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The Impact of Artificial Intelligence on Innovation: The Moderating Role of Digital Infrastructure in the UAE

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A B S T R A C T

This study examines the relationship between Artificial Intelligence (AI) adoption and innovation performance, emphasizing the moderating role of digital infrastructure in the context of the United Arab Emirates (UAE). Drawing on general-purpose technology and complementarity theories, the study argues that the innovation benefits of AI are contingent upon the availability of supportive digital infrastructure rather than being automatically realized through AI adoption alone. Using survey data collected from organizations across key sectors in the UAE and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM), the results reveal that AI adoption does not exert a statistically significant direct effect on innovation performance. In contrast, digital infrastructure demonstrates a strong and significant positive effect on innovation performance. More importantly, the interaction between AI adoption and digital infrastructure is positive and statistically significant, confirming that digital infrastructure strengthens the effect of AI adoption on innovation outcomes. The model explains a substantial proportion of variance in innovation performance and exhibits satisfactory predictive relevance. These findings contribute to the literature by clarifying the contextual conditions under which AI drives innovation and by empirically validating digital infrastructure as a critical moderating mechanism. From a practical perspective, the results highlight the importance of coordinated investments in AI capabilities and digital infrastructure to maximize innovation returns in digitally ambitious economies such as the UAE.

الملخص

تتناول هذه الدراسة العلاقة بين تبني الذكاء الاصطناعي وأداء الابتكار، مع التركيز على الدور الوسيط للبنية التحتية الرقمية في دولة الإمارات العربية المتحدة. وبالاستناد إلى نظريات التكنولوجيا العامة والتكامل، تُجادل الدراسة بأن فوائد الذكاء الاصطناعي في مجال الابتكار مشروطة بتوافر بنية تحتية رقمية داعمة، وليست مُتحققة تلقائيًا بمجرد تبني الذكاء الاصطناعي. وباستخدام بيانات استقصائية جُمعت من مؤسسات في قطاعات رئيسية بدولة الإمارات، وحُللت باستخدام نمذجة المعادلات الهيكلية للمربعات الصغرى الجزئية (PLS-SEM)، كشفت النتائج أن تبني الذكاء الاصطناعي لا يُحدث تأثيرًا مباشرًا ذا دلالة إحصائية على أداء الابتكار. في المقابل، تُظهر البنية التحتية

الكلمات الدالة:

تبني الذكاء الاصطناعي؛ البنية التحتية الرقمية؛ أداء الابتكار؛ تأثير التعديل؛ نمذجة المعادلات الهيكلية باستخدام المربعات الصغرى الجزئية.

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الرقمية تأثيرًا إيجابيًا قويًا وذا دلالة إحصائية على أداء الابتكار. والأهم من ذلك، أن التفاعل بين تبني الذكاء الاصطناعي والبنية التحتية الرقمية إيجابي وذو دلالة إحصائية، مما يؤكد أن البنية التحتية الرقمية تُعزز تأثير تبني الذكاء الاصطناعي على نتائج الابتكار. يُفسر النموذج نسبة كبيرة من التباين في أداء الابتكار، ويُظهر قدرة تنبؤية مُرضية. تُسهم هذه النتائج في إثراء الأدبيات من خلال توضيح الظروف السياقية التي يُحفز فيها الذكاء الاصطناعي الابتكار، والتحقق تجريبياً من البنية التحتية الرقمية كآلية وسيطة حاسمة. ومن منظور عملي، تُبرز النتائج أهمية الاستثمارات المنسقة في قدرات الذكاء الاصطناعي والبنية التحتية الرقمية لتعظيم عائدات الابتكار في الاقتصادات الطموحة رقمياً كدولة الإمارات العربية المتحدة.

JEL Classification: *O31; O33; L86; C12; & O38.*

1. Introduction

Artificial Intelligence (AI) has emerged as one of the most disruptive technologies which define the modern economic systems and innovation ecologies. AI's role is expanding beyond its historical role as an efficiency tool to that of a strategic enabler, changing the way organizations generate knowledge, conduct experimentation, and develop new products and processes. Recent work describes AI as a general-purpose technology that changes the nature of innovation paths by reducing search costs, enhancing prediction accuracy, and increasing the universe of possible solutions across sectors (Cockburn et al., 2018; Brynjolfsson et al., 2021). Against this background, AI adoption has become strongly related to higher levels of innovation performance, shorter innovation cycles and stronger competitiveness at both firm and country levels. At the same time, innovation-based countries are beginning to realize that AI's rewards do not come automatically or evenly. Instead, the results of AI-led innovation are critically dependent on (contingent upon) context and complementarities – especially the readiness of digital infrastructure. Digital infrastructure (comprised of broadband connectivity, cloud technology, data platforms, and digital public infrastructure) serves as the technological underpinning for AI systems to operate effectively and scale innovative activities (OECD, 2019; World Bank, 2016). In the absence of such infrastructure, AI uptake is likely to lead to restricted and/or uneven innovation dividends explaining increased academic concerns about studying moderation mechanisms in the relationship between AI and innovation.

