

## *Firm-Level Innovation and Performance Outcomes : A Longitudinal Empirical Assessment*

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### RÉSUMÉ

*Cette étude analyse l'influence de l'innovation sur la performance organisationnelle à partir d'un panel longitudinal de 120 entreprises issues de secteurs variés. L'observation des entreprises sur plusieurs périodes permet de prendre en compte les dynamiques temporelles ainsi que les spécificités propres à chaque organisation, souvent négligées dans les analyses transversales. La recherche distingue trois dimensions de l'innovation : l'innovation de produit, visant l'élargissement des débouchés commerciaux ; l'innovation de procédé, orientée vers l'amélioration de l'efficacité opérationnelle ; et un environnement organisationnel favorable à l'innovation, facilitant l'adoption des technologies. Des modèles à effets fixes et à effets aléatoires sont mobilisés afin d'évaluer l'impact de ces dimensions sur la performance.*

*Les résultats montrent que les innovations de produit et de procédé exercent un effet positif et significatif sur la performance des entreprises. Par ailleurs, un climat organisationnel orienté vers l'innovation contribue de manière indirecte à la performance en soutenant les processus d'amélioration continue et l'intégration technologique. Ces conclusions mettent en évidence le rôle pluriel de l'innovation dans le maintien de la croissance de la performance et de la capacité d'adaptation des organisations évoluant dans des environnements concurrentiels et changeants.*

**Mots-clés :** *Performance de l'entreprise ; capacité d'innovation ; capacité d'adaptation ; transformation technologique ; amélioration opérationnelle ; analyse de données de panel.*

### ABSTRACT

*This study investigates the impact of innovation on organizational performance using a longitudinal panel of 120 firms from diverse sectors. Tracking firms over time allows the analysis to capture both temporal dynamics and firm-specific characteristics often overlooked in cross-sectional studies.*

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*The research examines three dimensions of innovation : product innovation to enhance market reach, process innovation to improve operational efficiency, and an innovation-supportive organizational environment that facilitates technology adoption. Fixed-effects and random-effects models are applied to evaluate their effects on performance.*

*Findings reveal that product and process innovations positively and significantly influence firm performance, while an innovation-oriented environment contributes indirectly by fostering continuous improvement and supporting technology integration. The results underscore the multifaceted role of innovation in sustaining performance growth and organizational adaptability in dynamic markets.*

**Keywords:** *Firm performance ; innovation capability ; adaptive capacity ; technological transformation ; operational improvement ; panel data analysis.*

## ***Firm-Level Innovation and Performance Outcomes : A Longitudinal Empirical Assessment***

### **INTRODUCTION**

In today's rapidly evolving economic landscape, shaped by globalization, technological advances, and accelerated innovation cycles, organizations face mounting pressure to continuously innovate in order to remain competitive. Innovation has become a central strategic priority, no longer merely a differentiating tool but a key determinant of firms' sustainability and performance in uncertain and competitive environments (Teece, 2018). Its influence extends beyond the development of new products and services, affecting internal operations, knowledge management, talent development, technological adoption, and the organizational culture that supports innovation (Pisano, 2019). Consequently, innovation serves not only to enhance competitiveness and differentiation but also to optimize costs, improve operational efficiency, and strengthen organizational resilience amid economic and technological turbulence (Chen, Viardot, & Brem, 2019).

Managing innovation, however, presents significant challenges. Firms must integrate emerging technologies while ensuring operational stability, transforming innovation into a sustained competitive advantage and aligning product, process, and organizational innovations with their strategic goals. Scholars such as Christensen (2013) and Warner & Wäger (2019) highlight that innovation drives industrial transformation and that failure to innovate can result in the displacement of established firms by more agile and innovative newcomers. Yet, despite the widely acknowledged importance of innovation for performance, the precise mechanisms through which it influences organizational outcomes remain underexplored. Effects vary depending on sector, type of innovation, organizational culture, and adopted strategies (Habibi & Guati, 2022 ; Zahra & George, 2002).

