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# The Digital Imperative: Dynamic Managerial Capabilities, Organizational Readiness, and Innovation in China's High-Tech Frontier

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**Abstract**

**Background and Aim:** The Chengdu–Chongqing high-tech corridor is a key innovation engine in China. However, how internal managerial capabilities—particularly in digital contexts—translate into innovation performance (IP) remains underexplored. This study addresses this gap by examining how dynamic managerial capabilities (DMCs) affect IP both directly and indirectly through organizational readiness (OR), while considering the moderating role of environmental factors (EFs).

**Method:** Drawing on the theory of dynamic capabilities and the resource-based view, this study develops a four-dimensional DMC construct that incorporates digital literacy. Survey data from 488 managers in high-tech firms in the Chengdu–Chongqing region were analyzed using partial least squares structural equation modeling (PLS-SEM).

**Results:** The findings show that DMCs significantly enhance both OR and IP. Alternatively, partially mediates the DMC–IP relationship. Among the environmental moderators, only the effect of DMCs on OR was significantly influenced by contextual conditions.

**Conclusion:** This study contributes to theory by extending the DMC framework to include digital literacy and validating OR as a mechanism for capability deployment. Practically, the findings suggest that firms in emerging economies should strengthen internal readiness systems to capitalize on managerial capabilities in dynamic and digital environments fully.

**Keywords:** Digital Literacy; Dynamic Managerial Capabilities; Organizational Readiness; Innovation Performance; Environmental Factors

## Introduction

Innovation is the cornerstone of competitive advantage in emerging markets, especially under conditions of rapid digital transformation. This is more evident than in China's Chengdu–Chongqing region—a nationally designated "fourth growth pole"—where combined GDP exceeded RMB 8 trillion in 2023. Despite strong state-led innovation support, many regional firms struggle to translate internal capabilities into innovation performance (IP), particularly in environments characterized by policy complexity, fast-changing technologies, and globalized competition.

Dynamic Managerial Capabilities (DMCs), defined as managers' ability to sense, seize, and reconfigure organizational resources, have been widely acknowledged as critical drivers of innovation (Helfat & Martin, 2015). However, the mechanisms through which DMCs lead to IP remain under-theorized, particularly in policy-driven innovation ecosystems like Chengdu–Chongqing. Most DMC frameworks emphasize cognitive and relational assets, yet digital literacy—a managerial capability increasingly crucial in high-tech contexts—has received limited empirical attention (Zahoor et al., 2023).

To fill this gap, this study develops a moderated mediation model to examine how DMCs affect IP directly and indirectly through Organizational Readiness (OR), incorporating environmental dynamism, competitiveness, and institutional support as moderators. Grounded in dynamic capability theory, resource-based view, and contingency theory, the model is tested using data from 488 high-tech firms in Chengdu and Chongqing.

This research addresses three gaps:



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(1) It integrates digital literacy as a fourth dimension of DMCs.

(2) It clarifies the mediating role of OR as a translation mechanism between DMCs and innovation;

(3) It explores how environmental conditions affect these relationships. The study contributes to theory and practice by offering a contextualized understanding of managerial innovation capability in emerging economies.

**Research Question:**

How do dynamic managerial capabilities, particularly digital literacy, affect innovation performance in high-tech firms within Chengdu–Chongqing, and how do organizational readiness and environmental factors shape this relationship?

## Objectives

This study investigates the effect of dynamic managerial capabilities (DMC) on the innovation performance of high-tech enterprises in the Chengdu–Chongqing region.

## Literature review

### 1. Dynamic Managerial Capabilities (DMCs)

Dynamic managerial capabilities (DMCs) refer to managers' ability to build, integrate, and reconfigure organizational competencies to address rapidly changing environments (Helfat & Martin, 2015; Teece, 2007). Traditionally, DMCs encompass cognitive, human, and social capital dimensions (Adner & Helfat, 2003). However, with the rise of digital transformation in emerging economies, digital literacy has emerged as a critical fourth dimension (Zahoor et al., 2023). Digital fluency enables managers to sense digital trends, seize technological opportunities, and reconfigure structures accordingly. In China's high-tech industries, where digital ecosystems are evolving rapidly, incorporating digital literacy is crucial to extending the DMC framework.

### 2. Organizational Readiness (OR)

Organizational readiness (OR) reflects the extent to which a firm is structurally and culturally prepared to implement change (Weiner, 2009). It captures leadership alignment, communication flow, resource availability, and employee receptiveness to innovation. Recent studies have explored OR as a precursor to effective digital transformation (Lokuge et al., 2019). Suwannapirom and Pranee (2023) highlight that perceived organizational support and job well-being significantly affect innovative work behavior through engagement and internal preparedness. In this study, OR is a key mediating mechanism through which DMCs translate into innovation performance (Schilke et al., 2018).

### 3. Innovation Performance (IP)

Innovation performance (IP) refers to a firm's ability to develop, implement, and commercialize new ideas, products, or processes. In volatile and resource-constrained environments, IP often reflects not only R&D inputs but also strategic agility and execution (Jun et al., 2022). Pimsuwan et al. (2023) operationalize IP across five dimensions: financial, marketing, technical, customer, and strategic performance. This multi-faceted view enables a more holistic assessment of innovation outcomes, especially in tech-intensive sectors.

### 4. Environmental Context as Moderator

Environmental factors such as dynamism, competitiveness, and institutional support shape how internal capabilities influence innovation (Schilke, 2014). High levels of environmental dynamism intensify the need for adaptive capabilities and organizational flexibility. Competitiveness increases the pressure on firms to innovate faster, while institutional support (e.g., government incentives, favorable regulation) can amplify or constrain strategic responses. These factors are theorized to moderate the relationships between DMCs, OR, and IP in this study.

### 5. Research Gap and Contributions

This study addresses three key gaps in the literature:



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a. It empirically extends the DMC framework by integrating digital literacy as a critical capability in emerging economies.

b. It clarifies the mediating role of OR as the mechanism through which managerial capabilities drive innovation.

c. It explores how environmental conditions—dynamism, competitiveness, and supportiveness—affect the link between internal capabilities and performance.