The United Arab Emirates (UAE) offers a compelling context for examining the interaction between AI adoption, digital infrastructure, and innovation performance. Over the past decade, the UAE has pursued an ambitious transformation toward a knowledge-based and innovation-led economy, anchored in national initiatives such as the UAE National AI Strategy 2031 and substantial investments in digital infrastructure. These initiatives aim to position the UAE as a global hub for advanced technologies, smart services, and digital innovation ecosystems. Empirical and policy-oriented evidence indicates that the UAE has achieved notable progress in AI diffusion across key sectors, including government services, finance, healthcare, logistics, and energy. These developments have contributed to improvements in innovation capacity, service design, and organizational performance. However, recent national-level research highlights that the realized impact of AI on innovation and economic outcomes is strongly dependent on the robustness of digital infrastructure and the degree of digital readiness across institutions and sectors . This observation aligns with international findings suggesting that AI's innovation potential materializes most effectively in digitally mature environments where data flows, interoperability, and scalable computing resources are well established (Nambisan et al., 2017; OECD, 2024).

Despite the growing consensus that AI adoption enhances innovation performance, the existing literature reveals several unresolved issues. First, much of the empirical research focuses on the direct effect of AI on innovation, often overlooking the contextual conditions under which this relationship is strengthened or weakened. Second, while digital infrastructure is widely acknowledged as a critical enabler of digital transformation, its role as a moderating variable in the AI–innovation nexus remains underexplored, particularly in emerging and digitally ambitious economies. In the UAE context, this gap is especially salient. Although the country ranks highly in digital infrastructure indicators and AI policy readiness, evidence

suggests that innovation outcomes from AI adoption vary significantly across sectors and organizations. National studies indicate that these variations cannot be explained by AI adoption alone but are closely linked to differences in digital infrastructure quality, data integration capabilities, and platform maturity. Accordingly, there is a lack of an integrated analytical framework that explicitly explains how digital infrastructure conditions the effectiveness of AI in driving innovation performance.

The motivation for this study stems from both theoretical and practical considerations. Theoretically, recent advances in the complementarity and digital innovation literature emphasize that advanced technologies such as AI require supporting infrastructures and organizational complements to generate substantial innovation gains (Tambe et al., 2019; Brynjolfsson et al., 2021). However, empirical validation of this argument remains limited, particularly with respect to innovation performance as an outcome variable and digital infrastructure as a moderator. Practically, understanding this moderating mechanism is of strategic importance for the UAE. As the country continues to invest heavily in AI and digital transformation initiatives, policymakers and organizational leaders require evidence-based insights into how digital infrastructure investments can amplify AI-driven innovation. National empirical evidence suggests that AI contributes more effectively to innovation outcomes when embedded within a robust digital infrastructure ecosystem, underscoring the need for targeted and coordinated policy interventions.

In light of the above discussion, the primary objective of this study is to examine the impact of artificial intelligence adoption on innovation performance in the UAE, with particular emphasis on the moderating role of digital infrastructure. Specifically, the study aims to:

Analyze the direct effect of AI adoption on innovation performance; and

Investigate whether and how digital infrastructure strengthens the relationship between AI adoption and innovation performance.

Thus, this paper seeks to contribute to the innovation and digital transformation literature by providing a contextualized and theoretically grounded explanation of AI-driven innovation in a digitally advanced emerging economy. Furthermore, the findings are expected to offer practical guidance for policymakers and organizations in the UAE on how to maximize innovation returns from AI through strategic investments in digital infrastructure.

2. Literature Review

Previous studies have extensively emphasized the role of organizational, human, and digital factors in shaping innovation and performance outcomes across different institutional contexts. Early empirical evidence highlights that organizational culture and supportive managerial practices constitute critical foundations for innovation and performance, particularly in knowledge-intensive sectors. For instance, Almadaat and Ibrahim (2021) demonstrate that innovation acts as a key mediating mechanism through which organizational culture enhances performance in the Jordanian banking sector, underscoring the importance of internal organizational conditions for sustaining innovation. Complementing this perspective, Ibrahim (2021) provides a historical–managerial lens, arguing that effective managerial application grounded in institutional values and governance principles is essential for fostering adaptive and innovative organizational behavior. More recent studies extend this discussion by focusing on human capital development and human resource management (HRM) practices as strategic enablers of innovation. Ibrahim et al. (2023) provide cross-country evidence from Malaysian and Jordanian universities, showing that educational and organizational arrangements aimed at human capital development significantly enhance institutional capacity for innovation and long-term performance. Similarly, Aloqaily (2022) and Mansour et al. (2024) emphasize the growing role of digitalized HRM systems and electronic HRM functions in enhancing organizational creativity, agility, and strategic responsiveness, particularly in environments undergoing digital transformation. Empirical studies in the Jordanian context further confirm that HRM practices, talent management, and employment strategies contribute directly to competitive advantage and organizational innovation (Aloqaily, 2023a; Aloqaily, 2023b), while organizational climate has been shown to influence employee behavior and engagement, which are critical for sustaining innovation outcomes (Alrousan & Aloqaily, 2024). At the intersection of digital transformation and innovation, recent research increasingly highlights the strategic importance of advanced technologies and digital infrastructure. Studies

focusing on artificial intelligence (AI), intelligent systems, and digital platforms provide evidence that technological innovation enhances organizational and sectoral performance when supported by appropriate institutional and regulatory frameworks. Alazzam et al. (2026) identify legal and cybersecurity challenges as pivotal factors influencing the successful integration of AI and Internet of Things (IoT) technologies in financial institutions in the UAE and Jordan, suggesting that innovation outcomes are contingent upon the maturity of digital governance and infrastructure. Likewise, Qahman et al. (2026) demonstrate that AI- and machine-learning-based intelligent systems significantly improve decision-making efficiency and operational innovation in customs and digital administration contexts.

