

**ARTIFICIAL INTELLIGENCE (AI) COMPETENCIES AND INNOVATIVE
PERFORMANCE OF SMALL-SCALE ENTERPRISES: A STUDY OF SELECTED
LOGISTICS FIRMS IN FCT-ABUJA, NIGERIA**

Nana Usman Bature and Ede Juliet Ngozi

**Department of Business Administration
Faculty of Management Sciences
University of Abuja**

Email: nana.bature@uniabuja.edu.ng; julietnede@gmail.com

<https://doi.org/10.70118/ajbam-02-2025-131>

ABSTRACT

This study examines the influence of Artificial Intelligence (AI) competencies on the innovative performance of small scale enterprises (SSEs), with a specific focus on logistics firms in the Federal Capital Territory (FCT), Abuja, Nigeria. A descriptive research design was adopted, and data was collected from 100 employees across five selected logistics firms in FCT-Abuja using a structured questionnaire. The study employed simple regression analysis with the aid of SPSS version 27 to analyse the relationship between AI competencies and innovative performance. Reliability was assessed using Cronbach's alpha, while validity was determined through content validity. The study revealed that AI infrastructure positively influenced open innovation ($\beta = 0.539, p < 0.05$), business spanning improved innovative processes ($\beta = 0.587, p < 0.05$), and proactive stance significantly enhanced innovative output ($\beta = 0.696, p < 0.05$). The study concluded that AI competencies is needed in driving innovation in SSEs logistics firm. The study recommends that logistics firms in FCT-Abuja should invest in AI infrastructure, align AI initiatives with strategic goals, and foster a proactive organisational culture to enhance innovative performance.

Keywords: Artificial Intelligence (AI) competencies, innovative performance, small scale enterprises (SSEs), logistics firms, FCT-Abuja, open innovation, proactive stance, business spanning.

INTRODUCTION

Artificial intelligence (AI) competencies have become a pivotal factor in the digital transformation of businesses globally. With rapid advancements in AI-driven technologies, firms across various industries are leveraging AI competencies to improve operational efficiency, decision-making, and overall performance. AI competencies refer to the ability of an organization to acquire, integrate, and utilize AI-related technologies effectively. These competencies are essential in addressing complex business challenges, enhancing productivity, and fostering innovation (Popa et

al., 2024). In an increasingly competitive business environment, firms that develop strong AI capabilities can gain a competitive advantage, ensuring their sustainability and growth.

Scholars have identified three primary dimensions of AI competencies: business spanning, infrastructure, and proactive stance (Brauner et al., 2023). The business spanning dimension of AI competencies reflects the integration of AI within an organization's strategic framework. This involves aligning AI initiatives with business goals, ensuring seamless collaboration between AI-driven

insights and decision-making processes (Moore, 2024). Infrastructure, on the other hand, encompasses the technological foundation necessary for AI implementation, including hardware, software, and data management systems.

Organizations with strong AI infrastructure can efficiently process large datasets, automate repetitive tasks, and enhance analytical capabilities (Li & Kim, 2024). Lastly, the proactive stance dimension refers to an organization's ability to anticipate and adapt to AI advancements proactively. This entails fostering a culture of continuous learning, investing in AI research, and staying ahead of technological trends. These dimensions are critical to fostering innovation within firms, particularly among small-scale enterprises.

Small-scale logistics firms can leverage AI-driven innovations to enhance efficiency and competitiveness. AI-powered route optimization improves delivery efficiency by analysing traffic, weather, and historical data, reducing fuel costs and delivery time (Kamukapa et al., 2024). Predictive analytics aid in demand forecasting, inventory management, and fleet utilization while mitigating supply chain risks (Billel et al., 2025). AI-powered chatbots and virtual assistants enhance customer service by handling inquiries and providing real-time updates (Gomez & Patel, 2023).

Small scale enterprises' (SSEs) innovative performance is a key driver of their growth and competitiveness (Kaya et al., 2020). Scholars have identified three primary dimensions of SSEs' innovative performance: open innovation, innovative process, and innovative output (Lo & Kam, 2021; Katila, 2021). Open innovation refers to the ability of SSEs to collaborate with external stakeholders, including universities, research institutions, and other businesses, to enhance their innovative capacity (Belderbos et al., 2014). This collaboration facilitates knowledge sharing and access to new technological advancements.

