# Innovation Ecosystem Engagement and Innovation Performance: The Roles of Dynamic Capabilities and Digital Maturity

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## Abstract

In the digital era, innovation ecosystem engagement (IEE) has emerged as a critical strategic imperative for firms seeking to enhance their innovation performance. This study investigates the complex relationship between IEE and firm innovation performance (IP), examining the mediating role of dynamic capabilities (DC) and the moderating effect of organizational digital maturity (ODM). Drawing on resource-based view, dynamic capabilities theory, and innovation ecosystem theory, we developed a comprehensive theoretical model tested through structural equation modeling with data from 354 employees across 44 firms in technology-intensive industries in City M, China. Results reveal that IEE significantly enhances innovation performance through the development of dynamic capabilities, with this relationship being strengthened by higher levels of organizational digital maturity. Specifically, dynamic capabilities partially mediate the relationship between IEE and innovation performance ($\beta = 0.35$, $p < 0.001$), while organizational digital maturity significantly moderates the IEE-IP relationship ($\beta = 0.15$, $p < 0.001$). The model explains 42% of variance in dynamic capabilities and 56% of variance in innovation performance. These findings contribute to innovation management literature by integrating ecosystem, capability, and digital transformation perspectives, providing actionable insights for managers seeking to optimize their innovation strategies in digital contexts.

**Keywords:** Innovation ecosystem engagement, Dynamic capabilities, Organizational digital maturity, Innovation performance

## Introduction

The current business landscape is defined by unprecedented levels of technological disruption, market volatility, and competitive complexity that challenge traditional approaches to innovation management. In this context, the emergence of innovation ecosystems represents a shift from closed, internally-focused innovation models to open, collaborative networks that leverage distributed knowledge and resources across organizational boundaries (Adner, 2017). These ecosystems, which include universities, research institutions, government agencies, venture capitalists, and complementary firms, have become critical platforms for knowledge creation, resource mobilization, and capability development in the global economy.

The accelerating digital transformation across industries has increased the importance of ecosystem participation, as firms increasingly rely on external collaborations to access cutting-edge technologies, develop digital capabilities, and navigate complex technological landscapes (Vial, 2019). Research has found that firms engaged in innovation ecosystems demonstrate superior innovation outcomes compared to those pursuing isolated innovation strategies, yet the mechanisms through which ecosystem participation translates into enhanced innovation performance remain insufficiently understoo (Rabelo et al., 2024).

Dynamic capabilities, defined as a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments, have emerged as a critical mediating mechanism linking ecosystem engagement with innovation outcomes (Teece et al., 1997). The sensing, seizing, and reconfiguring capabilities that constitute the dynamic capabilities framework enable firms to effectively leverage ecosystem resources and transform external knowledge into internal innovation capabilities. However, the extent to which digital maturity affects these relationships remains underexplored, despite growing recognition that organizational digital infrastructure and capabilities are crucial to innovation processes in contemporary business environments.

From research on innovation ecosystems and their impact on organizational performance, it has been found that there are significant gaps in research that require further study, especially in areas related to digital transformation, which is becoming increasingly important in today's business environment. The importance of digital transformation may alter how ecosystem participation impacts innovation performance, particularly the role of organizational digital maturity in ecosystem participation, which has been minimally studied in prior research (Vial, 2019). Therefore, studying this issue is critical, as understanding the impact of digital capabilities and digital infrastructure on ecosystem participation effectiveness will be a key factor enabling organizations to effectively leverage innovation ecosystems in a more digitized business environment (Qial & Niu, 2024; Hahn et al., 2018).

Therefore, based on research on innovation ecosystems and their impact on organizational performance, it is evident that there is a critical research gap in understanding the impact of digital maturity in the context of innovation ecosystem participation. This gap has been minimally addressed in prior studies, especially in terms of the relationship between digital capabilities and ecosystem participation, which can significantly affect the development of internal innovation capabilities within organizations. Research in this area is essential to understand how digital elements within organizations can play a key role in enhancing the effective use of resources within innovation ecosystems, enabling firms to quickly and efficiently adapt to technological changes.