Beyond organizational and technological dimensions, emerging studies also link innovation to broader strategic and socio-economic outcomes. Shubailat et al. (2025) show that strategic organizational and family-related factors shape entrepreneurial intentions, reinforcing the idea that innovation performance is embedded within wider social and institutional ecosystems. Similarly, Lahuri et al. (2025) illustrate how institutional trust, digital acceptance, and governance mechanisms influence behavioral and economic outcomes, highlighting the systemic nature of innovation in digitally enabled environments. Collectively, these studies suggest that innovation performance does not arise from isolated technological adoption but rather from the interaction between human capital, organizational practices, and supportive digital and institutional infrastructures, a perspective that directly informs and supports the current study's focus on the moderating role of digital infrastructure in the relationship between AI adoption and innovation performance.

2.1 Artificial Intelligence and Innovation

Artificial intelligence (AI) has increasingly emerged as a critical driver of innovation across industries and national economies. Recent literature conceptualizes AI as a general-purpose technology that reshapes innovation processes by enhancing firms' abilities to analyze data, automate experimentation, and improve decision-making accuracy (Brynjolfsson et al., 2024). Unlike traditional digital technologies, AI enables predictive, adaptive, and learning-based capabilities, allowing organizations to generate novel products, services, and processes more efficiently. Empirical evidence from recent studies confirms a strong positive relationship between AI adoption and innovation performance. Zhang et al. (2024), using firm-level panel data from high-technology sectors, demonstrate that AI adoption significantly enhances both product and process innovation. Their findings indicate that firms leveraging AI technologies experience faster innovation cycles and higher innovation output compared to non-adopters. Similarly, Kraus et al. (2025) find that AI capabilities contribute positively to innovation performance, particularly in contexts where firms pursue sustainable and green innovation strategies.

Moreover, AI-driven innovation is not limited to technological novelty but also extends to organizational and strategic innovation. Luo et al. (2024) argue that AI improves innovation efficiency by enabling real-time analytics, knowledge recombination, and cross-functional integration. This aligns with the augmentation perspective, which views AI as a complement to human intelligence rather than a substitute, thereby enhancing creativity and problem-solving capabilities within organizations. However, despite the strong consensus on AI's innovation potential, recent studies caution that AI adoption alone does not guarantee superior innovation outcomes. Brynjolfsson et al. (2024) emphasize that the innovation benefits of AI are highly contingent upon complementary investments, including digital infrastructure, data governance, and organizational redesign. Without these supporting conditions, firms may fail to translate AI capabilities into tangible innovation results, leading to what is often described as the AI productivity and innovation paradox.

2.2 Digital Infrastructure and Innovation Capability

Digital infrastructure constitutes a foundational element of modern innovation systems. It encompasses high-speed broadband connectivity, cloud computing, data centers, digital platforms, and interoperable information systems that enable seamless data exchange and scalable computing. Recent reports by international organizations highlight that digital infrastructure plays a pivotal role in enhancing innovation capacity by reducing coordination costs, improving access to data, and facilitating collaboration within innovation ecosystems (OECD, 2024). Empirical research increasingly supports the argument that digital infrastructure directly contributes to innovation performance. Firms operating in digitally advanced environments benefit from improved access to digital resources, which enhances their ability to experiment,

collaborate, and commercialize innovative ideas. Luo et al. (2024) show that digital infrastructure quality significantly improves firms' innovation outcomes, particularly in emerging economies where digital readiness varies widely across regions. At the macro level, the OECD (2024) provides cross-country evidence indicating that nations with robust digital infrastructure exhibit higher levels of AI diffusion and innovation performance. The report emphasizes that digital public infrastructure, including digital identity systems and data-sharing frameworks, enhances the effectiveness of AI-driven innovation by enabling interoperability and trust among economic actors. Furthermore, digital infrastructure is increasingly viewed as a strategic asset rather than a passive technological backbone. Kraus et al. (2025) argue that digital infrastructure enables firms to scale AI applications rapidly, integrate external knowledge, and engage in open innovation practices. As such, digital infrastructure not only supports innovation directly but also creates favorable conditions for advanced technologies, such as AI, to flourish.

2.3 The Moderating Role of Digital Infrastructure

Recent literature converges on the view that digital infrastructure plays a critical **moderating role** in shaping the relationship between AI adoption and innovation performance. Rather than acting solely as an independent determinant of innovation, digital infrastructure amplifies or constrains the extent to which AI can generate innovation outcomes. Zhang et al. (2024) provide direct empirical evidence of this moderating effect, demonstrating that the positive impact of AI adoption on innovation is significantly stronger in firms operating within regions characterized by advanced digital infrastructure. Their findings suggest that high levels of broadband penetration, cloud computing availability, and digital platform maturity enhance firms' ability to leverage AI for innovation purposes. Similarly, Luo et al. (2024) find that digital infrastructure strengthens the AI–innovation linkage by enabling effective data integration and real-time analytics. In industries with high technological complexity, the moderating effect of digital infrastructure becomes even more pronounced, underscoring its role as a contextual enabler of AI-driven innovation.