The study builds upon Zahoor et al. (2023), Suwannapirom & Pranee (2023), and Pimsuwan et al. (2023), contributing a novel framework tailored to digital transformation contexts in China.

**Conceptual Framework and Hypothesis Development**

This study integrates three theoretical perspectives to develop its conceptual model: Dynamic Capability Theory (DCT), the Resource-Based View (RBV), and Contingency Theory. These frameworks complement each other in explaining how internal capabilities translate into innovation performance, especially within volatile, policy-driven emerging markets like Chengdu–Chongqing.

Dynamic Capability Theory (Teece, 2007; Helfat & Martin, 2015) emphasizes a firm's ability to adapt, integrate, and reconfigure internal and external competencies in response to rapidly changing environments. This is critical in high-tech sectors, where innovation cycles are short and disruption is frequent.

The Resource-Based View (RBV) (Barney, 1991) asserts that sustainable competitive advantage arises from valuable, rare, inimitable, and non-substitutable resources (VRIN). In this context, dynamic managerial capabilities—including cognitive flexibility, social capital, and mainly digital literacy—serve as strategic resources.

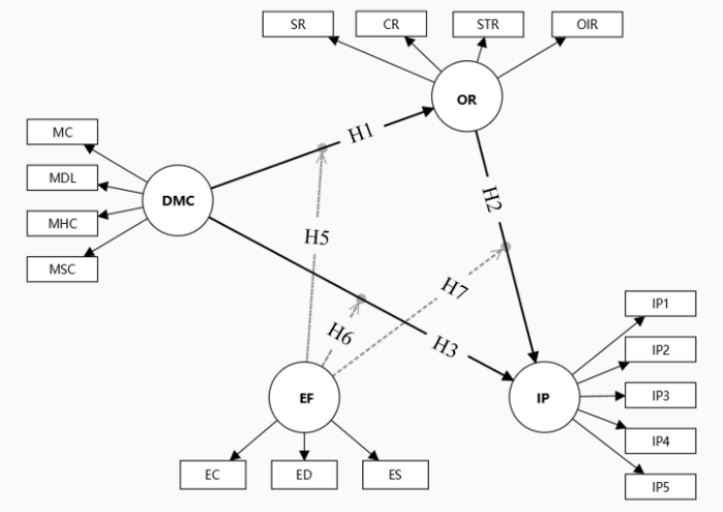


**Figure 1** Conceptual Framework and Hypotheses

Contingency Theory (Schilke, 2014) posits that the effectiveness of any strategy or capability is context-dependent. It supports the inclusion of environmental moderators—such as dynamism, competitiveness, and institutional support—to explain variance in the strength and direction of capability-performance relationships.

**Hypothesis development**

**H1: Dynamic Managerial Capabilities positively influence Organizational Readiness.**

DMCs signify an organization's capacity to integrate, develop, and reconfigure internal resources in response to external changes (Helfat & Martin, 2015). The aforementioned capabilities—cognitive



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flexibility, experiential knowledge, relational networks, and digital fluency—enable managers to anticipate and prepare for changes essential for executing innovation. Prior research associates DMCs with adaptive organizational infrastructure, implying that managerial leadership facilitates the development of environments conducive to innovation (Wilden et al., 2013; Zahoor et al., 2023).

OR encompasses a firm's structural, cultural, strategic, and relational preparedness to implement innovation initiatives (Weiner, 2009; Lokuge et al., 2019). Managers with robust DMCs are more inclined to establish flexible structures, foster innovation-conducive cultures, and mobilize cross-boundary collaborations—readiness characteristics in turbulent environments. Empirical studies in digital transformation and high-tech contexts substantiate that DMCs are critical antecedents to organizational readiness (Pan & Xu, 2023; Agyapong et al., 2023).

H1: Dynamic managerial capabilities have a positive effect on organizational readiness.

**H2: Organizational Readiness → Innovation Performance**

Organizational readiness serves as a critical antecedent to innovation execution. Firms that exhibit high readiness are more agile, willing to experiment, and capable of mobilizing cross-functional resources (Scaccia et al., 2015; Shahrasbi & Paré, 2015). These capabilities are particularly vital in high-tech sectors, where innovation timelines are compressed and the risk of failure is elevated.

Readiness fosters innovation by enabling the translation of ideas into scalable outcomes (Rafferty et al., 2013). It builds internal alignment across departments, ensures access to innovation-enabling infrastructure, and creates a supportive culture that tolerates risk and embraces learning (Lokuge et al., 2019). Prior studies confirm that firms with greater innovation readiness outperform peers on product development, patenting, and commercialization (Guenduez & Mergel, 2022; Jun et al., 2022).

H2: Organizational readiness positively influences innovation performance

**H3: Dynamic Managerial Capabilities → Innovation Performance**

The dynamic capabilities perspective posits that superior managerial capabilities are essential for innovation under conditions of environmental turbulence (Schoemaker et al., 2018; Teece, 2007). Managers must be able to sense emerging opportunities, seize them through timely resource reallocation, and transform firm routines to maintain competitiveness.

In digitally transforming economies, digital literacy has emerged as a central enabler of innovation performance (Pan & Xu, 2023; Zahoor et al., 2023). Managers with strong digital capabilities lead more successful digital initiatives, engage in real-time data-informed decision-making, and adopt frontier technologies (Cetindamar et al., 2022). Empirical studies in high-tech sectors consistently link DMCs—especially those integrating digital skills—to firm innovation outcomes (Agyapong et al., 2023; Wang & Wang, 2012).

H3: Dynamic managerial capabilities positively influence innovation performance.

**H4: Organizational Readiness mediates the DMC → IP relationship**

While DMCs influence innovation performance, this effect may manifest indirectly in organizations, necessitating cross-functional coordination, cultural alignment, and a robust readiness infrastructure. Readiness may serve as the "activation mechanism" to actualize the capability potential (Rafferty et al., 2013; Schilke et al., 2018).