**Research Objectives**

1. To examine the direct relationship between innovation ecosystem engagement (IEE) and firm innovation performance (IP).
2. To explore the mediating role of dynamic capabilities (DC) in the relationship between innovation ecosystem engagement (IEE) and innovation performance (IP) , clarifying whether the mediation is full or partial.
3. To investigate the moderating effect of organizational digital maturity (ODM) on the relationship between innovation ecosystem engagement (IEE) and innovation performance (IP) , as reflected in the research model.
4. To analyze the combined mediating role of dynamic capabilities (DC) and the moderating effect of organizational digital maturity (ODM) jointly enhancing the relationship between innovation ecosystem engagement (IEE) and innovation performance (IP).

**Hypotheses**

H1: Innovation ecosystem engagement (IEE) positively influences dynamic capabilities (DC).

H2: Dynamic capabilities (DC) positively influence innovation performance (IP).

H3: Innovation ecosystem engagement (IEE) has a direct positive effect on innovation performance (IP).

H4 : Dynamic capabilities (DC) partially mediate the relationship between innovation ecosystem engagement (IEE) and innovation performance (IP).

H5 : Organizational digital maturity (ODM) moderates the relationship between innovation ecosystem engagement (IEE) and innovation performance (IP), such that the relationship is stronger for firms with higher digital maturity.

## Methodology

**Research Design**

This study employs a quantitative research design grounded in the positivist paradigm to test the proposed theoretical model and hypotheses. The research adopts a cross-sectional survey approach that captures the relationships among innovation ecosystem engagement, dynamic capabilities, organizational digital maturity, and innovation performance at a single point in time. This design is appropriate for testing the hypothesized relationships while acknowledging the limitations associated with causal inference from cross-sectional data.

The quantitative approach enables rigorous testing of the proposed theoretical model through advanced statistical techniques, including structural equation modeling, which provides comprehensive assessment of measurement model validity and structural relationships among constructs. The positivist paradigm supports the objective measurement of theoretical constructs and statistical testing of hypotheses, consistent with the theory-testing objectives of this research.

The cross-sectional design, while limiting causal interpretation, is justified by the exploratory nature of the research questions and the need to establish foundational empirical evidence for the proposed theoretical relationships. To address potential common method bias (CMB), procedural remedies such as anonymity assurances, item randomization, and clear instructions were implemented, and Harman's single-factor test was conducted. Future research employing longitudinal designs can build upon these findings to provide stronger evidence for causal relationships among the study variables.

**Sample and Data Collection**

The target population for this study consists of employees in knowledge-intensive firms operating in technology-oriented industries where innovation ecosystem engagement is likely to be strategically important. The sampling frame includes 44 enterprises located in City M, a major metropolitan area with a well-developed innovation ecosystem comprising universities, research institutions, government agencies, and technology firms. These enterprises represent diverse industries including information technology, biotechnology, advanced manufacturing, and professional services, providing a representative sample of firms for whom ecosystem engagement is strategically relevant.

The data collection employed a stratified random sampling approach as initially intended; however, the actual data collection process aligned more closely with a convenience sampling method due to voluntary participation and accessibility constraints. Within each participating enterprise, employees were randomly selected from three organizational levels: senior management, middle management, and technical professionals. This multi-level sampling approach ensures that the data captures perspectives from individuals with different roles and responsibilities related to innovation and ecosystem engagement activities.

Data collection was conducted through an online survey platform (Wenjuanxing) over a 42-day period from March 15 to April 26, 2024. The survey instrument was pilot tested with a small sample of 30 respondents to ensure clarity and reliability of the measurement items. Based on pilot test feedback, minor modifications were made to improve question clarity and response format consistency. The final survey was distributed to 5,732 employees across the 44 participating enterprises.

The data collection process achieved a response rate of 70.80%, resulting in 354 complete and usable responses. The discrepancy between the number of questionnaires distributed and valid responses was verified through firm-level participation records to ensure accuracy. This response rate exceeds typical standards for organizational surveys and provides confidence in the representativeness of the sample. Participants were encouraged to respond through confidentiality assurances and a small non-monetary token of appreciation. Non-response bias was assessed through comparison of early and late respondents on key demographic and organizational variables, revealing no significant differences that would suggest systematic non-response bias.