This study aims to empirically examine the impact of innovation on organizational performance using panel data. By tracking firms over multiple periods, panel data capture the dynamic evolution of performance while controlling for firm-specific characteristics. This method allows for a more nuanced understanding of temporal fluctuations, contextual differences, and external factors shaping the innovation-performance relationship. It also enables controlling for internal fixed effects, providing a clearer view of how innovations—whether in products, processes, or organizational culture—translate into performance outcomes.

The research is structured around three hypotheses. First, H1 posits that product innovation, through the development of new or improved offerings, positively influences revenue growth by attracting and retaining customers and responding to evolving market demands (Kotler & Keller, 2006). Second, H2 suggests that process innovation, encompassing improvements in operational workflows, enhances efficiency, reduces costs, and strengthens competitiveness (Porter, 1985). Third, H3 emphasizes the role of organizational culture, arguing that fostering values such as collaboration, openness, and continuous learning facilitates the adoption of new technologies, stimulates creativity, and supports long-term performance (Schein, 2010 ; West & Farr, 1990).

By employing advanced panel econometric models, this study provides decision-makers with insights into the mechanisms through which innovation shapes performance. Building on prior research (Wang & Ahmed, 2007 ; Jiménez-Jiménez & Sanz-Valle, 2011 ; Hael, Belhaj, & Zhang, 2024), it moves beyond traditional cross-sectional approaches to explore the temporal and contextual dimensions of innovation's impact. The findings offer empirical evidence linking various forms of innovation to organizational performance and provide practical guidance for designing effective innovation strategies in increasingly competitive and digitalized markets.

Moreover, this research enriches the literature by clarifying how innovation generates value, supporting the development of targeted approaches aligned with specific organizational contexts.

## I. CONCEPTUAL AND THEORETICAL FOUNDATIONS OF INNOVATION MANAGEMENT

### *1.1. Innovation management as a strategic and organizational capability*

Innovation management can be understood as an organizational capability that structures the processes through which firms generate, select, implement, and diffuse new ideas. Beyond a simple collection of tools or practices, it represents a systemic approach that integrates strategic orientation, organizational design, and operational coordination (Tidd & Bessant, 2018).

In contemporary economic environments characterized by heightened uncertainty, accelerated technological change, and global competitive pressures, innovation has become a central mechanism for value creation and renewal. As emphasized by Chen et al. (2019), innovation reshapes not only products and services but also internal routines, governance mechanisms, and inter-organizational relationships. Consequently, innovation management plays a pivotal role in organizational transformation and long-term sustainability.

From a strategic perspective, innovation management enables firms to anticipate market evolution and reconfigure their resource base in response to emerging opportunities and threats. At the operational level, it supports efficiency gains and learning dynamics through the integration of new technologies and managerial practices. Economically, it contributes to performance by fostering differentiation, enhancing customer value, and enabling the development of novel business models.

Importantly, innovation should not be reduced to radical breakthroughs. Incremental and continuous innovations, embedded in everyday organizational routines, are equally decisive in sustaining competitiveness. Firms that institutionalize innovation management as a core capability tend to exhibit greater adaptability and resilience in turbulent environments.

### *1.2. Typology of innovation : a multidimensional approach*

Innovation is inherently multidimensional, encompassing several interrelated forms that affect organizational outcomes in distinct yet complementary ways.

#### • **Product and Service Innovation**

This dimension refers to the introduction of new offerings or significant improvements in existing products and services. Product innovation enhances perceived customer value and strengthens market differentiation. Empirical studies highlight its central role in capturing emerging demand and responding to evolving consumer preferences (Kotler et al., 2006).

#### • **Process Innovation**

Process innovation involves the reconfiguration of production, logistics, and administrative processes, often driven by digitalization and automation. By reducing costs and improving productivity, process innovation contributes to operational efficiency and reinforces competitive positioning (Liao, 2016).

#### • **Organizational Innovation**

Organizational innovation encompasses changes in governance structures, coordination mechanisms, and human resource management practices. The adoption of flexible organizational forms, cross-functional teams, and decentralized decision-making fosters knowledge sharing and accelerates innovation processes (O'Reilly & Tushman, 2011).

This multidimensional view underscores that innovation outcomes depend not on isolated initiatives, but on the coherence and complementarity among different innovation forms.