Organizations exhibiting robust DMCs can enhance their preparedness by reforming organizational structures, investing in cultural initiatives, and establishing strategic alignment. This approach consequently escalates the probability of success for innovation projects. Recent empirical investigations substantiate this mediating pathway within the realms of digital and emerging economies (Arshi & Rao, 2019; Jun et al., 2022), indicating that OR is not merely a contextual variable but a fundamental translational layer.

H4: Organizational readiness mediates the relationship between dynamic managerial capabilities and innovation performance.



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**H5: Environmental Factors moderate DMC → OR**

In volatile, competitive, and resource-rich settings, managers must reconfigure structures more rapidly, making dynamic managerial capabilities (DMCs) especially salient for building organizational readiness (OR). Prior work shows that environmental dynamism heightens the value of top-manager agility for internal alignment (Li & Liu, 2014; Schilke, 2014). Competitive pressure further compresses decision windows, forcing managers to translate cognitive insight and social ties into swift structural change (Porter, 1980; Zhou & Li, 2010). In supportive institutional contexts—rich in subsidies, R&D infrastructure, and collaboration platforms—firms can mobilise external resources that magnify the preparatory impact of DMCs (Autio & Thomas, 2014; Zaheer & Bell, 2005).

H5: Environmental Factors positively moderate the relationship between dynamic managerial capabilities and organizational readiness.

**H6: Environmental Factors moderate OR → IP**

When an industry simultaneously exhibits high environmental dynamism, intense competition, and institutional support, the marginal contribution of OR to innovation performance rises markedly. Rapid technological change and competitive pressure compress product life cycles and raise the cost of innovation failure, making OR a critical safeguard for transforming innovative ideas into market outcomes. (Auh & Menguc, 2005; Jansen et al., 2006). Supportive policy regimes provide legitimacy and risk-sharing that help ready firms extract greater value from innovation investments (Berchicci et al., 2016; Wu et al., 2016).

H6: Environmental Factors positively moderate the relationship between organizational readiness and innovation performance.

**H7: Environmental Factors moderate DMC → IP**

The direct translation of DMCs into innovation performance (IP) is also context-sensitive. Under rapid technological change, superior managerial cognition and digital literacy become more effective in orchestrating new product launches (Wilden & Gudergan, 2014; Zahoor et al., 2023). Competitive intensity raises the stakes of timely innovation, enhancing the returns to managerial skill (Kafouros et al., 2023). Meanwhile, supportive ecosystems—through subsidies, partnerships, and knowledge spill-overs—facilitate the transformation of managerial capability into concrete innovations, especially in emerging economies (Gaur et al., 2017; Li & Atuahene-Gima, 2001).

H7: Environmental Factors positively moderate the relationship between dynamic managerial capabilities and innovation performance.

## Methodology

### 1. Measurement Instrument

The measurement instrument was designed based on validated constructs from prior literature and adapted to the context of high-tech firms in China. Dynamic managerial capabilities (DMCs) were measured using a four-dimensional scale encompassing cognitive, human, social, and digital literacy capabilities. This adaptation draws on Helfat and Martin (2015), Adner and Helfat (2003), and Zahoor et al. (2023), with digital literacy items reflecting managers' ability to use data, systems, and digital tools effectively.

Organizational readiness (OR) was measured using five items capturing structural, cultural, and leadership readiness, adapted from Weiner (2009) and Lokuge et al. (2019). Innovation performance (IP) was conceptualized using a five-factor structure—financial, marketing, technical, customer, and strategic performance—adopted from Pimsuwan et al. (2023), Hannachi (2015), and Griffin and Page (1996).

Environmental context was measured as a second-order formative construct composed of three reflective dimensions: dynamism, competitiveness, and institutional support. These dimensions were adapted from Schilke (2014), Zahoor et al. (2023), and regional policy frameworks.



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All reflective measures were scored using a seven-point Likert scale (1 = strongly disagree to 5 = strongly agree). The questionnaire underwent expert validation and translation following the back-translation method to ensure linguistic and contextual equivalence. A pilot test with 38 respondents from the target population led to minor wording revisions and confirmed the reliability of all constructs (Cronbach's alpha > 0.80).

This instrument thus reflects theoretical robustness and contextual relevance for the empirical testing of the proposed framework.

**2. Sampling and Data Collection**

The study employed a multi-stage sampling strategy to ensure broad representation across high-tech firms in the Chengdu–Chongqing region. The initial population frame consisted of 3,200 firms listed in provincial innovation databases and regional industrial development zones.

A stratified sampling method was used based on three criteria: (1) firm size (micro, small, medium), (2) industry subsector (e.g., electronics, biotech, software), and (3) geographic location within the Chengdu–Chongqing economic zone. This ensured that variation in innovation orientation and resource context was captured.

The survey was distributed in July–August and October–November 2023 to enhance data reliability and improve participation. This staggered approach accounted for seasonal workload fluctuations and allowed additional follow-up with non-respondents.

Of 1,002 valid contact points, 568 completed responses were received (response rate = 56.7%). After screening for completeness, consistency, and eligibility criteria (i.e., firms operating for>3 years with a defined innovation function), 488 usable responses remained for analysis.

Participants included senior and mid-level managers directly responsible for strategic decision-making, innovation oversight, or organizational planning. The final sample reflects sectoral balance, with approximately 40% from electronics and digital tech, 25% from advanced manufacturing, and the rest from biotech, green tech, and service-based innovation sectors.

All respondents were assured that ethical review standards would be obtained, anonymity would be ensured, and informed consent would be obtained.

**3. Respondent Profile**

Table 1 summarizes the demographic characteristics of the respondents and the firms they represent. The data captures **individual-level attributes** (e.g., education, position, and years of experience) and **firm-level attributes** (e.g., industry type, location, ownership, and firm size). This dual-level profiling provides a comprehensive view of the study's context.

Regarding education levels, 47% of respondents held a bachelor's degree, 28% a master's, and 13% a doctoral degree, totaling 88%. The remaining 12% held qualifications below a bachelor's level.

