted a significant negative effect on DC ($\beta = -0.116$, $T = 2.657$, $p = 0.008$; $f^2 = 0.039$), indicating that B2C-oriented startups reported lower digital capability scores relative to B2B-oriented startups after controlling for TO and IOL. This finding reflects the structurally complex digital integration demands characteristic of B2B operating environments. Business Age (Lama Usaha) did not exert a significant effect on DC ($\beta = -0.000$, $T = 0.009$, $p = 0.993$; $f^2 \approx 0.000$), suggesting that organizational maturity in years does not independently predict DC within the sampled startup population. Table 3 summarizes the structural path coefficients and their significance.

Table 3. Structural Path Coefficients (Bootstrapping, n = 5,000)

Path	β	T-stat	p-value	95% CI	f²
TO → DC (H1)	0.382	8.529	<0.001	[0.298, 0.473]	0.398
IOL → DC (H2)	0.407	9.057	<0.001	[0.319, 0.495]	0.471
TO×IOL → DC (H3)	0.430	10.451	<0.001	[0.341, 0.505]	0.586
Segmentasi Pasar → DC (control)	*−0.116*	*2.657*	*0.008*	*[−0.200, −0.040]*	*0.039*
Lama Usaha → DC (control)	*−0.000*	*0.009*	*0.993*	*[−0.055, 0.055]*	*≈0.000*

Note: β = standardized path coefficient; CI = confidence interval; f² = effect size; control variable rows in italics.

Discussion

The results of this study provide robust empirical support for all three hypothesized relationships, yielding several theoretically and practically significant insights about the formation of digital capability in Indonesian digital startups.

Technology Orientation as a Direct Antecedent of Digital Capability (H1). The confirmation of H1 ($\beta = 0.382$, $p < 0.001$) establishes that firms with stronger proactive orientations toward technology acquisition and experimentation develop meaningfully higher digital capability. This finding is consistent with the broader TO literature (Gatignon & Xuereb, 1997; Xi et al., 2025) and extends it to the Indonesian startup context. Within Dynamic Capability Theory (Teece et al., 1997), TO functions as a sensing-oriented resource: it directs managerial attention toward digital opportunities and constructs the environmental conditions for capability formation. The substantial effect size ($f^2 = 0.398$) confirms that TO is not merely a background condition but a generative force in the capability development process. Importantly, the direct effect of TO on DC remains significant even after the moderating interaction term is included in the model, suggesting that TO exerts both main and joint effects on DC accumulation.

Innovation-Oriented Leadership as the Dominant Direct Driver of Digital Capability (H2). The confirmation of H2 with the model's highest individual direct path coefficient ($\beta = 0.407$, $p < 0.001$, $f^2 = 0.471$) is particularly significant. IOL emerged as the strongest individual predictor of DC, exceeding the direct effect of TO. This finding aligns with the theoretical argument advanced in this study: IOL is not merely a contextual amplifier of TO but an independent and powerful driver of DC in its own right — the organizational mechanism through which digital resources are mobilized into embedded capabilities. The result resonates with Engelen et al. (2014), who documented the cross-cultural universality of leadership's influence on innovation orientation, and with Xi et al. (2025), who confirmed IOL's pivotal role in TO–DC pathways. In the startup context, where the founder-leader's behaviors directly shape organizational culture, resource allocation, and learning routines (Bass & Riggio, 2006), this primacy of IOL is theoretically coherent and practically consequential.

The Synergistic Interaction of TO and IOL (H3). The most theoretically significant finding of this study is the strong positive interaction effect of TO × IOL on DC ($\beta = 0.430$, T = 10.451, $p < 0.001$, $f^2 = 0.586$ the largest effect size in the model). This finding confirms that TO and IOL operate synergistically rather than additively: startups that combine high technology orientation with high innovation-oriented leadership achieve digital capability levels that substantially exceed what either condition independently predicts. The interaction effect is consistent with Xi et al. (2025), who demonstrated that IOL nearly tenfold amplifies the TO–DC pathway under high-IOL conditions, and with Hwangbo et al. (2022), who found that leadership type significantly moderates technology–performance relationships. The magnitude of the interaction coefficient (0.430), which exceeds both individual direct effects, indicates that the joint configuration of TO and IOL constitutes a capability-generating system: technology orientation provides the strategic orientation and resource signals, while innovation-oriented leadership provides the behavioral architecture and institutional commitment to convert those signals into embedded digital competencies. This finding advances Dynamic Capability Theory by identifying a specific micro-foundational mechanism the TO–IOL interaction through which sensing (TO) and seizing (IOL) capabilities jointly produce reconfigured organizational competencies (DC).