### ***1.3. Innovation and Organizational Performance : Conceptual Foundations***

The link between innovation and organizational performance occupies a central place in management and organizational theory. Rather than operating as a simple input–output mechanism, innovation affects performance through multiple and interconnected channels that extend beyond short-term financial outcomes.

#### **Impact on Economic Performance**

From an economic perspective, innovation plays a key role in enhancing firm performance by stimulating growth and improving efficiency. Organizations that engage in product, process, or organizational innovation are generally better equipped to respond to evolving customer expectations and to capitalize on emerging market opportunities. These capabilities translate into improved revenue generation, higher productivity levels, and strengthened market positions over time.

#### **Innovation as a Source of Strategic Advantage**

Beyond measurable financial indicators, innovation contributes to the construction of durable competitive advantages. Drawing on the resource-based view, innovation capabilities can be understood as strategic assets when they are embedded in organizational routines, knowledge bases, and learning processes. Such assets are not easily transferable or replicable, allowing firms to differentiate themselves from competitors and sustain their strategic advantage in dynamic environments. Overall, innovation emerges both as a catalyst for organizational performance and as a strategic lever that supports long-term positioning and differentiation.

### ***1.4. Key Theoretical Approaches to Innovation***

Understanding innovation within organizations requires mobilizing several complementary theoretical lenses that shed light on how innovative activities emerge, evolve, and are sustained over time.

#### **Open Innovation Approach**

The open innovation approach, developed in the early 2000s, departs from the assumption that innovation can be fully generated and controlled internally. It emphasizes the strategic integration of external knowledge, ideas, and technologies into the firm’s innovation processes. By engaging with a broader ecosystem including research institutions, start-ups, suppliers, and users organizations can enhance learning opportunities, shorten development cycles, and mitigate innovation-related risks.

#### **Innovation Life Cycle Perspective**

The innovation life cycle perspective views innovation as a progressive and evolving process rather than a static outcome. Innovations typically pass through successive stages, beginning with exploratory experimentation and moving toward consolidation and standardization. Each stage is associated with specific organizational challenges, requiring differentiated managerial practices, structures, and resource allocations to ensure continuity and performance.

Taken together, these theoretical perspectives underscore the need for organizational adaptability, openness, and the capacity to manage interactions across internal and external boundaries throughout the innovation process.

### ***1.5. Innovation Culture as a Micro-Foundation of Organizational Performance***

Organizational culture plays a pivotal role in shaping the conditions under which innovation can emerge and contribute to performance. As a micro-foundation of innovation capability, culture influences individual behaviors, collective routines, and the way organizations interpret and respond to change.

A cultural context that values exploration, continuous learning, and measured risk-taking encourages employees to engage in creative problem-solving and knowledge sharing. When individuals perceive that experimentation is supported rather than penalized, they are more likely to contribute novel ideas and participate actively in innovation processes.

In addition, innovation-oriented cultures foster relational dynamics based on trust, cooperation, and psychological safety. These elements facilitate cross-functional interaction and collective learning, which are essential for sustaining innovation over time. Such cultural settings also enhance the organization's ability to absorb, adapt, and integrate new technologies, thereby strengthening agility and resilience in environments characterized by rapid and uncertain change.

## **II. STRATEGIC ROLE AND INSTRUMENTS OF INNOVATION MANAGEMENT**

Innovation management has become a strategic imperative for firms operating in volatile and competitive environments. It provides a structured framework to guide innovation activities from ideation to market deployment and continuous improvement (Brown & Anthony, 2018).

Assessing innovation maturity is a key managerial challenge. Diagnostic tools such as Autodiag Manag'Inno enable firms to evaluate their innovation capabilities and identify areas for development. Enhancing maturity involves investments in human capital, entrepreneurial skills, and organizational learning processes (Tidd & Bessant, 2021).

The protection of intellectual assets represents another strategic pillar. Intellectual property management, through patents, trademarks, and digital surveillance secures the economic returns of innovation and reinforces the firm's intangible resource base, as emphasized by the World Intellectual Property Organization (WIPO).

For small and medium-sized enterprises, strategic intelligence systems support innovation by enabling continuous monitoring of technological, competitive, and regulatory environments. These systems enhance decision-making and reduce uncertainty.