In the company location and industry type categories, the label "Other" refers to firms operating in mixed or emerging subsectors that do not fall neatly into standard classifications. For example:

"Other" industry types include firms in robotics, nanotechnology, or cross-disciplinary R&D.

"Other" locations include adjacent economic zones that are not officially part of Chengdu or Chongqing but are included in the regional innovation corridor.

This clarification ensures the representativeness of firms across the full spectrum of the Chengdu–Chongqing economic circle.

**Table 1** Demographic characteristics

| Characteristics | Frequency | Percent |
|---|---|---|
| Education level | | |
| Under a bachelor's degree | 60 | 12% |
| Bachelor's degree | 228 | 47% |
| Master's degree | 135 | 28% |
| Doctoral degree | 65 | 13% |
| Years of experience in the high-tech industry | | |
| Less than 3 years | 77 | 16% |
| 3-5 years | 133 | 27% |
| 6-10 years | 157 | 32% |



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| Characteristics | Frequency | Percent |
|---|---|---|
| 11-15 years | 80 | 16% |
| More than 15 years | 41 | 8% |
| Position in current company | | |
| Senior management | 86 | 18% |
| Middle-level managers | 112 | 23% |
| Grassroots management personnel | 99 | 20% |
| Professional and technical personnel | 136 | 28% |
| Experts and consultants | 42 | 9% |
| Others | 13 | 3% |
| The company's main business | | |
| Electronic information and intelligent terminals | 74 | 15% |
| Intelligent network-connected and new energy vehicles | 83 | 17% |
| High-end equipment manufacturing | 63 | 13% |
| New materials | 57 | 12% |
| Biomedicine and medical devices | 76 | 16% |
| New generation information technology | 80 | 16% |
| Energy conservation and environmental protection | 49 | 10% |
| Other high-tech industries | 6 | 1% |
| Company Location | | |
| Chengdu City | 161 | 33% |
| Chongqing City | 137 | 28% |
| Chengdu and the surrounding areas | 86 | 18% |
| The Chongqing surrounding areas | 89 | 18% |
| Other | 15 | 3% |
| Number of employees | | |
| 50 or less | 42 | 9% |
| 50-149 people | 70 | 14% |
| 150-299 people | 99 | 20% |
| 300-499 people | 147 | 30% |
| 500 people and above | 130 | 27% |
| Ownership of the Company | | |
| State-owned enterprises | 129 | 26% |
| Private enterprises | 214 | 44% |
| Sino-foreign joint ventures | 128 | 26% |
| Wholly Foreign-Owned Enterprise | 17 | 3% |

## 4. Analysis Method

This study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 4.0 (Ringle et al., 2022) to test the measurement and structural models. PLS-SEM is well-suited for this study due to its strength in handling complex models with latent constructs and its applicability in theory-building research in emerging market contexts.

The Variance Inflation Factor (VIF) values were calculated for all predictor variables to ensure the structural model's reliability and rule out multicollinearity. All VIF values were below the conservative threshold of 3.3, indicating no multicollinearity concerns (Hair et al., 2017).



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The measurement model was evaluated using standard criteria: indicator reliability (outer loadings > 0.708), composite reliability (CR > 0.70), convergent validity (AVE > 0.50), and discriminant validity using HTMT (threshold < 0.85). The two-stage approach was applied to model second-order constructs, such as Dynamic Managerial Capabilities and Organizational Readiness, enhancing model parsimony and validity. The structural model evaluation included:

- $R^2$ values to assess explained variance,
- $f^2$ effect sizes for individual paths,
- $Q^2$ values for predictive relevance via blindfolding,
- and bootstrapping (5,000 resamples) to determine path significance.

This approach ensures a rigorous and methodologically robust analysis consistent with current best practices in PLS-SEM literature.

## Results

This section presents the results of the PLS-SEM analysis in four stages: (1) model fit, (2) measurement model assessment, (3) structural model results, including mediation analysis, and (4) moderation effects.

### 1. Model Fit

The second-order reflective model was assessed using multiple model fit indices. The SRMR value of 0.043 was below the conservative threshold of 0.08, indicating acceptable global model fit (Henseler et al., 2016). Additional metrics such as d_ULS (0.793), d_G (0.504), and HI99 values (all within acceptable ranges) further confirmed the model's adequacy.

### 2. Measurement Model Evaluation

All latent constructs exhibited strong psychometric properties.

- Outer loadings exceeded 0.708,
- Cronbach's alpha and composite reliability values were above 0.85,
- AVE values exceeded 0.65, demonstrating convergent validity,
- HTMT values were well below 0.90, supporting discriminant validity.

These results affirm that both first-order and second-order constructs meet the standards for reliability and validity.

**Table 2** Evaluation of the measurement model

**Panel A: Indicators' reliability and validity**

| Constructs | Factor loading | Cronbach's alpha | Composite reliability ($\rho_a$) | Composite reliability ($\rho c$) | Average variance extracted (AVE) |
|---|---|---|---|---|---|
| Dynamic Managerial Capabilities | | 0.878 | 0.879 | 0.916 | 0.733 |
| MC | 0.872 | 0.853 | | | |
| MHC | 0.856 | 0.821 | | | |
| MSC | 0.859 | 0.822 | | | |
| MDL | 0.836 | 0.837 | | | |
| Organizational Readiness | | 0.872 | 0.872 | 0.912 | 0.722 |
| SR | 0.844 | 0.826 | | | |
| CR | 0.848 | 0.833 | | | |
| STR | 0.844 | 0.840 | | | |
| OIR | 0.863 | 0.856 | | | |
| Innovation Performance | | 0.868 | 0.87 | 0.905 | 0.656 |

**Panel B: discriminant validity (HTMT)**

| | DMC | IP | OR |
|---|---|---|---|
| DMC | | | |
| IP | 0.892 | | |
| OR | 0.881 | 0.84 | |



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As shown in Table 2, all factor loadings exceeded 0.708 (Hair Jr et al., 2021). Composite reliability (CR) values remained above 0.7, indicating good internal consistency and structural reliability (Hair et al., 2019). AVE values ranged from 0.656 to 0.733, establishing convergent validity (Fornell & Larcker, 1981); all HTMT values were below the conservative threshold of 0.90 (Henseler et al., 2015).