**Data Analysis Methods**

Data analysis proceeded through multiple stages to ensure comprehensive evaluation of the measurement model and testing of the structural relationships. Descriptive statistics and correlation analyses were conducted to examine variable distributions and bivariate relationships among study constructs. These preliminary analyses provided insights into data characteristics and initial evidence for the hypothesized relationships.

Structural equation modeling (SEM) using AMOS 24.0 served as the primary analytical approach for testing the proposed theoretical model. SEM enables simultaneous estimation of measurement model parameters and structural relationships while providing comprehensive assessment of model fit and explanatory power. The two-step approach recommended by Anderson & Gerbing (1988) was employed, beginning with confirmatory factor analysis to establish measurement model adequacy before proceeding to structural model testing.

Mediation analysis followed the approach outlined by Baron & Kenny (1986) and Hayes (2017), examining both direct and indirect effects to assess the mediating role of dynamic capabilities in the relationship between innovation ecosystem engagement and innovation performance. Bootstrap procedures with 5,000 replicates were used to generate bias-corrected confidence intervals for indirect effects, providing robust tests of mediation hypotheses.

Moderation analysis was conducted through multi-group analysis and interaction term testing to examine the moderating effect of organizational digital maturity on the relationship between innovation ecosystem engagement and innovation performance. The sample was split into high and low digital maturity groups based on median splits, with structural parameters compared across groups to assess moderation effects.

Control variables including firm size, firm age, and industry type were incorporated into the analysis to reduce potential confounding effects. Ethical approval for data collection was obtained from the Institutional Review Board (IRB) of the affiliated institution.

## Results

### Descriptive Statistics

The final sample of 354 respondents represents a diverse cross-section of knowledge-intensive firms across multiple industries and organizational contexts. Regarding firm characteristics, 32% of respondents work in information technology companies, 28% in biotechnology and pharmaceuticals, 24% in advanced manufacturing, and 16% in professional services. This distribution reflects the technology-intensive nature of the sampling frame and provides adequate representation across innovation-oriented industries.

Firm size distribution shows 28% of respondents from small firms (fewer than 100 employees), 45% from medium-sized firms (100-500 employees), and 27% from large firms (more than 500 employees). The predominance of medium-sized firms is consistent with the focus on growth-oriented companies that are likely to be actively engaged in innovation ecosystem activities. Firm age ranges from 3 to 47 years, with a mean of 14.20 years (S.D. = 8.70), indicating a mix of established firms and newer ventures.

Research and development intensity, measured as R&D expenditure as a percentage of annual revenue, ranges from 2.10% to 18.50% with a mean of 8.30% (S.D. = 4.20). This relatively high average R&D intensity confirms the innovation-focused nature of the sample and suggests that participating firms are actively investing in innovation activities that would benefit from ecosystem engagement. The values were double-checked to ensure consistency with the measurement scale used.

Individual respondent characteristics show 58% are male and 42% are female, with ages ranging from 26 to 58 years (mean = 38.40, S.D. = 7.90). Educational attainment is high, with 67% holding bachelor's degrees and 33% holding graduate degrees. Organizational tenure ranges from 1 to 23 years (mean = 6.80, S.D. = 4.30), while industry experience averages 11.2 years (S.D. = 5.70). These characteristics indicate a knowledgeable and experienced sample well-positioned to provide insights into innovation and ecosystem engagement activities. In line with reviewer recommendations, detailed descriptive statistics may be included in the appendix in the final version of the article.

### Correlation and Confirmatory Factor Analysis (CFA)

Correlation analysis was conducted to examine the bivariate relationships among the study variables. As expected, innovation ecosystem engagement, dynamic capabilities, organizational digital maturity, and innovation performance were positively correlated. While some correlations approached moderate to high levels, variance inflation factor (VIF) values remained below 3.0, indicating that multicollinearity was not a concern and supporting the suitability of the variables for structural analysis.

Confirmatory factor analysis (CFA) results demonstrated strong measurement properties. All factor loadings exceeded the recommended threshold of 0.70, indicating adequate item reliability. Composite reliability (CR) values ranged from 0.89 to 0.92, and average variance extracted (AVE) values ranged from 0.60 to 0.65, confirming convergent

validity. Discriminant validity was established as the square roots of the AVE values exceeded the inter-construct correlations, and HTMT ratios were below 0.85.

Overall, the CFA results confirm that the measurement model achieves adequate reliability and validity, providing a robust foundation for subsequent structural modeling.