Financing innovation remains a structural challenge, particularly for SMEs. Public incentives such as research and innovation tax credits, as well as international funding programs, play a crucial role in mitigating financial constraints and supporting innovation investment (Garcia & Calantone, 2002).

In parallel, responsible innovation has gained prominence, integrating social and environmental considerations into innovation strategies. This perspective aligns with the Creating Shared Value approach, which emphasizes the joint creation of economic and societal value (Dembek et al., 2016).

## **III. EMPIRICAL FRAMEWORK AND RESEARCH MODEL**

### ***III.1. Research Objectives and Methodological Justification***

The empirical framework is designed to analyze the relationship between innovation and

organizational performance through the use of panel data techniques. This approach makes it possible to examine firms across multiple time periods, thereby accounting for both inter-firm differences and intra-firm changes over time.

By combining cross-sectional and longitudinal dimensions, panel data analysis offers a robust means of capturing dynamic relationships that cannot be observed through purely static models. It allows for the control of unobserved firm-specific characteristics and time-dependent effects, reducing potential estimation biases and improving the reliability of the results.

Within this framework, innovation is treated as a multidimensional construct encompassing product, process, and cultural dimensions. This methodological choice enables a more refined assessment of how distinct forms of innovation interact with organizational performance, providing deeper insights into their respective and combined effects.

### ***III.2. Research Hypotheses Development***

To systematically investigate the relationship between innovation and organizational performance, it is necessary to conceptualize innovation as a multidimensional construct and to formulate testable hypotheses grounded in both theory and empirical evidence. Innovation encompasses not only tangible changes in products and processes but also the intangible organizational culture that fosters creativity, experimentation, and knowledge sharing. Establishing clear hypotheses provides a structured framework for analyzing how each dimension contributes to firm outcomes, while also highlighting the mechanisms through which innovation exerts its influence. Drawing on prior studies and theoretical insights, the following hypotheses were developed to guide the empirical analysis.

H1 : Product innovation positively affects revenue growth.

By introducing differentiated and improved offerings, firms are able to enhance customer satisfaction, penetrate new markets, and strengthen their competitive position. Empirical studies consistently indicate that product innovation is a key driver of sales performance and market expansion, reinforcing its strategic importance for organizational growth.

H2 : Process innovation improves operational efficiency, thereby enhancing revenue growth.

Process improvements, such as optimized workflows, better resource allocation, and the adoption of advanced technologies, enable firms to reduce costs and increase productivity. These operational gains translate into improved economic performance, demonstrating the role of process innovation in sustaining competitiveness and profitability.

H3 : An innovation-supportive culture facilitates technological adoption and enhances organizational performance.

Firms that cultivate a culture encouraging experimentation, learning, and knowledge sharing are better positioned to implement new technologies and adapt rapidly to environmental changes. Such cultural support not only accelerates the diffusion of innovation internally but also strengthens organizational agility, contributing to overall performance improvements.

Collectively, these hypotheses capture the multidimensional nature of innovation and provide a coherent analytical framework for examining its direct and indirect effects on organizational outcomes. This framework allows for a nuanced understanding of how product, process, and cultural innovation interact to shape firm performance, offering insights that are both theoretically robust and practically relevant.

## IV. ECONOMETRIC FRAMEWORK FOR ANALYZING INNOVATION IMPACT

Innovation is a multidimensional phenomenon whose effects on organizational performance are both complex and dynamic. To rigorously examine this relationship, this study employs an econometric framework based on panel data analysis. Unlike purely cross-sectional or time-series approaches, panel data techniques enable the simultaneous exploration of inter-firm heterogeneity and temporal evolution, providing a more robust assessment of causal mechanisms. By capturing both within-firm changes over time and differences across firms, this framework allows a comprehensive understanding of how product, process, and cultural innovations contribute to organizational outcomes.

### *IV.1. Model Specification*

The analytical framework employed in this study conceptualizes innovation as a multidimensional construct, encompassing three core components : product innovation, process innovation, and an innovation-supportive culture, and examines their relationships with organizational performance. Product innovation captures a firm's efforts in developing new products or services, investing in R&D, and responding to evolving market trends, thereby directly influencing revenue generation and competitive positioning. Process innovation, in contrast, reflects improvements in operational workflows, efficiency gains, and the adoption of new technologies or practices, emphasizing the role of internal optimization in sustaining performance. The cultural dimension considers the organizational environment that fosters creativity, employee engagement, knowledge sharing, and experimentation, recognizing that supportive culture facilitates the effective implementation and diffusion of both product and process innovations.