**3. Structural Model Results and Mediation Analysis**

The structural model demonstrated solid explanatory power, with $R^2$ values of 0.596 for Organizational Readiness (OR) and 0.649 for Innovation Performance (IP), indicating moderate to strong model predictiveness.

Key findings include:

- **H1 (DMC → OR):** $\beta = 0.772$, $p < 0.01$ – strong and significant.
- **H2 (OR → IP):** $\beta = 0.319$, $p < 0.01$ – moderate effect.
- **H3 (DMC → IP):** $\beta = 0.533$, $p < 0.01$ – direct effect confirmed.

**Table 3** Structural Model Results and Hypothesis Testing

| Hypotheses and paths | | Path Coefficient | t-values | p-values | $f^2$ | VIF | Result | Effect evaluation |
|---|---|---|---|---|---|---|---|---|
| H1 | DMC →OR | 0.772 | 26.837 | 0 | 1.475 | 1.189 | Support | Large effect |
| H2 | OR → IP | 0.319 | 4.829 | 0 | 0.117 | 2.526 | Support | Small effect |
| H3 | DMC → IP | 0.533 | 8.262 | 0 | 0.327 | 2.582 | Support | Medium effect |

The significance of the hypothesized direct relationships was assessed using the PLS-SEM approach and bootstrapping with 5,000 resamples. As shown in Table 3, all three hypothesized paths are statistically significant at the 1% level ($p < 0.01$), indicating strong empirical support for the proposed model. According to Cohen (1988), $f^2$ values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively.

H1 (DMC → OR) – Dynamic managerial capabilities strongly raise organizational readiness ($\beta = 0.772$, $t = 26.837$, $p < 0.01$; $f^2 = 1.475$, large).

H2 (OR → IP) – Organizational readiness improves innovation performance ($\beta = 0.319$, $t = 4.829$, $p < 0.01$; $f^2 = 0.117$, small).

H3 (DMC → IP) – Dynamic managerial capabilities also have a direct, moderate impact on innovation performance ($\beta = 0.533$, $t = 8.262$, $p < 0.01$; $f^2 = 0.327$, medium).

By the full collinearity test delineated by Kock (2015), all variance inflation factor (VIF) values for the second-order latent constructs within the model varied from 1.19 to 2.58, which remains significantly beneath the conservative threshold of 3.3. This observation implies that common method variance (CMV) is unlikely to seriously threaten the validity of the results.

**Table 4** Coefficient of Determination ($R^2$) and Predictive Relevance ($Q^2$)

| Variables | $R^2$ | $R^2$ adjusted | Evaluate | $Q^2$ | predictive relevance |
|---|---|---|---|---|---|
| OR | 0.596 | 0.595 | Moderate | 0.427 | Yes |
| IP | 0.649 | 0.647 | Moderate to Strong | 0.421 | Yes |

The model accounts for 59.6% of the variance in organizational readiness and 64.9% in innovation performance. Predictive relevance assessments substantiate these figures: $Q^2$ values of 0.427 for organizational readiness and 0.421 for innovation performance exceed zero, indicating that the model forecasts out-of-sample behavior rather than merely conforming to the sample data (Hair et al., 2019).

**4. Mediation Effect Analysis**

A mediation analysis was conducted using bootstrapping with 5,000 resamples. The indirect effect from DMC to IP through OR was $\beta = 0.246$ ($p < 0.01$), indicating partial mediation with a VAF of 31.6%. This supports H4 and validates the role of OR as a key conduit through which managerial capabilities influence innovation.



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**Table 5** Mediation Analysis Results

| Effect type | Path | Effect | 95% Confidence Interval | Interpretation |
|---|---|---|---|---|
| Direct Effect | DMC → IP | 0.321 | [0.205, 0.436] | Significant |
| Indirect Effect | DMC → OR → IP | 0.246 | [0.148, 0.359] | Significant |
| Total Effect | DMC → IP (Total) | 0.779 | [0.734, 0.82] | Significant |
| VAF | Indirect Effect/Total Effect | 31.60% | - | Partial mediation |

*Note: VAF = (Indirect Effect) / (Total Effect)*

Figure 2 illustrates the second-order PLS-SEM structural model. Dynamic management capability (DMC) and organizational readiness (OR) are second-order reflective constructs, each comprising four first-order dimensions. The figure represents the principal effect chain DMC→OR→IP, devoid of any moderated paths, and presents the standardized path coefficients (β) as well as the $R^2$ values of the endogenous variables.