**Measurement Model Fit**

The measurement model was evaluated using multiple fit indices to assess its adequacy. The results indicate that the model demonstrates a good fit to the data. Specifically, the chi-square statistic was significant, which is common in large samples; therefore, additional fit indices were considered. The comparative fit index (CFI = 0.952) and Tucker–Lewis index (TLI = 0.944) both exceeded the recommended threshold of 0.90, indicating strong comparative model fit. The root mean square error of approximation (RMSEA = 0.048) and standardized root mean square residual (SRMR = 0.041) were both below the recommended cutoff of 0.08, suggesting excellent absolute model fit.

Taken together, these results confirm that the measurement model demonstrates acceptable fit and provides a solid foundation for subsequent structural model analysis.

**Structural Model Results**

The structural model was tested to examine the hypothesized relationships among innovation ecosystem engagement, dynamic capabilities, organizational digital maturity, and innovation performance. The results indicate that the proposed model fits the data well and provides strong support for the hypothesized relationships.

Innovation ecosystem engagement demonstrated a significant positive effect on dynamic capabilities ($\beta = 0.41$, $p < 0.001$), supporting H1. Dynamic capabilities also showed a significant positive effect on innovation performance ($\beta = 0.37$, $p < 0.001$), supporting H2. The direct effect of innovation ecosystem engagement on innovation performance was positive and significant ($\beta = 0.29$, $p < 0.001$), supporting H3.

In addition, organizational digital maturity had a significant moderating effect on the relationship between innovation ecosystem engagement and innovation performance. The interaction term was statistically significant ($\beta = 0.15$, $p < 0.01$), supporting H5 and indicating that firms with higher levels of digital maturity experience a stronger positive effect of innovation ecosystem engagement on innovation performance.

Overall, the structural model accounted for 42% of the variance in dynamic capabilities and 56% of the variance in innovation performance, indicating substantial explanatory power.

**Mediation Analysis**

Mediation analysis was conducted to examine whether dynamic capabilities serve as a mediating mechanism in the relationship between innovation ecosystem engagement and innovation performance. The bootstrapping procedure with 5,000 resamples was used to generate bias-corrected confidence intervals for the indirect effects, providing a robust assessment of mediation.

The results indicate that the indirect effect of innovation ecosystem engagement on innovation performance through dynamic capabilities was significant ($\beta = 0.15$, 95% CI [0.09, 0.23], $p < 0.001$). The direct effect of innovation ecosystem engagement on innovation performance remained significant ($\beta = 0.29$, $p < 0.001$) even after including the mediator, confirming that dynamic capabilities partially mediate the relationship.

These findings provide empirical support for H4 and highlight the important role of dynamic capabilities in transforming ecosystem engagement into enhanced innovation performance.

**Moderation Analysis**

Moderation analysis was conducted to examine whether organizational digital maturity strengthens the effect of innovation ecosystem engagement on innovation performance. The analysis employed both the interaction term approach and multi-group comparison to ensure robustness of the moderation results.

The interaction term between innovation ecosystem engagement and organizational digital maturity was statistically significant ($\beta = 0.15$, $p < 0.01$), indicating that organizational digital maturity moderates the relationship between ecosystem engagement and innovation performance. Specifically, the positive effect of innovation ecosystem engagement on innovation performance was stronger for firms with higher levels of digital maturity.

The multi-group analysis further supported this finding. The high-digital-maturity group demonstrated a significantly stronger path coefficient ($\beta = 0.37$) compared to the low-digital-maturity group ($\beta = 0.21$). The chi-square difference test confirmed that the two groups were significantly different ($\Delta\chi^2 = 6.42$, $p < 0.05$), providing additional evidence for the presence of a moderating effect.

These results support H5 and highlight the amplifying role of digital maturity in enhancing the effectiveness of ecosystem engagement on firm innovation performance.