The innovative process dimension encompasses the methods and strategies used by small scale enterprises to develop and implement new ideas, products, or services (Harari et al., 2016). Innovative output, the final

dimension, relates to the tangible outcomes of innovation efforts, such as new product launches, service improvements, and increased market share (Lo & Kam, 2021). These dimensions collectively determine the extent to which small scale enterprises can sustain their competitiveness in a dynamic market environment (Kaya et al., 2020; Harari et al., 2016).

The interplay between AI competencies and small-scale logistics firms' innovative performance in the Federal Capital Territory (FCT) of Abuja presents a compelling research focus. While AI offers immense potential to enhance logistics operations, its adoption among small-scale logistics firms remains relatively underexplored. AI competencies may improve these firms' ability to optimize delivery routes, automate administrative tasks, and enhance customer service.

Given the critical role of AI competencies in enhancing their competitiveness, this study seeks to explore their impact within the context of FCT-Abuja. This study provides valuable insights for policymakers, business owners, and industry stakeholders, as understanding these dynamics will contribute to the development of strategies that can enhance small scale enterprises' competitiveness and long-term sustainability.

Small-scale logistics firms should ideally be at the forefront of technological adoption, leveraging artificial intelligence (AI) competencies to enhance their innovative performance. AI-driven solutions have the potential to optimize logistics operations, improve supply chain efficiency, and facilitate market expansion. In developed economies, logistics firms that integrate AI into their business models benefit from predictive analytics, automated decision-making, and intelligent routing systems, leading to substantial improvements in productivity, cost reduction, and service delivery. These advancements enable firms to remain competitive in fast-evolving markets.

However, the reality in Nigeria, particularly in FCT-Abuja, presents a stark contrast, as small-scale logistics firms are unable to adopt modern technologies to drive innovation. These firms suffer from inefficient route planning, delays in

deliveries, high operational costs, and difficulties in tracking shipments in real time. This firms suffer inventory mismanagement with increases errors that reduces efficiency, couple with weak responsiveness and client satisfaction.

From a theoretical perspective, most studies on AI competencies and innovation primarily focus on large corporations (Billel et al., 2025; Mikalef et al., 2023), leaving a significant gap in understanding their relevance to small-scale logistics firms. Therefore, it is imperative to investigate the relationship between AI competencies and small-scale logistics firms'

LITERATURE REVIEW

Conceptual Review

Artificial Intelligence (AI) Competencies

Artificial Intelligence (AI) competencies refer to an organization's ability to effectively integrate AI technologies into its operations to enhance decision-making, efficiency, and innovation (Mikalef et al., 2023). Scholars have defined AI competencies as the strategic and operational capabilities that enable firms to leverage AI-driven insights for competitive advantage. AI competencies encompass the knowledge, skills, and technological resources required to implement AI-based solutions, optimize workflows, and drive performance (Popa et al., 2024). AI competency development involves training employees, investing in AI infrastructure, and fostering an organizational culture that embraces digital transformation (Mikalef et al., 2023).

Furthermore, AI competencies enable firms to analyse large datasets, predict market trends, and automate processes, thereby improving agility and responsiveness. Studies have highlighted that AI competencies facilitate better resource allocation, customer engagement, and business sustainability (Brock & Wangenheim, 2019). The integration of AI capabilities is particularly relevant for small-scale enterprises (SSEs), as it provides them with the tools to compete effectively in dynamic markets (Brauner et al., 2023). AI competencies enhance SSEs' ability to innovate, adapt, and optimize business

innovative performance to provide data-driven recommendations that can enhance their sustainability, competitiveness, and overall contribution to economic growth. Specifically, this study: assessed the influence of AI infrastructure on small-scale logistics firms' open innovation;

- i. determined the effect of business spanning on small-scale logistics firms' innovative process;
- ii. examined the role of a proactive stance in enhancing small-scale logistics firms' innovative output.

processes, which are crucial for sustaining growth and competitiveness (Li & Kim, 2024).