The magnitude of the interaction effect warrants deeper examination, particularly in the context of digital startups with constrained resources. Why do TO and IOL mutually reinforce each other so powerfully in this population? The explanation lies in the structural logic of startup organizations. Unlike established firms, digital startups cannot rely on distributed capability-building infrastructure dedicated R&D departments, formal training systems, or middle-management layers responsible for implementing digital initiatives. The capability-building process is centralized in the founder-leader: the same individual who holds technology orientation also embodies or fails to embody innovation-oriented leadership. This structural fusion of strategic orientation and leadership agency means that TO and IOL are not independent inputs that additively combine; they are co-located in the same organizational actor, creating a mutual amplification dynamic.

Specifically, the synergy operates through three resource-leveraging mechanisms unique to resource-constrained startups. First, technology orientation without leadership commitment produces aspirational but non-actionable capability investments: the startup accumulates technological awareness but cannot convert it into embedded routines because the founder's attention and authority are required for every resource allocation decision. When IOL is high, this bottleneck is resolved the leader's own innovation disposition ensures that technology commitments are systematically embedded into organizational priorities, even with minimal formalized structures. Second, the interaction amplifies resource bundling (Sirmon et al., 2007): TO provides the technological resource signals (what to invest in and why), while IOL provides the organizational architecture (how to combine, deploy, and integrate those investments into coherent digital competencies). Neither bundle alone constitutes capability; the joint configuration does. Third, in the Indonesian startup context specifically, where external institutional support for digital capability development is limited (DSInnovate, 2023), the founder-leader's dual role as both technology strategist (TO) and organizational mobilizer (IOL) becomes the primary and often only mechanism through which digital capability is systematically constructed. This context-specificity explains why the interaction effect in this study ($f^2 = 0.586$) substantially exceeds the moderating effect reported by Xi et al. (2025) in their Chinese manufacturing sample, where institutional capability-building infrastructure is comparatively more developed.

Control Variables and Contextual Boundary Conditions. The significant negative effect of B2C market segmentation on DC ($\beta = -0.116$, $p = 0.008$) offers a substantively meaningful finding: B2B-oriented startups develop higher digital capability, net of TO and IOL. This is consistent with the differential DC demands of B2B environments, which require complex system integration, interoperability with client IT architectures, and enterprise security standards all of which necessitate higher levels of embedded digital competence (Khin & Ho, 2019). B2C startups, by contrast, may achieve competitive performance through consumer-facing platform features and user experience optimization that do not necessarily require the same depth of organizational DC. The non-significant effect of business age ($p = 0.993$) challenges the common assumption that older firms automatically develop superior digital capability through experience accumulation. Within the startup population, where digital nativeness is a founding condition and capability obsolescence is rapid, chronological age appears to be a weak proxy for organizational digital competence. This finding suggests that what matters is not how long a startup has existed but what leadership behaviors and technology commitments it has maintained throughout its existence.

5. Conclusion and Suggestion

5.1 Managerial Implications for Startup Founders.

The dominant interaction effect (TO×IOL, $f^2 = 0.586$) carries a precise and actionable implication for startup founders: technology strategy and leadership behavior must be developed simultaneously, not sequentially. Founders seeking to accelerate digital capability development must recognize that technology investment alone is insufficient if not accompanied by the deliberate cultivation of innovation-oriented leadership behaviors.