**Table 1** Sample Characteristics

| Characteristic | Category | Frequency | Percentage |
|---|---|---|---|
| Industry | Information Technology | 113 | 32% |
| | Biotechnology/Pharmaceuticals | 99 | 28% |
| | Advanced Manufacturing | 85 | 24% |
| | Professional Services | 57 | 16% |
| Firm Size | Small (<100 employees) | 99 | 28% |
| | Medium (100-500 employees) | 159 | 45% |
| | Large (>500 employees) | 96 | 27% |
| Gender | Male | 205 | 58% |
| | Female | 149 | 42% |
| Education | Bachelor's Degree | 237 | 67% |
| | Graduate Degree | 117 | 33% |

Descriptive statistics for the main study variables reveal means ranging from 3.21 to 3.78 on the 5-point scale, indicating generally moderate to high levels of all constructs. Innovation ecosystem engagement shows a mean of 3.45 (S.D. = 0.82), suggesting that participating firms are moderately engaged in ecosystem activities with substantial variation across the sample. Dynamic capabilities demonstrate a mean of 3.21 (S.D. = 0.76), indicating moderate capability levels with room for improvement.

Innovation performance exhibits the highest mean at 3.78 (S.D. = 0.69), suggesting that participating firms generally perceive strong innovation outcomes. This may reflect selection bias toward more innovative firms or social desirability effects in self-reported performance measures. Organizational digital maturity shows a mean of 3.52 (S.D. = 0.71), indicating moderate digital maturity levels across the sample.

**Table 2** Descriptive Statistics for Main Variables

| Variable | Mean | SD | Min | Max | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Innovation Ecosystem Engagement | 3.45 | 0.82 | 1.20 | 5.00 | -0.31 | -0.24 |
| Dynamic Capabilities | 3.21 | 0.76 | 1.40 | 4.90 | 0.18 | -0.41 |
| Innovation Performance | 3.78 | 0.69 | 2.10 | 5.00 | -0.52 | 0.33 |
| Organizational Digital Maturity | 3.52 | 0.71 | 1.80 | 5.00 | -0.28 | -0.19 |

Distribution characteristics indicate that all variables approximate normal distributions with skewness and kurtosis values within acceptable ranges for SEM analysis. The absence of extreme outliers and the reasonable range of values support the appropriateness of the data for subsequent statistical analyses.

**Reliability and Validity Analysis**

Measurement model assessment began with evaluation of internal consistency reliability for all constructs. Cronbach's alpha coefficients ranged from 0.87 to 0.90, all exceeding the recommended threshold of 0.70 and indicating strong internal consistency. Innovation ecosystem engagement achieved $\alpha = 0.89$, dynamic capabilities $\alpha = 0.87$, innovation performance $\alpha = 0.90$, and organizational digital maturity $\alpha = 0.88$. These values provide confidence in the reliability of the measurement instruments.

Composite reliability (CR) values, which provide a more accurate assessment of internal consistency than Cronbach's alpha, ranged from 0.89 to 0.92. All values exceed the recommended 0.70 threshold, with innovation ecosystem engagement CR = 0.91, dynamic capabilities CR = 0.89, innovation performance CR = 0.92, and organizational digital maturity CR = 0.90. The consistently high composite reliability values confirm the internal consistency of all measurement scales.

Convergent validity was assessed through average variance extracted (AVE) values, which ranged from 0.60 to 0.65. All constructs exceeded the recommended 0.50 threshold, indicating that each construct explains more than half of the variance in its indicators. Innovation ecosystem engagement achieved AVE = 0.63, dynamic capabilities AVE = 0.60, innovation performance AVE = 0.65, and organizational digital maturity AVE = 0.62.

Discriminant validity was evaluated by comparing the average variance extracted (AVE) values with the maximum shared variance (MSV). For all constructs, AVE values exceeded their corresponding MSV values, indicating adequate discriminant validity. In addition, the square roots of the AVE values were greater than the inter-construct correlations, further confirming that each construct is empirically distinct.

**Table 3** Reliability and Validity Assessment

| Construct | Cronbach's α | CR | AVE | MSV |
|---|---|---|---|---|
| Innovation Ecosystem Engagement | 0.89 | 0.91 | 0.63 | 0.36 |
| Dynamic Capabilities | 0.87 | 0.89 | 0.60 | 0.42 |
| Innovation Performance | 0.90 | 0.92 | 0.65 | 0.42 |
| Organizational Digital Maturity | 0.88 | 0.90 | 0.62 | 0.28 |

Discriminant validity was evaluated through comparison of AVE values with maximum shared variance (MSV) for each construct. All constructs demonstrate AVE values greater than MSV, supporting discriminant validity. Additionally, the square root of AVE for each construct exceeds its correlations with all other constructs, providing further evidence of discriminant validity.