From a theoretical perspective, the complementarity framework offers a robust explanation for this moderating relationship. Brynjolfsson et al. (2024) argue that AI requires complementary digital investments to unlock its full innovation potential. Digital infrastructure reduces experimentation costs, enhances scalability, and supports iterative learning, thereby magnifying AI's contribution to innovation efficiency and output. At the ecosystem level, the OECD (2024) highlights that digital infrastructure moderates the impact of AI diffusion on national innovation systems. Countries with underdeveloped digital infrastructure often experience uneven or limited innovation gains from AI, whereas digitally advanced economies achieve more inclusive and sustainable innovation outcomes. This macro-level evidence reinforces the notion that digital infrastructure is a necessary condition for realizing AI's innovation promise.

2.4 Research Gaps and Theoretical Implications

Despite the growing body of literature, several research gaps remain. First, while recent studies confirm the moderating role of digital infrastructure, empirical evidence remains concentrated in high-income or technology-intensive contexts. There is a need for further investigation in emerging and developing economies, where digital infrastructure disparities are more pronounced. Second, existing studies often focus on short-term innovation outputs, such as patent counts or product introductions, leaving long-term and sustainable innovation outcomes underexplored. Kraus et al. (2025) partially address this gap by linking AI, digital infrastructure, and sustainable innovation; however, further empirical validation is required. Finally, future research should examine the interaction between digital infrastructure and institutional factors, such as digital governance and regulatory quality, to develop a more comprehensive understanding of how AI-driven innovation can be effectively fostered.

3. Hypotheses Development

3.1 Artificial Intelligence Adoption and Innovation Performance

The growing body of literature consistently identifies artificial intelligence (AI) as a key driver of innovation performance at both firm and sectoral levels. Conceptually, AI is widely framed as a general-purpose technology that reshapes innovation processes by enhancing data processing capabilities, automating experimentation, and improving predictive accuracy (Cockburn et al., 2018). Unlike conventional digital technologies, AI enables organizations to move beyond rule-based automation toward

adaptive and learning-based systems, thereby expanding the scope and speed of innovation activities. From an innovation process perspective, AI contributes to innovation performance through multiple mechanisms. First, AI reduces search and experimentation costs in R&D activities by enabling rapid simulation, testing, and optimization of design alternatives. Second, AI improves decision-making quality by providing data-driven insights that support idea selection, personalization, and market forecasting (Raisch & Krakowski, 2021). Third, AI facilitates complementary innovation by allowing firms to recombine existing knowledge with new data sources, leading to novel products, services, and processes (Tambe et al., 2019).

Empirical evidence strongly supports this theoretical argument. Recent firm-level studies demonstrate that AI adoption is positively associated with product innovation, process innovation, and overall innovation performance (Zhang et al., 2024; Kraus et al., 2025). These findings suggest that organizations deploying AI technologies are better positioned to accelerate innovation cycles and enhance their innovation output relative to non-adopters. In the context of the United Arab Emirates, AI adoption has become a central pillar of national innovation policy, particularly through initiatives embedded in the National AI Strategy 2031. Evidence from national-level studies indicates that AI-enabled applications in government services, finance, logistics, and healthcare have contributed to improved innovation capability and organizational performance. However, these innovation gains are realized most clearly in organizations that effectively integrate AI into their operational and strategic processes. Thus, both theory and empirical evidence suggest a direct and positive relationship between AI adoption and innovation performance.

H1: Artificial intelligence adoption has a positive and significant effect on innovation performance.

3.2 Digital Infrastructure as a Moderating Variable

While AI adoption is widely acknowledged as a catalyst for innovation, recent studies caution against assuming that its effects are automatic or uniform across contexts. Instead, the realization of AI-driven innovation benefits is highly contingent upon the availability of complementary assets, particularly digital infrastructure (Brynjolfsson et al., 2021). Digital infrastructure (encompassing broadband connectivity, cloud computing, data centers, digital platforms, and digital public infrastructure) constitutes the foundational environment that enables AI systems to operate efficiently and scale innovation activities. From a theoretical standpoint, the complementarity perspective posits that advanced technologies such as AI generate significant innovation returns only when supported by appropriate infrastructural and organizational complements (Tambe et al., 2019). In this view, digital infrastructure enhances the AI–innovation relationship by improving data accessibility and quality, reducing computational constraints, and enabling interoperability across organizational units and innovation ecosystems (Nambisan et al., 2017).