To empirically assess these relationships, a panel data model is specified for each firm across multiple time periods, which incorporates firm-specific effects to account for unobserved, time-invariant characteristics such as management style, governance structures, and historical capabilities. The error term captures random shocks or unobserved factors that may influence performance outcomes. By decomposing innovation into these distinct dimensions, the model allows for a nuanced understanding of the relative contributions of each component to firm performance. It also enables the examination of both direct effects, such as R&D investments translating into new revenue streams, and indirect effects, such as a strong innovation culture enhancing the adoption and impact of process improvements. This approach provides a comprehensive analytical framework that not only quantifies the influence of innovation on performance but also illuminates the mechanisms through which different innovation dimensions interact and reinforce one another within the organizational context.

### *IV.2. Hypotheses Development*

Drawing on the literature on innovation, dynamic capabilities, and the resource-based view, the study formulates the following hypotheses :

#### **H1 : Product Innovation and Performance**

Product innovation is hypothesized to have a positive effect on organizational performance ( $\beta_1 > 0$ ). Introducing new products or services enables firms to access emerging markets, meet changing customer demands, and differentiate themselves from competitors.

#### **H2 : Process Innovation and Performance**

Process innovation is expected to enhance performance ( $\beta_2 > 0$ ) by increasing operational efficiency, reducing costs, and improving resource utilization. Efficient processes often amplify the returns of

product innovation and support organizational scalability.

### **H3 : Innovation-Oriented Culture and Performance**

An innovation-supportive culture is predicted to positively influence performance ( $\beta_3 > 0$ ) by fostering employee creativity, facilitating knowledge sharing, and encouraging the adoption of new technologies. Cultural enablers strengthen both product and process innovation outcomes, creating sustainable competitive advantages.

Collectively, these hypotheses reflect both direct and indirect mechanisms through which innovation contributes to firm performance. They recognize the multidimensional nature of innovation and the synergistic effects between tangible (product and process) and intangible (culture) dimensions.

#### ***IV.3. Panel Data Estimation Techniques***

Panel data analysis is particularly suitable for examining innovation-performance linkages due to its ability to handle temporal dynamics and unobserved heterogeneity. The following estimation techniques are considered :

##### **Fixed Effects (FE) Model :**

The FE model accounts for unobservable firm-specific characteristics that remain constant over time by introducing firm-level intercepts. This approach removes potential biases from omitted variables that are correlated with innovation measures. It is especially relevant in contexts where structural or strategic attributes of firms, such as management practices or corporate governance, may influence performance outcomes (Wooldridge, 2010 ; Greene, 2012). FE estimation emphasizes within-firm variation over time, allowing the researcher to focus on how changes in innovation activities affect performance trajectories.

##### **Random Effects (RE) Model :**

The RE model assumes that firm-specific effects are uncorrelated with explanatory variables and treats them as part of the composite error term. This approach enables the inclusion of time-invariant regressors and often provides more efficient estimates than FE, provided that the key assumption of non-correlation holds. RE is particularly useful when studying innovation across heterogeneous firms where some firm-specific characteristics are assumed independent of innovation practices.

##### **Model Selection : Hausman Test :**

To rigorously determine the appropriate model, the Hausman test compares FE and RE estimates by testing whether firm-specific effects correlate with the regressors. A significant test result indicates correlation, favoring the FE model for its unbiased and consistent estimates. Conversely, a non-significant result suggests the RE model can be used, offering efficiency gains (Hausman, 1978). This step ensures that the econometric analysis accurately captures innovation effects while controlling for potential biases arising from unobserved heterogeneity.

## **V. RESEARCH SAMPLE AND DATA COLLECTION APPROACH**

Examining the relationship between innovation and organizational performance requires a well-structured empirical design that combines a carefully selected sample with a reliable data collection process. Given the complex and multidimensional nature of innovation, particular attention is paid to ensuring diversity among participating firms as well as methodological rigor in data gathering. This section details the sampling framework, selection procedures, data collection instrument, and the measures adopted to enhance data reliability and validity.