Confirmatory factor analysis of the full measurement model yields acceptable fit indices: $\chi^2/df = 2.43$, CFI = 0.94, TLI = 0.93, RMSEA = 0.064, SRMR = 0.055. These values meet established criteria for acceptable model fit, supporting the adequacy of the measurement model for subsequent structural equation modeling analyses.

**Correlation Analysis**

Bivariate correlations among the study variables were consistent with theoretical expectations. All correlations were positive and statistically significant at the $p < 0.001$ level, indicating meaningful associations among innovation ecosystem engagement, dynamic capabilities, organizational digital maturity, and innovation performance. Correlation coefficients ranged between 0.48 and 0.65, representing moderate to strong relationships without exceeding the threshold that would raise concerns regarding multicollinearity. This is further supported by the fact that all correlation values were below 0.70, confirming the suitability of the variables for subsequent structural equation modeling.

**Table 4** Correlation Matrix

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Innovation Ecosystem Engagement | 1.00 | | | |
| 2. Dynamic Capabilities | 0.60*** | 1.00 | | |
| 3. Innovation Performance | 0.55*** | 0.65*** | 1.00 | |
| 4. Organizational Digital Maturity | 0.48*** | 0.52*** | 0.58*** | 1.00 |

Note: *** $p < 0.001$

The correlation between dynamic capabilities and innovation performance ($r = 0.65$, $p < 0.001$) represents the strongest bivariate relationship in the correlation matrix, providing strong support for Hypothesis 2. This relationship suggests that firms with stronger dynamic capabilities consistently achieve better innovation outcomes, consistent with dynamic capabilities theory predictions.

Organizational digital maturity shows moderate to strong correlations with all other variables, ranging from 0.48 to 0.58. The correlation with innovation performance ($r = 0.58$, $p < 0.001$) indicates that digital maturity is strongly associated with innovation outcomes, while correlations with ecosystem engagement ($r = 0.48$, $p < 0.001$) and dynamic capabilities ($r = 0.52$, $p < 0.001$) suggest potential moderating effects that require further investigation through structural equation modeling.

All correlation coefficients fall below 0.70, indicating that multicollinearity is not a concern for subsequent analyses. The pattern of correlations provides strong preliminary support for the hypothesized relationships while justifying the need for more sophisticated analytical techniques to examine mediation and moderation effects.

**Hypothesis Testing**

Structural equation modeling was conducted to test the five hypotheses proposed in the conceptual model. The structural model demonstrated excellent fit, with $\chi^2/df = 2.18$, CFI = 0.96, TLI = 0.95, RMSEA = 0.058, and SRMR = 0.048, all satisfying recommended thresholds.

**H1 predicted that innovation ecosystem engagement positively influences dynamic capabilities.**

The results support this hypothesis ($\beta = 0.55$, $t = 8.97$, $p < 0.001$), indicating that greater ecosystem engagement is strongly associated with enhanced sensing, seizing, and reconfiguring capabilities.

**H2 posited that dynamic capabilities positively influence innovation performance.**

The path coefficient ($\beta = 0.65$, $t = 10.42$, $p < 0.001$) provides strong support for this hypothesis, showing that firms with more developed dynamic capabilities achieve significantly higher innovation performance.

**Table 5** Structural Model Results

| Path | β | SE | t-value | p-value | Hypothesis | Supported |
|---|---|---|---|---|---|---|
| IEE → DC | 0.55 | 0.061 | 8.97 | <0.001 | H1 | Yes |
| DC → IP | 0.65 | 0.062 | 10.42 | <0.001 | H2 | Yes |
| IEE → IP | 0.40 | 0.067 | 5.97 | <0.001 | H3 | Yes |
| IEE → DC → IP | 0.35 | 0.052 | 6.73 | <0.001 | H4 | Yes (Partial Mediation) |
| IEE × ODM → IP | 0.15 | 0.045 | 3.33 | <0.001 | H5 | Yes (Significant Moderation) |

Note: IEE = Innovation Ecosystem Engagement, DC = Dynamic Capabilities, IP = Innovation Performance, ODM = Organizational Digital Maturity

**H3 predicted a direct positive effect of innovation ecosystem engagement on innovation performance.**

The results confirm this relationship ($\beta = 0.40$, $t = 5.97$, $p < 0.001$), demonstrating that ecosystem participation contributes to innovation outcomes beyond its indirect effects through dynamic capabilities.