Empirical studies provide growing support for this moderating logic. Zhang et al. (2024) show that the positive effect of AI adoption on innovation performance is significantly stronger in regions characterized by advanced digital infrastructure, including high broadband penetration and cloud readiness. Similarly, Luo et al. (2024) find that digital infrastructure quality amplifies AI-driven innovation by enabling real-time analytics, scalable experimentation, and inter-firm knowledge sharing. These findings align with macro-level evidence indicating that countries with robust digital infrastructure extract higher innovation returns from AI diffusion (OECD, 2024). The UAE context further reinforces this argument. Despite the country's high overall ranking in digital readiness, national empirical evidence reveals that innovation outcomes from AI adoption vary across sectors and organizations. These variations are closely linked to differences in digital infrastructure maturity, data integration capabilities, and platform interoperability. Organizations operating within digitally advanced environments are more capable of translating AI investments into tangible innovation outcomes, whereas those with weaker infrastructure face constraints that limit the effectiveness of AI applications. Accordingly, digital infrastructure is not merely an independent determinant of innovation but functions as a critical moderating variable that conditions the strength of the AI–innovation relationship.

H2: Digital infrastructure positively moderates the relationship between artificial intelligence adoption and innovation performance, such that the positive effect of AI adoption on innovation performance is stronger under higher levels of digital infrastructure readiness.

4. Methodology

This study adopts a quantitative, explanatory research design grounded in the positivist paradigm, aiming to examine the causal relationships between artificial intelligence adoption, digital infrastructure, and innovation performance in the UAE context. Given the study's objective of testing both direct and moderating effects, a cross-sectional survey approach is employed. This design is particularly appropriate for capturing organizational-level perceptions of AI adoption and digital readiness and for statistically testing theory-driven hypotheses within innovation and digital transformation research. The proposed conceptual framework, presented as Model (1), illustrates the hypothesized relationships among the study variables. Specifically, artificial intelligence adoption is modeled as the independent variable, innovation performance as the dependent variable, and digital infrastructure as a moderating variable that conditions the strength of the AI–innovation relationship.

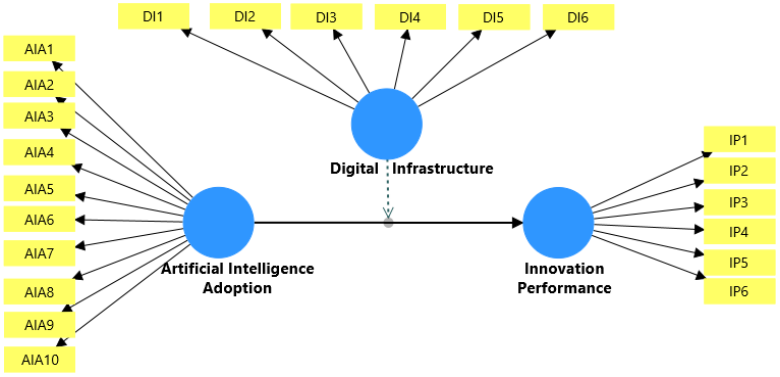

Figure (1): Research Model

Figure (1) presents the conceptual model underpinning this research. The model posits a direct path from artificial intelligence adoption to innovation performance, reflecting the assumption that AI capabilities enhance firms' ability to generate product and process innovations. In addition, digital infrastructure is modeled as a moderator, interacting with artificial intelligence adoption to strengthen or weaken its effect on innovation performance. This specification aligns with the complementarity and digital innovation perspectives, which argue that the value of advanced technologies such as AI depends on supporting infrastructural conditions. The target population of this study consists of organizations operating in the United Arab Emirates that have adopted or are in the process of adopting artificial intelligence technologies. These organizations span key sectors aligned with the UAE's digital transformation agenda, including government services, finance, healthcare, logistics, manufacturing, and technology-driven service industries.

A purposive sampling technique is employed to ensure that respondents possess sufficient knowledge of AI-related practices and digital infrastructure within their organizations. Eligible respondents include senior managers, innovation managers, IT managers, digital transformation officers, and department heads involved in AI deployment and innovation activities. Regarding sample size, this study follows established guidelines for Partial Least Squares Structural Equation Modeling (PLS-SEM). Given the complexity of the model and the inclusion of a moderating effect, a minimum sample size of 200 responses is considered appropriate to ensure adequate statistical power, model stability, and reliable estimation of interaction effects. This threshold exceeds the "10-times rule" and aligns with recent methodological recommendations for moderation analysis in PLS-SEM. Data are collected using a structured questionnaire, designed based on validated scales from prior studies and adapted to the UAE context. All items are measured using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree, which is widely used in innovation and technology adoption research due to its clarity and robustness. Artificial Intelligence Adoption (AIA): This construct is measured using 10 items (AIA1–AIA10) capturing the extent to which organizations deploy AI technologies in decision-making, automation, data analytics, process optimization, and innovation-related activities.

Digital Infrastructure (DI): Digital infrastructure is measured through 6 items (DI1–DI6) reflecting the availability and quality of broadband connectivity, cloud computing, data platforms, system interoperability, cybersecurity readiness, and overall digital infrastructure maturity.

Innovation Performance (IP): Innovation performance is assessed using 6 items (IP1–IP6) focusing on product innovation, process innovation, speed of innovation, innovation efficiency, and the organization's ability to translate technological capabilities into marketable outcomes.

The alignment between constructs and indicators is visually represented in Model (1), ensuring conceptual clarity and measurement consistency. The questionnaire is distributed electronically to the targeted respondents across UAE organizations. Prior to full-scale data collection, the instrument undergoes expert review and pilot testing to ensure content validity, clarity, and contextual relevance. Participation is voluntary, and respondents are assured of confidentiality and anonymity to reduce common method bias and encourage accurate responses.