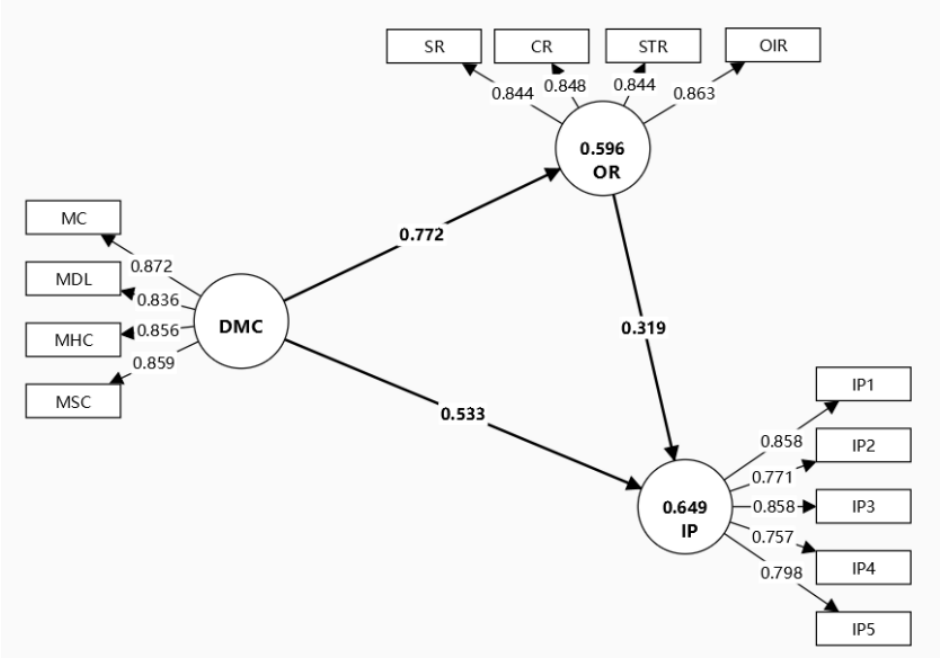


**Figure 2** Structural model results for the second-order PLS-SEM analysis

## 5. Moderating Effect Analysis

Interaction terms were introduced to assess the moderating role of environmental factors (EF).

- H5 (EF × DMC → OR): β = 0.098, p = 0.026 – significant moderation.
- H6 (EF × OR → IP): Not significant (p = 0.491).
- H7 (EF × DMC → IP): Not significant (p = 0.272).

Interestingly, only H5 was supported, suggesting that environmental conditions moderate the influence of DMCs on readiness, but not their influence on innovation outcomes. This finding supports the contingency perspective that external conditions selectively shape the internal capability-performance pathways.



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**Table 6** Hypothesis Testing for Moderating Effects (H5–H7)

| Hypothesis and Path | | Interaction Effect | T-values | P-values | $f^2$ | Result |
|---|---|---|---|---|---|---|
| H5 | EF x DMC → OR | 0.098 | 2.232 | 0.026 | 0.017 | Support |
| H6 | EF x OR → IP | 0.044 | 0.689 | 0.491 | 0.002 | NO |
| H7 | EF x DMC →IP | 0.07 | 1.098 | 0.272 | 0.006 | NO |

Figure 3 demonstrates the moderating effect of environmental factors (EF) on the relationship between dynamic managerial capabilities (DMC) and organizational readiness (OR). The simple slope analysis indicates that DMC exerts a consistently positive effect on OR across all levels of EF. However, the strength of this relationship diminishes as EF becomes more favorable: the slope decreases from approximately 0.50 at low EF (−1 SD) to 0.45 at the mean, and to 0.37 at high EF (+1 SD). This pattern suggests a substitution effect; in more supportive environments, the role of DMC in fostering organizational readiness becomes less critical, as firms benefit from external stability and institutional support. Conversely, robust managerial capabilities are essential under less favorable conditions to compensate for environmental constraints and promote readiness.

A simple slope analysis revealed that DMCs had a more substantial effect on OR under low EF conditions, suggesting a substitution effect where external support diminishes the marginal value of internal managerial agility.

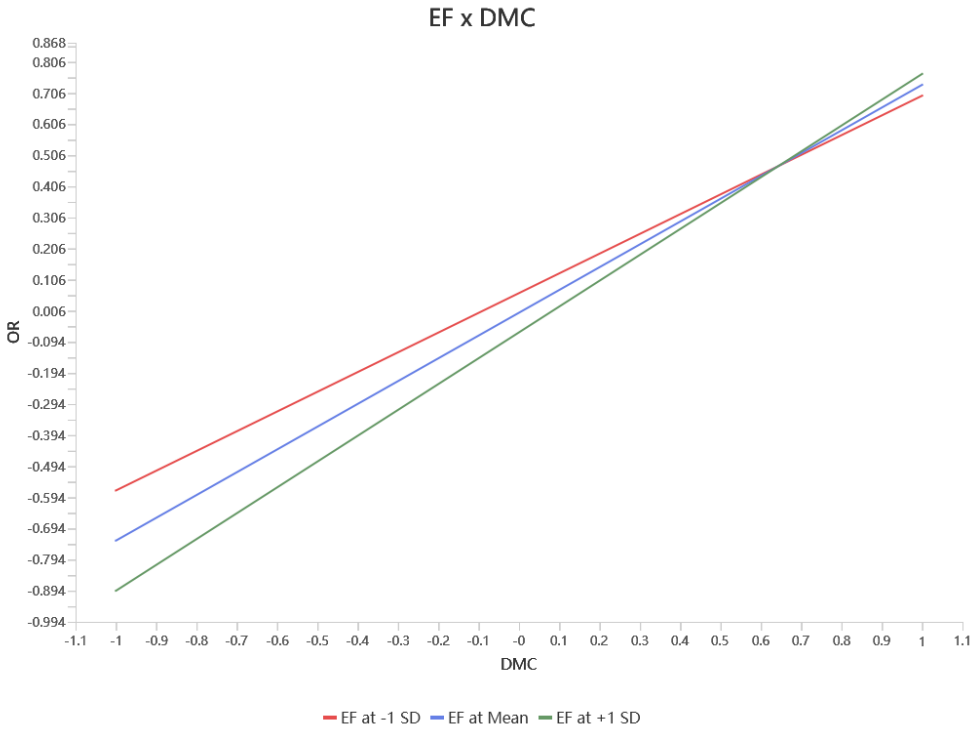


**Figure 3** The Interaction Plot with Simple Slopes

## Discussion

### 1. Theoretical Implications

This study contributes to the advancement of Dynamic Capability Theory by empirically validating digital literacy as a fourth core dimension of Dynamic Managerial Capabilities (DMCs), alongside cognition, human capital, and social capital. This refinement addresses recent calls for a more digitally



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attuned capability framework in the era of rapid technological transformation (Zahoor et al., 2023; Pan & Xu, 2023).

Furthermore, by identifying Organizational Readiness (OR) as a mediating mechanism between DMCs and Innovation Performance (IP), the study extends the capability–performance literature (Schilke et al., 2018). OR is positioned as the "activation layer" through which strategic capabilities are translated into innovation outcomes, particularly in emerging market firms facing institutional complexity.