### *V.1. Sample Structure and Selection Principles*

The study targeted firms across diverse economic sectors to capture variation in innovation practices and their impact on organizational performance. A stratified, multi-criteria sampling approach ensured representation of both sectoral diversity and firm characteristics. Four sectors were considered—technology, manufacturing, services, and health—each exhibiting distinct innovation dynamics and pressures. Firms were also classified by size (small, medium, and large) to examine potential scale effects. Only organizations actively engaged in at least one innovation dimension (product, process, or culture) and capable of providing reliable performance and innovation data were included, with preference for those maintaining formal R&D or dedicated innovation units.

**Table 1. Sample Distribution of Tunisian SMEs by Sector and Firm Size (N = 120)**

Sector (Tunisia)	Small SMEs (< 50 employees)	Medium SMEs (50–250 employees)	Total
Technology & Digital Services	15	15	30
Manufacturing & Industrial Activities	15	15	30
Services (Logistics, Consulting, Trade)	10	20	30
Health-related Activities	10	20	30
<b>Total</b>	<b>50</b>	<b>70</b>	<b>120</b>

The final sample comprises 120 firms, proportionally distributed across sectors and size categories. This stratification ensures a balanced representation of organizational structures, varying levels of innovation intensity, and heterogeneous competitive contexts. By combining sectoral diversity, size variation, and active engagement in innovation, the sampling strategy provides a robust foundation for analyzing the complex interplay between innovation initiatives and organizational performance in a range of economic and organizational settings.

### *V.2. Sampling, Data Collection, and Quality Assurance*

The study employed a hybrid sampling approach to ensure representativeness across diverse organizational contexts while maintaining feasibility. Firms were first stratified by sector and size, capturing variations in innovation practices and performance across different economic activities. Willing and capable firms were then included based on accessibility, and random selection within each stratum minimized selection bias, enhancing generalizability (Bryman & Bell, 2015 ; Hair et al., 2021).

Primary data were collected through a structured questionnaire designed to measure product innovation, process innovation, innovation-supportive culture, and organizational performance. Items were adapted from validated scales and measured on a five-point Likert scale. Pilot testing refined the instrument, and senior managers, R&D leaders, innovation officers, and operations directors were targeted as respondents to ensure informed and reliable data.

To guarantee data reliability and validity, internal consistency was assessed using Cronbach's alpha, while construct validity was confirmed via confirmatory factor analysis (CFA). Additional safeguards included follow-ups to reduce non-response bias, data triangulation with secondary sources, and measures to mitigate social desirability and common method biases, such as anonymization and temporal separation of variables. These procedures collectively ensured that the collected data were robust, reliable, and suitable for comprehensive empirical analysis of innovation practices in SMEs.

## VI. DISCUSSION AND RESULTS

Before presenting the empirical results, it is important to contextualize the purpose of the panel estimation. The analysis aims to quantify the relative impact of product innovation, process innovation, and innovation-supportive culture on organizational performance while controlling for firm-specific characteristics that may affect these relationships. By comparing fixed-effects and random-effects models, we can assess both the robustness of the estimates and the extent to which unobserved heterogeneity influences the innovation–performance link. This approach provides a rigorous foundation for understanding how different forms of innovation contribute to competitive advantage, operational efficiency, and long-term resilience across diverse organizational contexts.

Table 2 below summarizes the estimation outcomes, including coefficients, standard errors, t-values, p-values, and goodness-of-fit measures. It highlights the magnitude and significance of each innovation dimension under both modeling assumptions and provides the basis for interpreting their differentiated roles in driving organizational performance.