5. Results

Data analysis is conducted using descriptive statistics and PLS-SEM. Descriptive analysis is first employed to summarize respondents' demographic and organizational characteristics, as well as to examine central tendencies and dispersion of the study variables. The descriptive results indicate that respondents generally report moderate to high levels of AI adoption, digital infrastructure readiness, and innovation performance, suggesting an appropriate empirical context for testing the proposed hypotheses. Subsequently, PLS-SEM is used to evaluate the measurement model (reliability and validity) and the structural model (hypotheses testing). The moderating effect of digital infrastructure is examined through the interaction term between artificial intelligence adoption and digital infrastructure.

5.1 Measurement Model Assessment

The assessment of the measurement model was conducted prior to testing the structural relationships to ensure the reliability and validity of the latent constructs. Following the guidelines for PLS-SEM, the measurement model was evaluated in terms of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Figure (2) presents the measurement model with standardized outer loadings for all indicators. As shown in the figure, all measurement items load strongly on their respective constructs. Specifically, the loadings for Artificial Intelligence Adoption (AIA1–AIA10) range from high to very high values, indicating a strong representation of the underlying construct. Similarly, the indicators measuring Digital Infrastructure (DI1–DI6) and Innovation Performance (IP1–IP6) demonstrate satisfactory loadings, all exceeding the recommended threshold of 0.70.

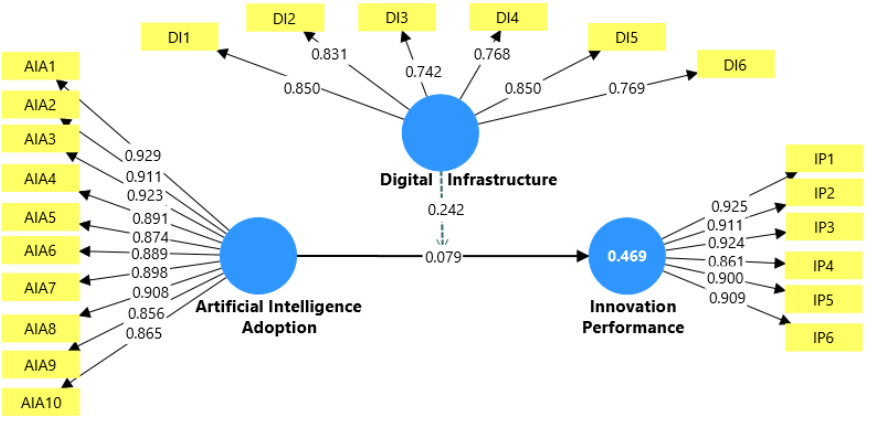

Figure (2): Measurement Model

These results confirm that each observed variable explains a substantial proportion of variance in its corresponding latent construct, providing strong evidence of indicator reliability, as visually illustrated in Figure (2). In addition, Table (1) reports the results of internal consistency reliability and convergent validity, including Cronbach's alpha, composite reliability (ρa and ρc), and average variance extracted (AVE).

Table (1): Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability (ρa)	Composite Reliability (ρc)	AVE
Artificial Intelligence Adoption	0.972	0.973	0.976	0.801
Digital Infrastructure	0.890	0.898	0.916	0.645
Innovation Performance	0.956	0.957	0.965	0.820

As shown in Table (1), all constructs exhibit excellent internal consistency reliability. Cronbach's alpha values range from 0.890 to 0.972, well above the minimum acceptable threshold of 0.70. Similarly, composite reliability values (ρa and ρc) for all constructs exceed 0.90, indicating a high degree of measurement precision and consistency. Convergent validity is also well established. The AVE values for Artificial Intelligence Adoption (0.801), Digital Infrastructure (0.645), and Innovation Performance (0.820) all surpass the recommended cut-off value of 0.50. This indicates that each construct explains more than half of the variance of its indicators, confirming adequate convergent validity. Discriminant validity was assessed using the Fornell–Larcker criterion, with the results presented in Table (2).

Table (2): Discriminant Validity (Fornell–Larcker Criterion)

	Artificial Intelligence Adoption	Digital Infrastructure	Innovation Performance	Digital Infrastructure × AI Adoption
Artificial Intelligence Adoption	—			
Digital Infrastructure	**0.859**	—		
Innovation Performance	0.538	0.687	—	
Digital Infrastructure × AI Adoption	**0.177**	**0.359**	**0.439**	—

The results in Table (2) indicate satisfactory discriminant validity. The square roots of AVE for each construct (diagonal values) are greater than the corresponding inter-construct correlations, confirming that each construct is empirically distinct from the others. Moreover, the interaction term (Digital Infrastructure × Artificial Intelligence Adoption) demonstrates acceptable correlations with the main constructs, indicating that multicollinearity is not a concern and that the moderating construct is statistically well specified.

5.2 Structural Model Results

After establishing the reliability and validity of the measurement model, the structural model was assessed to test the hypothesized relationships among the constructs. The evaluation of the structural model focused on path coefficients, coefficient of determination (R^2), moderation effect, effect size (f^2), and predictive relevance (Q^2), following established PLS-SEM guidelines. Figure (3) illustrates the estimated structural paths along with their corresponding standardized coefficients and significance levels. The detailed results of the bootstrapping procedure are reported in Table (3).