This research also engages with Contingency Theory by testing whether environmental conditions—specifically dynamism, competitiveness, and institutional support—moderate internal capability pathways. Contrary to expectations, the moderating effect was only significant for DMC → OR, suggesting that external environments shape organizational preparedness, but do not necessarily alter the capability–performance relationship. This challenges the assumption that environmental support always amplifies internal strengths and supports a more nuanced, selective contingency perspective (Agyapong et al., 2023; Schilke, 2014).

**2. Practical Implications**

**For Managers:**

Firms in emerging high-tech regions must prioritize the development of digital leadership across all managerial levels. Investments in tools, training, and decision-making frameworks that support digital agility will be critical. Furthermore, building organizational readiness through open innovation systems, cross-functional alignment, and cultural support can substantially enhance a firm's capacity to convert strategic intent into innovation outcomes.

Even in supportive policy environments, internal readiness cannot be substituted. Instead, external support should complement—not replace—internal agility. The diminishing marginal effect of external factors at high support levels underscores the risk of over-relying on subsidies or infrastructure without fostering internal adaptability.

**For Policymakers:**

Governments should recognize the complementarity between institutional support and internal capabilities. Policies that promote technology adoption, managerial digital literacy, and organizational learning ecosystems are essential for long-term competitiveness. Cross-regional innovation networks, digital capability development programs, and talent pipelines are vital to sustain innovation performance in volatile contexts.

**3. Comparison with Prior Research**

The findings reinforce the mainstream view that DMCs are critical drivers of innovation, consistent with studies such as Helfat & Martin (2015), Wilden et al. (2013), and Fainshmidt et al. (2016). The partial mediation of OR corroborates arguments by Schilke et al. (2018) regarding the "missing link" between capability stocks and innovation flows.

However, unlike studies that report strong moderation by environmental dynamism (e.g., Wilhelm et al., 2015), this study finds limited moderation, echoing Agyapong et al. (2023), who emphasize selective environmental effects in emerging economies. The confirmation of digital literacy as a core DMC dimension aligns with newer empirical trends that position digital fluency as a strategic competence in turbulent markets (Zahoor et al., 2023).

## Conclusion

This study examined how Dynamic Managerial Capabilities (DMCs) influence Innovation Performance (IP) in emerging high-tech firms, both directly and indirectly through Organizational Readiness (OR), with a focus on the Chengdu–Chongqing economic region. Drawing on Dynamic Capability Theory, the Resource-Based View, and Contingency Theory, we developed and tested a moderated mediation model using PLS-SEM with data from 488 managers.

The results demonstrate that:

- DMCs significantly improve OR and IP, supporting the idea that managers' strategic, social, and digital capabilities are key innovation enablers.
- OR partially mediates the DMC → IP relationship, confirming its role as an internal activation mechanism that transforms potential into outcomes.
- Only one environmental factor interaction (EF × DMC → OR) was statistically significant, suggesting that environmental conditions selectively influence internal capability activation, but not all capability-performance pathways.



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This supports a more contextualized view of capability deployment—external support may strengthen, weaken, or substitute internal efforts, depending on the environmental configuration. These findings refine our understanding of how firms operating in institutionally complex, rapidly digitizing economies can better leverage managerial competencies for innovation.

**Limitations and Future Research**

While this study contributes to theory and practice, several limitations remain:

- Cross-sectional design: This limits causal inference. Future research could employ longitudinal or mixed-method designs to capture capability evolution.
- Perceptual measures: All variables were self-reported. Incorporating objective indicators—such as R&D spending, patent counts, or actual innovation output—would enhance robustness.
- Single-region scope: Although Chengdu–Chongqing is a key innovation hub, expanding to multi-regional or cross-national samples would strengthen generalizability.

Future studies might also explore interactions among capabilities, such as the interplay between digital literacy and open innovation practices, or investigate the temporal sequencing of DMC development and OR maturity in dynamic environments.

**Appendix A:** Constructs, Dimensions, and Sources of Measurement Scales

| Construct | Item | Description |
|---|---|---|
| **Dynamic Managerial Capabilities (DMC)** | | |
| Managerial Cognition (Corrêa et al., 2019; Hodgkinson & Healey, 2011) | MC1 | Management keenly discerns technological trends in the industry and swiftly adjusts strategy. |
| | MC2 | Management makes forward-looking decisions based on market and competitive dynamics and formulates matching strategies. |
| | MC3 | Management flexibly responds to external uncertainty, dynamically reallocating resources and redirecting business focus. |
| Managerial Human Capital (Corrêa et al., 2019; Dimov, 2017) | MHC1 | Management's extensive industry experience enhances the firm's innovation capability. |
| | MHC2 | Management's educational background and professional expertise contribute positively to the firm's strategic development. |
| | MHC3 | Management regularly attends industry forums, training, or high-level exchanges to upgrade professional competence continually. |
| Managerial Social Capital (Acquaah, 2007; Corrêa et al., 2019) | MSC1 | Management collaborates closely with peer firms, universities, and research institutions to facilitate innovation resource flow. |
| | MSC2 | Management sustains strong relations with government agencies, helping secure policy support and sectoral guidance. |
| | MSC3 | Management acquires cutting-edge technology, market trends, and policy information through industry social networks. |
| Managerial Digital Literacy (Avinç & Doğan, 2024; Chetty et al., 2018) | MDL1 | Management is proficient in using data analytics tools to support corporate decision-making. |
| | MDL2 | Management drives digital transformation to enhance efficiency and innovation. |
| | MDL3 | Management is well-versed in artificial intelligence, big data, and other frontier technologies and effectively integrates them into business processes. |
| **Organizational Readiness (OR)** | | |
| Structural Readiness (Hameed et al., 2012; Uzkurt et al., 2013) | SR1 | The organizational structure supports cross-department collaboration and stimulates innovation. |
| | SR2 | The firm possesses ample financial, human, and technological resources for innovation. |