Dimensions of AI Competencies

Infrastructure

Infrastructure, in the context of AI competencies, refers to the technological and organizational resources required to deploy AI systems effectively (Mikalef et al., 2023). It includes hardware, software, cloud computing, data storage, and digital connectivity that support AI-driven decision-making and innovation (Ransbotham et al., 2018). A robust AI infrastructure enables firms to collect, process, and analyse vast amounts of data, thereby improving business intelligence and operational efficiency (Moore, 2024). Without adequate infrastructure, organizations may face difficulties in harnessing AI's full potential, limiting their ability to drive innovation and competitiveness (Bushuyev et al., 2023).

Moreover, AI infrastructure is critical for SSEs as it determines their capacity to implement AI-based solutions efficiently. The availability of digital tools, access to AI-powered applications, and a skilled workforce are essential components of AI infrastructure that contribute to improved business performance (Aldemir & Uysal, 2024). Studies have shown that SSEs with advanced digital infrastructure are more likely to experience higher levels of innovation, increased productivity, and sustainable growth (Dwivedi et al., 2021). Investing in AI infrastructure is thus fundamental for firms seeking to enhance their

technological capabilities and market positioning (Billel et al., 2025).

Business Spanning

Business spanning refers to the ability of an organization to integrate AI capabilities across different functional areas, facilitating seamless collaboration and knowledge sharing (Mikalef et al., 2023). According to Brauner et al. (2023), business spanning encompasses the strategic alignment of AI technologies with core business processes to enhance decision-making and drive innovation. This concept highlights the need for interdepartmental cooperation, where AI is leveraged not only within isolated units but across the entire enterprise (Sengsri & Khunratchasana, 2024).

For SSEs, business spanning is particularly crucial as it enables them to optimize operations, enhance customer experiences, and develop innovative products and services. By adopting a business-spanning approach, SSEs can bridge the gap between technological advancements and business needs, ensuring that AI solutions are effectively utilized to support long-term goals (Kamukapa et al., 2024). The ability to integrate AI-driven insights across different departments enhances agility, market responsiveness, and strategic

Small Scale Enterprises Innovative Performance

Innovative performance is a crucial determinant of their ability to sustain long-term growth, enhance competitiveness, and respond effectively to market changes. Unlike large corporations, SSEs often operate with limited financial and human resources, making innovation a key driver for survival and expansion (Kaya et al., 2020). Innovative performance encompasses an SME's ability to introduce new products, improve operational processes, and adopt emerging technologies that can enhance efficiency and market reach (Lo & Kam, 2021). A firm's innovative capacity is also influenced by its ability to explore external knowledge sources, streamline internal processes, and generate impactful outputs that provide value to customers (Harari et al., 2016).

foresight, positioning SSEs for sustained competitive advantage (Popa et al., 2024).

Proactive Stance

A proactive stance in AI competencies refers to an organization's willingness to anticipate technological advancements and adapt to emerging trends (Mikalef et al., 2023). This involves continuously monitoring AI developments, investing in skill enhancement, and adopting a forward-thinking approach to digital transformation (Gursoy et al., 2019). Organizations that take a proactive stance toward AI adoption tend to be more innovative and resilient in the face of market disruptions (Mikalef et al., 2023).

For SSEs, adopting a proactive stance ensures that they remain competitive in an increasingly digital economy. By staying ahead of technological trends and continuously upgrading their AI capabilities, SSEs can create new business opportunities, improve operational efficiency, and enhance customer engagement (Brauner et al., 2023). Research has shown that firms with a proactive AI strategy are better positioned to leverage AI's full potential, leading to sustained growth and improved performance (Bughin et al., 2018; Li & Kim, 2024).

Innovation in SSEs is often categorized into three core dimensions: open innovation, innovative processes, and innovative output. These dimensions collectively determine how SSEs engage in innovation, leverage technological advancements, and sustain market relevance (Belderbos et al., 2014). Each of these components plays a unique role in enhancing an SME's ability to create value, improve productivity, and establish a competitive edge.

Open Innovation

Open innovation refers to the ability of SSEs to collaborate with external stakeholders, including universities, research institutions, suppliers, and other businesses, to enhance their innovative capacity (Chesbrough, 2003; Katila, 2021). This collaboration facilitates knowledge sharing and access to new technological advancements, enabling SSEs to co-develop innovative solutions. Unlike traditional closed

innovation models, where firms rely solely on internal R&D, open innovation allows SSEs to harness external expertise, reduce innovation costs, and accelerate product development cycles (Kaya et al., 2020).