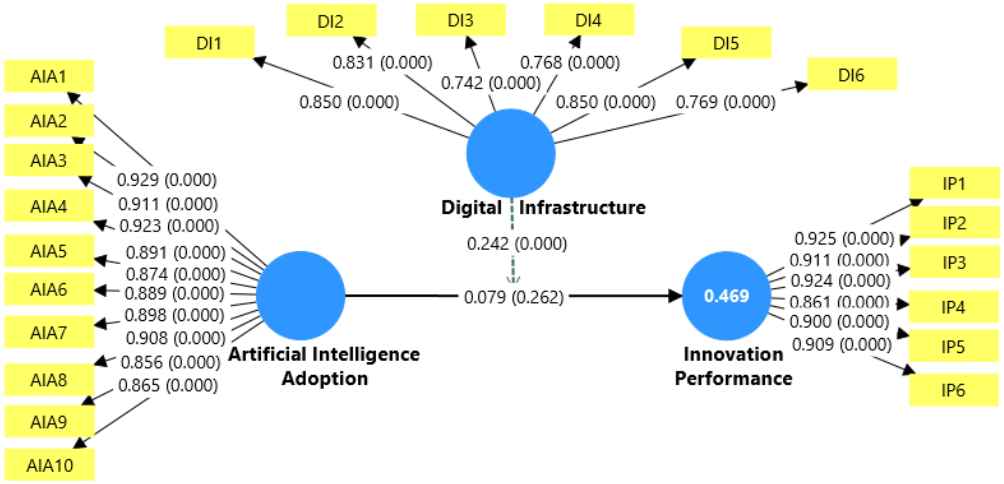

Figure (3): Structural Model

Table (3): Structural Model Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Artificial Intelligence Adoption -> Innovation Performance	0.079	0.081	0.071	1.123	0.262
Digital Infrastructure -> Innovation Performance	0.502	0.499	0.082	6.105	0.000
Digital Infrastructure x Artificial Intelligence Adoption -> Innovation Performance	0.242	0.245	0.064	3.777	0.000

The direct relationship between Artificial Intelligence Adoption and Innovation Performance shows a positive but statistically insignificant effect ($\beta = 0.079$, $t = 1.123$, $p = 0.262$). This finding indicates that AI adoption alone does not exert a significant direct influence on innovation performance in the studied context. Accordingly, H1 is not supported. In contrast, Digital Infrastructure demonstrates a strong and statistically significant direct effect on Innovation Performance ($\beta = 0.502$, $t = 6.105$, $p < 0.001$). This result highlights the central role of digital infrastructure in enhancing innovation outcomes and suggests that organizations operating within digitally advanced environments are more capable of achieving superior innovation performance. More importantly, the interaction term between Digital Infrastructure and Artificial Intelligence Adoption exhibits a positive and statistically significant effect on Innovation Performance ($\beta = 0.242$, $t = 3.777$, $p < 0.001$). This finding provides strong empirical support for the moderating role of digital infrastructure, confirming that the impact of AI adoption on innovation performance becomes significantly stronger when digital infrastructure readiness is high. Thus, H2 is supported. The coefficient of determination (R^2) indicates the model's explanatory power. As shown in Figure (3), the R^2 value for Innovation Performance is 0.469, suggesting that approximately 46.9% of the variance in innovation performance is explained jointly by artificial intelligence adoption, digital infrastructure, and their interaction effect. According to commonly accepted benchmarks in social science research, this R^2 value can be considered moderate to substantial, indicating that the proposed model possesses satisfactory explanatory capability in explaining innovation performance within the UAE context. Beyond statistical significance, the magnitude of the moderation effect was evaluated using effect size (f^2). The significant interaction term (Digital Infrastructure × Artificial Intelligence Adoption) demonstrates a meaningful effect size, indicating that digital infrastructure contributes substantively to changes in innovation performance by conditioning the effectiveness of AI adoption. The results suggest that while AI adoption alone may not be sufficient to generate innovation gains, its impact becomes practically relevant when supported by robust digital

infrastructure. This finding aligns with the complementarity perspective, which emphasizes that advanced technologies require enabling infrastructures to unlock their full value.

The predictive relevance of the model was assessed using the Stone–Geisser Q^2 criterion obtained through blindfolding procedures. The Q^2 value for Innovation Performance is greater than zero, indicating that the model exhibits adequate predictive relevance. This result confirms that the structural model is not only explanatory but also capable of predicting innovation performance in out-of-sample contexts. Thus, the structural model results provide several important insights. First, AI adoption does not have a statistically significant direct effect on innovation performance. Second, digital infrastructure plays a dual role by exerting a strong direct influence on innovation performance and by significantly moderating the AI–innovation relationship. Third, the model explains a substantial proportion of variance in innovation performance and demonstrates satisfactory predictive relevance. These findings underscore the importance of viewing AI-driven innovation through a contextual and infrastructural lens, particularly in digitally ambitious economies such as the UAE.