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| Construct | Item | Description |
|---|---|---|
| | SR3 | The firm has a robust digital infrastructure that underpins innovation activities. |
| Cultural Readiness (Uzkurt et al.,2013; Lokuge et al.,2019) | CR1 | The organizational culture encourages employees to propose innovative ideas and offers corresponding rewards. |
| | CR2 | Top management supports experimentation and tolerates reasonable failure. |
| | CR3 | The firm has established efficient knowledge-sharing and learning mechanisms that spark innovative thinking. |
| Strategic Readiness (Uzkurt et al.,2013; Lokuge et al.,2019) | STR1 | Innovation is a core strategic goal of the firm, with a clear roadmap. |
| | STR2 | Budgets and resource allocations give priority to innovation projects. |
| | STR3 | The firm has an innovation governance mechanism that ensures senior management regularly reviews and optimizes the innovation strategy. |
| Open Innovation Readiness (Clausen, 2013; Lichtenthaler, 2008) | OIR1 | The firm collaborates with external enterprises, research institutions, or industry alliances and shares innovation resources. |
| | OIR2 | The firm absorbs external technologies and knowledge and applies them effectively in innovation practice. |
| | OIR3 | Open-innovation collaborations, such as new products, technologies, or business-model innovations, have yielded substantial outcomes. |
| **Innovation Performance** (Jiménez-Jiménez & Sanz-Valle,2011; Wang & Wang,2012; Zhu and Chen,2008) | IP1 | In the past three years, the number of new products/services launched by companies has increased significantly. |
| | IP2 | The company has seen significant growth in core technologies/patents over the past three years. |
| | IP3 | The competitiveness of the company's innovative products/technologies in the market has significantly improved. |
| | IP4 | The company's Innovation achievements have significantly grown operating income or profits in the past three years. |
| | IP5 | The company continues to increase its investment in innovation and has established a stable mechanism. |
| **Environmental Factors (EF)** | | |
| Environmental Dynamism (Jaworski & Kohli, 1993; Li & Liu, 2014) | ED1 | The market demand and technology of the industry in which the company operates have changed rapidly in the past three years. |
| | ED2 | Over the past three years, the company's industry's competitive landscape and customer demands have changed frequently, requiring constant strategy adjustment. |
| Environmental Competitiveness (Jaworski & Kohli,1993; Jansen et al., 2006) | EC1 | The current industry competition is fierce, and companies will struggle to maintain their market position unless they continue to innovate. |
| | EC2 | The main competitors update their technology or products rapidly, which puts greater pressure on the company. |
| Environmental Supportiveness (Li & Atuahene-Gima, 2001; Zaheer & Bell, 2005) | ES1 | Enterprises can obtain government science and technology support policies (subsidies, tax incentives, science and technology funds, etc.). |
| | ES2 | The region where the enterprise is located has a good innovation ecosystem (such as rich resources, university cooperation, venture capital, and incubators). |



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**Appendix B:** Reliability and convergent validity of first-order constructs

| Constructs | Loading | Cronbach's alpha | Composite reliability ($\rho_a$) | Composite reliability ($\rho c$) | Average variance extracted (AVE) |
|---|---|---|---|---|---|
| Managerial Cognition (MC) | | 0.853 | 0.855 | 0.911 | 0.773 |
| MC1 | 0.846 | | | | |
| MC2 | 0.894 | | | | |
| MC3 | 0.898 | | | | |
| Managerial Human Capital (MHC) | | 0.821 | 0.821 | 0.894 | 0.738 |
| MHC1 | 0.898 | | | | |
| MHC2 | 0.876 | | | | |
| MHC3 | 0.8 | | | | |
| Managerial Social Capital (MSC) | | 0.822 | 0.823 | 0.894 | 0.737 |
| MSC1 | 0.869 | | | | |
| MSC2 | 0.859 | | | | |
| MSC3 | 0.848 | | | | |
| Managerial Digital Literacy (MDL) | | 0.837 | 0.839 | 0.902 | 0.754 |
| MDL1 | 0.877 | | | | |
| MDL2 | 0.84 | | | | |
| MDL3 | 0.887 | | | | |
| Structural Readiness (SR) | | 0.826 | 0.828 | 0.896 | 0.742 |
| SR1 | 0.876 | | | | |
| SR2 | 0.843 | | | | |
| SR3 | 0.864 | | | | |
| Cultural Readiness (CR) | | 0.833 | 0.834 | 0.9 | 0.75 |
| CR1 | 0.869 | | | | |
| CR2 | 0.859 | | | | |
| CR3 | 0.87 | | | | |
| Strategic Readiness (STR) | | 0.84 | 0.847 | 0.904 | 0.758 |
| STR1 | 0.847 | | | | |
| STR2 | 0.9 | | | | |
| STR3 | 0.864 | | | | |
| Open Innovation Readiness (OIR) | | 0.856 | 0.856 | 0.912 | 0.777 |
| OIR1 | 0.873 | | | | |
| OIR2 | 0.896 | | | | |
| OIR3 | 0.874 | | | | |
| Innovation Performance（IP） | | 0.868 | 0.87 | 0.905 | 0.656 |
| IP1 | 0.858 | | | | |
| IP2 | 0.771 | | | | |
| IP3 | 0.858 | | | | |
| IP4 | 0.757 | | | | |
| IP5 | 0.799 | | | | |



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## Recommendation

### Practical Recommendations

Improving Teaching Methods: Art-related disciplines require educational institutions to adopt interactive and student-focused teaching methods, which will improve student involvement and creative thinking.

Enhancing Teacher Training: Educators require consistent professional development opportunities to become acquainted with new teaching tools and interdisciplinary methods.

Curriculum Development: Educational programs need revision to incorporate new teaching approaches and digital resources that match today's educational trends and student demands.

### Recommendations for Further Research

Diverse Student Populations: Subsequent research needs to evaluate how the suggested teaching methods influence students with different educational histories, cultural environments, and academic standings.

Longitudinal Studies: Perform extended research to analyze how new teaching methods continue to affect student performance and engagement over time.

Comparative Analyses: Studying how traditional and modern teaching methods perform in various institutions across different areas could provide valuable information for wider use.

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