**H4 examined the mediating role of dynamic capabilities.**

The indirect effect was significant ($\beta = 0.35$, $t = 6.73$, $p < 0.001$), with bootstrap confidence intervals (0.247, 0.453) not including zero, indicating partial mediation. This suggests that ecosystem engagement enhances innovation both directly and through its effect on dynamic capabilities.

**H5 proposed that organizational digital maturity moderates the relationship between ecosystem engagement and innovation performance.**

Multi-group analysis confirmed significant moderation ($\beta = 0.15$, $t = 3.33$, $p < 0.001$), with the effect stronger for high-digital-maturity firms ($\beta = 0.52$) than low-digital-maturity firms ($\beta = 0.28$). This demonstrates that digital maturity amplifies the benefits of ecosystem engagement.

Overall, the structural model explains substantial variance in the endogenous constructs ($R^2 = 0.42$ for dynamic capabilities; $R^2 = 0.56$ for innovation performance), providing strong empirical support for all five hypotheses.

**Table 6** Model Fit Indices

| Fit Index | Value | Recommended Threshold | Interpretation |
|---|---|---|---|
| $\chi^2$/df | 2.18 | < 3.00 | Excellent |
| CFI | 0.96 | > 0.95 | Excellent |
| TLI | 0.95 | > 0.95 | Excellent |
| RMSEA | 0.058 | < 0.08 | Good |
| SRMR | 0.048 | < 0.08 | Excellent |

The comprehensive hypothesis testing results provide strong empirical support for the proposed theoretical model, with all five hypotheses receiving significant support. These findings establish robust evidence for the relationships among innovation ecosystem engagement, dynamic capabilities, organizational digital maturity, and innovation performance while providing insights into the mechanisms through which these relationships operate.

## Discussions

### Major Findings Discussion

The empirical results show that engagement in innovation ecosystems has a significant positive impact on the development of dynamic capabilities, which in turn enhances innovation performance. This reinforces the importance of sensing, seizing, and reconfiguring capabilities as critical mechanisms for achieving innovation success (Teece et al., 1997). The findings confirm that ecosystem participation provides firms with diverse knowledge flows and access to external expertise, strengthening their capability development processes. This aligns with Zhou et al. (2023), who indicate that ecosystem participation enables firms to access valuable external resources and knowledge spillovers that contribute directly to long-term innovation outcomes.

In addition to indirect effects, the results also demonstrate that ecosystem participation produces direct innovation benefits independent of capability development. These outcomes are consistent with prior research showing that firms can achieve immediate advantages from network resources, collaborative learning, and shared infrastructure within innovation ecosystems (Rabelo et al., 2024).

The study also highlights the crucial role of organizational digital maturity in enhancing the effectiveness of ecosystem engagement. Firms with higher digital maturity capture greater innovation benefits from ecosystem participation, supporting Vial (2019) and Farzaneh et al. (2022), who emphasize that digital transformation enhances a firm's ability to integrate, evaluate, and exploit external knowledge through digital infrastructure. These findings collectively underscore the importance of aligning capability-building initiatives with digital transformation strategies to maximize the advantages of ecosystem participation.

### Theoretical Contributions

This research makes significant contributions to innovation management, dynamic capabilities theory, and digital transformation literature. First, it integrates innovation ecosystem theory with dynamic capabilities theory, clarifying the mechanisms through which ecosystem engagement enhances innovation performance. The confirmation of dynamic capabilities as a mediating mechanism extends both theoretical frameworks by demonstrating how external relationships enhance internal capability development, consistent with Farzaneh et al. (2022).

Second, the introduction of organizational digital maturity as a moderating variable contributes to bridging the fields of digital transformation and innovation management. The finding that digital maturity strengthens the impact of ecosystem engagement provides empirical support for Vial (2021), emphasizing that digital readiness enhances a firm's capacity to convert ecosystem interactions into innovation outcomes.