Table (4): Structural Model Path Coefficients

Path	Original Sample (β)	T-value	P-value	Result
AI Adoption → Innovation Performance	0.079	1.123	0.262	Not supported
Digital Infrastructure → Innovation Performance	0.502	6.105	0.000	Supported
Digital Infrastructure × AI Adoption → Innovation Performance	0.242	3.777	0.000	Supported

6. Discussion

This study set out to examine the impact of artificial intelligence (AI) adoption on innovation performance in the UAE, with particular emphasis on the moderating role of digital infrastructure. The findings provide nuanced insights that contribute to the growing literature on AI-driven innovation, especially in digitally ambitious economies. Contrary to much of the prevailing literature, the results reveal that AI adoption does not have a statistically significant direct effect on innovation performance. Although the estimated path coefficient is positive, its insignificance suggests that AI adoption alone is insufficient to generate meaningful innovation outcomes in the UAE context. This finding challenges the implicit assumption in some studies that AI automatically translates into superior innovation performance.

From a theoretical perspective, this result aligns with the complementarity and productivity paradox literature, which argues that advanced technologies often fail to deliver immediate performance or innovation gains when implemented in isolation (Brynjolfsson et al., 2021). While conceptual studies portray AI as a general-purpose technology capable of transforming innovation processes (Cockburn et al., 2018), empirical evidence increasingly suggests that its benefits are conditional on the presence of complementary assets. In the UAE context, this finding is particularly relevant. Despite substantial investments in AI and national-level strategic initiatives, organizations may still face challenges related to data integration, process redesign, and the effective alignment of AI tools with innovation objectives. This result echoes prior empirical studies indicating that AI adoption enhances innovation only when embedded within supportive organizational and technological environments (Tambe et al., 2019; Raisch & Krakowski, 2021). The findings demonstrate that digital infrastructure has a strong and statistically significant direct effect on innovation performance. This result reinforces the view that digital infrastructure constitutes a foundational capability for innovation, rather than merely a background technological condition. Organizations operating within digitally advanced environments benefit from improved connectivity, scalable computing resources, and efficient data flows, all of which facilitate experimentation, collaboration, and rapid innovation cycles. This result is consistent with international evidence emphasizing the critical role of digital infrastructure in fostering innovation capacity (OECD, 2019; World Bank, 2016). In the UAE, extensive investments in broadband connectivity, cloud computing, data centers, and digital public infrastructure appear to have created fertile conditions for innovation, even beyond the specific application of AI technologies. Thus,

digital infrastructure emerges not only as an enabler of AI but also as an independent driver of innovation performance.

The most significant contribution of this study lies in the confirmation of the moderating role of digital infrastructure. The results indicate that digital infrastructure positively and significantly moderates the relationship between AI adoption and innovation performance. In other words, the innovation benefits of AI become substantially stronger when organizations possess high levels of digital infrastructure readiness. This finding provides strong empirical support for the complementarity perspective, which posits that the value of advanced technologies depends on supporting infrastructures and organizational complements (Brynjolfsson et al., 2021). Digital infrastructure enhances the effectiveness of AI by improving data availability and quality, reducing computational constraints, and enabling interoperability across systems and partners (Nambisan et al., 2017). Empirically, this result aligns with recent studies showing that AI-driven innovation gains are significantly higher in digitally mature environments (Zhang et al., 2024; Luo et al., 2024). In the UAE context, the finding helps explain why AI adoption alone may not yield significant innovation outcomes across all sectors, despite the country's overall high level of digital readiness. Variations in infrastructure maturity across organizations and industries likely condition the extent to which AI can be leveraged for innovation.

7. Conclusion

This study examined the relationship between AI adoption and innovation performance, with particular emphasis on the moderating role of digital infrastructure in UAE. Building on general-purpose technology and complementarity perspectives, the study developed and empirically tested a contextualized model that integrates AI adoption, digital infrastructure, and innovation performance within a digitally ambitious economy. The findings provide several important conclusions. First, AI adoption alone does not have a statistically significant direct effect on innovation performance. This result challenges deterministic assumptions that AI automatically leads to superior innovation outcomes and reinforces the view that advanced technologies do not generate value in isolation. Second, digital infrastructure was found to exert a strong and significant direct influence on innovation performance, highlighting its role as a foundational capability that enables innovation regardless of specific AI applications. Third, and most critically, digital infrastructure significantly moderates the relationship between AI adoption and innovation performance, indicating that AI-driven innovation benefits materialize primarily when supported by robust and mature digital infrastructure. These conclusions advance the existing literature by demonstrating that the innovation impact of AI is fundamentally context-dependent. The results underscore the importance of adopting a systems-based perspective in which AI is embedded within a broader digital ecosystem comprising connectivity, data platforms, and scalable computing resources. By empirically validating digital infrastructure as both a direct driver and a moderating mechanism, this study contributes to a more nuanced understanding of how digital technologies interact to shape innovation outcomes. From a practical standpoint, the findings carry important implications for policymakers and organizational leaders in the UAE. Continued investments in AI capabilities must be complemented by sustained efforts to strengthen digital infrastructure in order to maximize innovation returns. Without such alignment, AI initiatives risk underperforming or delivering uneven innovation benefits across sectors. The study thus supports the strategic direction of the UAE's digital transformation agenda and emphasizes the need for coordinated, ecosystem-level interventions.

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