**Table 2. Panel Test Results**

Variable	Coefficient (FE)	SE (FE)	t-value (FE)	p-value (FE)	Coefficient (RE)	SE (RE)	t-value (RE)	p-value (RE)
<b>Intercept (<math>\beta_0</math>)</b>	1.50	0.35	4.29	<0.001	1.60	1.45	1.10	0.27
<b>Product Innovation (<math>\beta_1</math>)</b>	0.20	0.05	4.00	<0.001	0.22	0.18	1.22	0.22
<b>Process Innovation (<math>\beta_2</math>)</b>	0.30	0.06	5.00	<0.001	0.32	0.28	1.14	0.25
<b>Innovation Culture (<math>\beta_3</math>)</b>	0.10	0.04	2.50	0.01	0.12	0.08	1.50	0.14
<b>R<sup>2</sup></b>	0.60				0.54			
<b>Hausman Test (p-value)</b>	0.004							

Beyond their individual statistical significance, the estimated coefficients presented in the fixed-effects panel model provide deep insights into the differentiated and interrelated roles of product innovation, process innovation, and innovation-supportive culture in shaping organizational performance over time. The Hausman test ( $\chi^2 = 0.004$ ,  $p < 0.01$ ) confirms that the fixed-effects specification is preferable, indicating a significant correlation between firm-specific characteristics and innovation variables. This underscores the necessity of controlling for unobserved heterogeneity, such as organizational governance, historical capabilities, managerial orientation, and embedded routines, which may otherwise bias the estimation of innovation–performance linkages (Bryman & Bell, 2015 ; Hair et al., 2021).

The intercept of the model ( $\beta_0 = 1.50$ ,  $SE = 0.35$ ,  $t = 4.29$ ,  $p < 0.001$ ) represents the baseline level of organizational performance in the absence of structured innovation efforts, serving as a reference for evaluating the marginal effects of innovation activities. Product innovation exhibits a positive and statistically significant coefficient ( $\beta_1 = 0.20$ ,  $SE = 0.05$ ,  $t = 4.00$ ,  $p < 0.001$ ), indicating that a one-unit increase in product-related initiatives encompassing new product launches, service differentiation, and enhanced R&D intensity is associated with an average 20% increase in organizational performance. This finding aligns with Alharbi et al. (2019) and Elloumi (2024), reinforcing the view that product innovation is a primary mechanism for market-facing competitiveness. Beyond immediate revenue effects, product innovation strengthens long-term strategic positioning by allowing firms to continuously adapt to customer needs, capture emerging market niches, and enhance brand legitimacy in turbulent and technology-driven environments.

Process innovation demonstrates the strongest impact, with  $\beta_2 = 0.30$  ( $SE = 0.06$ ,  $t = 5.00$ ,  $p <$

0.001), highlighting that internal efficiency gains constitute a central channel through which innovation translates into measurable performance improvements. One-unit increases in process innovation through workflow optimization, technology adoption, or resource management improvements are associated with a 30% performance increase. These results are consistent with Schumpeter's (1934) foundational theory emphasizing productivity and operational efficiency as outcomes of innovative activity, and with Teece's (2010) dynamic capabilities perspective, which underlines the role of process innovations in enabling firms to reconfigure internal resources and respond dynamically to environmental changes. This coefficient suggests that investments in process optimization not only improve operational performance but also enhance resilience to external shocks, thus sustaining competitive advantage over time.

The coefficient for innovation-supportive culture is positive and significant, though more moderate ( $\beta_3 = 0.10$ ,  $SE = 0.04$ ,  $t = 2.50$ ,  $p = 0.01$ ). This indicates that cultural enablers such as employee engagement, knowledge-sharing practices, and support for experimentation enhance performance indirectly by facilitating the adoption and institutionalization of both product and process innovations. Cultural innovation contributes to organizational agility, absorptive capacity, and risk-taking readiness, providing the foundational environment necessary for innovation efforts to generate lasting outcomes (Cameron & Quinn, 2006). While its immediate effect on performance is smaller than product or process innovation, its strategic importance lies in creating a sustainable and adaptive organizational context, without which other innovation initiatives may fail to realize their full potential.

The model's explanatory power further substantiates these interpretations : the fixed-effects  $R^2$  is 0.60, compared to 0.54 for the random-effects model, demonstrating that accounting for firm-specific heterogeneity captures a substantial proportion of the variation in organizational performance. This result underscores that innovation–performance relationships are highly context-dependent and shaped by idiosyncratic firm characteristics, such as governance, accumulated knowledge, and path-dependent strategic choices (Bryman & Bell, 2015 ; Hair et al., 2021). Consequently, similar innovation inputs may yield widely divergent outcomes depending on alignment with firm-specific routines and resources.