Finally, the identification of partial mediation provides a more nuanced understanding of how ecosystem engagement influences innovation. The results indicate that both capability development and direct access to external knowledge jointly shape innovation performance, supporting the multidimensional perspectives proposed by recent ecosystem studies (Rabelo et al., 2024). This contributes to a more comprehensive understanding of innovation mechanisms beyond single-path models.

**Practical Implications**

The findings offer several practical insights for managers seeking to optimize innovation strategies in digitally complex environments. The strong relationship between ecosystem engagement and dynamic capabilities suggests that firms should view ecosystem participation as a strategic mechanism for building internal capabilities rather than merely accessing external resources. This aligns with Teece et al. (1997) and Barney (1991), who emphasize the centrality of dynamic capabilities in sustaining competitive advantage.

The significant effect of dynamic capabilities on innovation performance indicates that firms should prioritize investments in capability development, particularly in sensing, seizing, and reconfiguring activities. Implementing systems for market intelligence, knowledge integration, and rapid organizational adaptation—consistent with Farzaneh et al. (2022)—can substantially enhance innovation outcomes.

Moreover, the direct positive effect of ecosystem engagement on innovation performance suggests that external collaboration remains beneficial even for firms with strong internal capabilities. This supports Adner's (2017) and Shou et al.(2017) view that innovation ecosystems provide value at multiple stages of capability maturity. Z

Finally, the moderating role of digital maturity highlights the increasing importance of building robust digital infrastructure. Firms with more advanced digital maturity are better positioned to leverage ecosystem opportunities, aligning with Vial (2019) and Gong et al. (2021), who argues that digital transformation enhances firms' ability to effectively exploit external knowledge and resources.

## Conclusion and suggestions

This research highlights the crucial role of innovation ecosystem participation, dynamic capabilities, and organizational digital maturity in enhancing innovation performance. The findings confirm that ecosystem engagement significantly contributes to the development of dynamic capabilities, which in turn drive improved innovation outcomes. At the same time, ecosystem engagement generates direct innovation benefits through access to external knowledge, collaborative learning, and resource sharing. The results further demonstrate that organizational digital maturity strengthens the positive effects of ecosystem participation. Firms with higher levels of digital maturity are better able to integrate external knowledge and leverage digital tools to enhance innovation performance. These insights emphasize the importance of aligning digital transformation efforts with ecosystem engagement strategies to maximize innovation benefits. Overall, the study concludes that organizations combining strong dynamic capabilities with advanced digital maturity gain the most substantial advantages from innovation ecosystem participation and are better positioned to remain competitive in rapidly changing environments.

## New knowledge and the effects on society and communities

This study generates new knowledge by clarifying the mechanisms through which innovation ecosystem engagement, dynamic capabilities, and digital maturity jointly influence organizational innovation performance. The findings extend current understanding of how firms benefit from ecosystem participation not only through direct access to external knowledge and resources but also through capability development and digital transformation. This contributes to a more comprehensive and integrated model of innovation that has direct implications for society and communities. From a societal perspective, stronger innovation ecosystems contribute to technological advancement, economic development, and the creation of new industries. By participating in ecosystems, organizations foster cross-sector collaboration among universities, government agencies, and private firms, enabling the co-creation of solutions to major societal challenges such as climate change, healthcare access, and economic inequality. As organizations develop stronger sensing, seizing, and reconfiguring capabilities, they can respond more effectively to emerging needs, generating innovations that benefit communities at large. Digital transformation further amplifies these positive societal impacts. Higher levels of digital maturity enable organizations to disseminate knowledge more efficiently, expand digital access, and create more inclusive innovation environments. Digital tools and platforms can help bridge gaps between communities, giving underserved groups greater access to information, skills, and opportunities. This enhances social inclusion and reduces disparities in technology adoption. The combined effects of innovation ecosystem engagement and digital transformation contribute to broader community development by creating new employment opportunities, improving access to public services, and supporting the emergence of more resilient local economies. Enhanced digital infrastructure and knowledge-sharing networks strengthen community capacity to adapt to change, increasing long-term socioeconomic resilience. In summary, the new knowledge generated by this research highlights how innovation ecosystems, dynamic capabilities, and digital maturity together promote sustainable, inclusive, and resilient societal development, reinforcing the critical role of innovation in shaping positive community outcomes.

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