Three specific practices are recommended. First, an IOL Behavioral Audit: founders should conduct periodic self-assessments against IOL behavioral dimensions (Stock et al., 2014) risk tolerance in technology adoption decisions, active facilitation of cross-functional digital collaboration, provision of psychological safety for experimental failure, and visible modeling of openness to technological change. Deficits in any dimension reduce the return on technology orientation investments, regardless of how sophisticated the technology strategy is. Second, Structured Digital Capability Roadmaps: rather than pursuing digital investment ad hoc, founders should develop explicit quarterly DC roadmaps that translate technology orientation commitments into specific capability targets data analytics capability, digital process integration, platform scalability with IOL behaviors operationalized as the governance mechanism for mobilizing teams and reviewing progress. Third, B2B vs. B2C-Differentiated Strategies: given the finding that B2C startups exhibit significantly lower DC ($\beta = -0.116$, $p = 0.008$), B2C-oriented founders should deliberately invest in backend digital infrastructure and data architecture capabilities that may not be immediately visible in consumer products but are essential for long-term capability accumulation.

5.2 Policy Implications.

Two policy recommendations derive directly from the study's empirical findings. First, Capability-Based Eligibility Criteria: the finding that business age does not significantly predict DC ($\beta = -0.000$, $p = 0.993$) challenges the common practice of using age-based eligibility thresholds in government support programs. Policymakers should replace or supplement age-based criteria with capability-based diagnostic assessments that directly measure TO, IOL, and DC levels. Startups with high TO but low IOL or low DC regardless of age represent the highest-need beneficiaries of leadership development and digital capacity-building interventions.

Second, Targeted B2C Digital Capability Programs: the significant B2C disadvantage in DC development suggests that consumer-facing startups face structural barriers to deep DC accumulation that market incentives alone do not resolve. Government programs and Kominfo digital economy initiatives should design B2C-specific technical assistance tracks focused on backend digital infrastructure data architecture, API integration, cybersecurity rather than exclusively on consumer-facing product development. This targeted approach would address the DC gap identified in this study and strengthen the long-term competitiveness of Indonesia's B2C startup ecosystem.

5.3 Implications for Investors.

The study's high explanatory power ($R^2 = 0.669$) and the dominance of the TO×IOL interaction provide an empirical basis for redesigning early-stage due diligence frameworks. IOL-Inclusive Founder Assessment: standard due diligence protocols should incorporate structured IOL assessments alongside technology strategy evaluation. Founders who articulate strong technology orientation but demonstrate low risk tolerance, resistance to cross-functional collaboration, or low psychological safety provision are poor candidates for successful DC development, regardless of their product concept or market size. A structured IOL assessment rubric scoring founders on the five IOL dimensions from Stock et al. (2014) can be integrated into existing founder interview protocols.

Additionally, Stage-Gated DC Milestones: investment agreements should include stage-gated DC milestones as conditions for follow-on funding specifically, measurable indicators of organizational digital competence (percentage of core processes digitized, data infrastructure maturity, digital talent acquisition) rather than purely product or revenue milestones. Given the structural DC disadvantage of B2C startups identified in this study, investors with concentrated B2C portfolios should also factor this into capability risk assessments and consider allocating a portion of technical assistance budgets toward DC-building support for B2C portfolio companies.

5.4 Implications for Ecosystem Builders.

Startup incubators and accelerators — including Malang-based programs such as FILKOM UB Incubator and regional programs under Kemenkominfo — can use this study's findings to redesign their value propositions. IOL Development as Core Curriculum: leadership development programs within incubators should be explicitly calibrated to IOL behavioral dimensions, rather than generic entrepreneurial leadership content. Specific module recommendations include: Technology-Risk Calibration Workshops (helping founders develop risk tolerance frameworks for technology adoption decisions); Cross-Functional Digital Collaboration Labs (simulating the cross-boundary integration challenges of DC development); and Experimental Learning Culture Design (building organizational norms that make learning from digital failure psychologically safe). These modules should be delivered early in the incubation cycle — before intensive product development because IOL behaviors are the precondition for effective technology orientation translation.

Furthermore, Cohort-Based TO-IOL Alignment Diagnostics: at program intake, incubators should administer validated TO and IOL assessments (adapted from Gatignon & Xuereb, 1997 and Stock et al., 2014) to all cohort members. Founders with high TO but low IOL represent the highest-priority candidates for leadership coaching, while founders with high IOL but low TO may benefit from technology awareness programs. Finally, DC Benchmarking Within Cohorts: incubators should develop cohort-level DC benchmarking tools based on the validated DC scale from Khin and Ho (2019) — to track capability development trajectories across program stages. Comparing DC profiles across B2B and B2C participants within the same cohort would enable ecosystem builders to identify segment-specific support needs and design differentiated technical assistance tracks.