Integrating these findings reveals that innovation dimensions function in a complementary and mutually reinforcing manner. Product innovation drives external market value, process innovation ensures internal efficiency and scalability, and innovation-supportive culture maintains coherence and sustainability of innovation initiatives over time. Firms focusing solely on one dimension risk suboptimal outcomes, whereas a holistic and coordinated strategy across all three dimensions maximizes performance gains. This multidimensional perspective not only reinforces the strategic importance of balancing R&D investments with organizational and cultural initiatives but also provides actionable guidance for managers and policymakers seeking systemic innovation strategies beyond isolated technological interventions (Elloumi, 2024 ; Elloumi, 2025).

Beyond quantitative effects, these results offer qualitative managerial implications. Firms aiming to improve competitiveness should prioritize the alignment of product and process innovations with organizational culture, ensuring that internal practices support the rapid diffusion and effective utilization of new ideas. For policymakers, the findings suggest that innovation support programs should simultaneously encourage technological development, process optimization, and cultural transformation to maximize impact on firm performance. By conceptualizing innovation as a systemic, dynamic process rather than isolated activities, the study contributes to a richer understanding of how firms can achieve sustainable growth in complex and heterogeneous economic environments (Elloumi, 2025).

Overall, the integration of coefficients, standard errors, t-values, p-values, and  $R^2$  directly into the

interpretation provides a robust and nuanced framework for understanding innovation–performance dynamics. The analysis demonstrates that multidimensional innovation strategies—combining product, process, and culture are crucial for firms seeking to enhance competitiveness, operational efficiency, and long-term resilience in volatile markets.

## CONCLUSION

This study examined the multidimensional effects of innovation on organizational performance, focusing on product innovation, process innovation, and innovation-supportive culture across firms in diverse sectors. The analysis, based on a fixed-effects panel model, shows that each innovation dimension contributes differently yet complementarily to performance outcomes. Product innovation drives market-facing competitiveness by enabling firms to develop differentiated offerings and strengthen strategic positioning. Process innovation has the largest impact, improving operational efficiency, workflow optimization, and scalability. Innovation-supportive culture, while having a smaller direct effect, plays a crucial enabling role by fostering learning, experimentation, and the effective adoption of product and process innovations. Collectively, these findings underscore the importance of a holistic innovation strategy that integrates technological, operational, and cultural dimensions.

The study makes several theoretical and empirical contributions. It extends the innovation literature by adopting a systemic approach that moves beyond a narrow focus on R&D or product development, highlighting the interconnected role of culture and processes. Empirically, it provides robust evidence on the differentiated effects of innovation dimensions while accounting for firm-specific heterogeneity, demonstrating that organizational context and historical capabilities strongly shape performance outcomes.

From a managerial perspective, the findings offer actionable insights. Firms should adopt a balanced innovation strategy, combining investments in new products, process improvements, and the development of an innovation-supportive culture. Prioritizing process efficiency enhances operational performance, while a supportive culture ensures the sustainable implementation of innovation initiatives. For policymakers and business support organizations, programs encouraging both technological development and organizational capacity-building are likely to maximize firm-level innovation impact.

The study also has limitations. The sample is sector-specific and may not fully represent other industries or geographic contexts. Some data rely on self-reported measures, which, despite triangulation efforts, may introduce biases. The study focuses on a limited time frame, restricting the assessment of long-term innovation effects.

Future research could extend these findings by exploring additional innovation dimensions such as digital, green, or social innovation. Comparative studies across countries or industries would improve generalizability, and longitudinal designs could capture delayed or cumulative effects of innovation. Further investigation into the mechanisms through which innovation culture interacts with technological and process innovations would also enrich understanding of the organizational conditions that maximize performance outcomes.

In conclusion, innovation should be understood as a dynamic, multidimensional process. Integrating product, process, and cultural dimensions allows firms to achieve sustainable performance improvements, strengthen competitiveness, and enhance resilience in complex and evolving environments. These insights provide both theoretical guidance and practical recommendations for managers, policymakers, and researchers aiming to optimize innovation strategies.

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