6. Limitations and Future Research

This study has several limitations that should be noted when interpreting its findings. First, the sample is geographically confined to digital startups in Malang, Indonesia, which may limit generalizability to other Indonesian cities and international contexts. Second, the cross-sectional design precludes causal inference regarding the temporal development of TO, IOL, and DC. Third, the use of self-reported measures by founders introduces potential common method bias, though PLS-SEM and Harman's single-factor test were employed as procedural remedies. Fourth, the IOL construct was measured as a composite, which may obscure heterogeneity among its sub-dimensions. This study opens several productive avenues for future scholarly inquiry. First, the cross-sectional design employed in this study precludes causal inference about the temporal sequencing of the TO–IOL–DC chain. Future research should employ longitudinal panel designs to examine whether the interaction effects observed here persist, strengthen, or diminish as startups mature and transition across development stages. Tracking the same startups over multiple periods would enable researchers to map capability trajectories rather than cross-sectional snapshots, and to identify critical inflection points in the TO–IOL–DC relationship.

Second, this study was conducted within a single geographic context (Malang, Indonesia), which limits the generalizability of findings across different institutional environments, digital infrastructure levels, and cultural configurations. Cross-national comparative studies replicating this model in other Southeast Asian emerging economies (e.g., Vietnam, the Philippines, Thailand) or contrasting developing-economy startups with their counterparts in developed markets (e.g., South Korea, Germany) would test the boundary conditions of the TO–IOL interaction and its cultural portability.

Third, this study examined digital capability as a primary outcome. Future research should extend the model downstream to examine whether the TO–IOL-generated DC translates into superior innovation performance, financial sustainability, or startup survival rates. Repositioning DC as a mediator in a larger TO–IOL–DC–performance chain would enable researchers to assess the full value-generating pathway from strategic orientation and leadership to competitive outcomes addressing the performance implications of the present findings.

Fourth, future studies should investigate whether the market segmentation effect (B2C vs. B2B) operates as a genuine moderator of the TO–IOL–DC chain specifically, whether IOL matters in B2C environments compared to B2B environments. This would require a three-way interaction analysis (TO × IOL × Segmentasi) with a larger, more segmentally balanced sample. Understanding whether the synergistic TO–IOL effect on DC is equally potent across market types would have important implications for sector-specific startup support programs.

Finally, future research should explore the specific behavioral dimensions of IOL that most strongly drive DC development. The composite IOL measure used in this study drawing on Stock et al.'s (2014) five-item scale — obscures potential heterogeneity among IOL's constituent behaviors. Decomposing IOL into its sub-dimensions (e.g., risk tolerance, cross-functional collaboration facilitation, vision articulation, technological sensitivity) and testing their differential effects on specific DC components (e.g., data analytics capability, digital process integration, platform architecture) would provide more granular guidance for leadership development practitioners and extend the theoretical precision of the IOL construct within the digital startup domain.

7. Conclusion

This study examined the joint and interactive effects of Technology Orientation (TO) and Innovation-Oriented Leadership (IOL) on Digital Capability (DC) in Indonesian digital startups using PLS-SEM. All three hypotheses were supported with large effect sizes, and the overall model explained 66.9% of the variance in DC. The most significant finding the dominant interaction effect of TO × IOL ($\beta = 0.430$, $f^2 = 0.586$) establishes that the synergistic configuration of technology orientation and innovation-oriented leadership constitutes a more powerful driver of digital capability than either condition independently. This finding establishes that the synergistic co-configuration of technology orientation and innovation-oriented leadership constitutes a capability-generating system a micro-foundational account of how digital startups develop the organizational competencies necessary for competitive survival that advances Dynamic Capability Theory beyond additive models. The study contributes to Dynamic Capability Theory, the startup capability literature, and the emerging body of research on leadership-driven digital transformation in developing economies.

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