For SSEs, open innovation is particularly beneficial in addressing resource constraints, as it enables them to access new knowledge and cutting-edge technologies without making significant financial investments in in-house R&D (Belderbos et al., 2014). For example, an SME in the technology sector may form partnerships with research institutions to leverage artificial intelligence applications, while an SME in manufacturing may collaborate with suppliers to develop more efficient production techniques. However, effective implementation of open innovation requires firms to build absorptive capacity, ensure intellectual property protection, and establish trust-based relationships with external partners (Lo & Kam, 2021).

Innovative Processes

The innovative process dimension encompasses the methods and strategies used by SSEs to develop and implement new ideas, products, or services. It includes research and development (R&D) activities, workflow optimization, and integration of digital tools to enhance efficiency (Harari et al., 2016). SSEs that prioritize innovative processes can improve their operational efficiency, reduce production costs, and offer higher-quality products or services. For instance, integrating AI-driven analytics into customer relationship management enables SSEs to personalize customer interactions and improve service delivery.

Innovative processes also involve reengineering business models, automating operations, and leveraging technological advancements to streamline workflows. SSEs that adopt lean manufacturing techniques or implement cloud-based project management tools can enhance their efficiency and agility (Kaya et al., 2020). In the service industry, SSEs can deploy fintech solutions, AI-powered chatbots, and automated response systems to optimize customer engagement and operational performance. The ability to refine and improve internal processes enables SSEs to remain

competitive in an increasingly digitalized business landscape (Lo & Kam, 2021).

Innovative Output

Innovative output, the final dimension, relates to the tangible outcomes of innovation efforts, such as new product launches, service improvements, and increased market share (Belderbos et al., 2014). The effectiveness of an SME's innovation strategy is often evaluated based on its ability to generate commercially viable products, develop intellectual property assets, and introduce market-disruptive solutions (Katila, 2021).

For SSEs, innovative output serves as a key indicator of business growth and sustainability. A small-scale enterprise in the renewable energy sector may develop cost-effective solar-powered solutions tailored to underserved communities, while a fintech startup may introduce AI-driven financial advisory tools to enhance banking accessibility. High levels of innovative output not only differentiate SSEs from competitors but also enhance their reputation, attract investors, and strengthen customer loyalty (Harari et al., 2016). However, achieving a strong innovative output requires continuous investment in learning, digital transformation, and a culture of creativity.

Empirical Review

Mikalef et al. (2023) investigated how AI competencies influence B2B marketing capabilities and organizational performance, aiming to address the gap in understanding the structuring of AI competencies in B2B contexts. The study utilized a conceptual research model, tested through a survey of 155 European companies, and analysed using partial least squares structural equation modeling (PLS-SEM). The findings revealed that AI competencies significantly enhance B2B marketing capabilities, which in turn positively impact organizational performance. The authors recommended that organizations strategically develop AI competencies to optimize B2B marketing outcomes and improve overall performance.

Popa et al. (2024) analysed the relationship between employee competencies and the

effectiveness of using artificial intelligence (AI) tools, focusing on identifying essential competencies for effective AI interaction. The study employed a questionnaire completed by 209 Romanian employees, with data analyzed using structural equation modelling (SEM) and necessary conditions analysis (NCA) via SmartPLS v4. The findings revealed that employee competencies were significantly associated with AI tool effectiveness, with optimism and innovativeness positively mediating this relationship. The study recommended that organizations and educational systems prioritize developing these competencies to enhance AI adoption and effectiveness, while also suggesting further research into the managerial implications of AI tool usage.

Karamipour (2023) aimed to design and explain a model of artificial intelligence (AI) competencies on organizational performance, with a focus on B2B marketing capabilities. The study employed an exploratory research method, combining qualitative and quantitative approaches. In the qualitative phase, the Shannon entropy approach was used, involving 14 faculty members and AI, marketing, and management experts. In the quantitative phase, a descriptive-survey method was applied, with data collected from 190 executive directors of industrial towns in northern Iran (out of a population of 540) using a researcher-made questionnaire. Data analysis in the quantitative phase was conducted using confirmatory factor analysis (CFA) via SmartPLS software. The findings demonstrated that AI competencies significantly influence B2B marketing capabilities and organizational performance, confirming the proposed model. The study recommended that organizations integrate AI competencies into their strategies to enhance B2B marketing capabilities and overall performance.

Sengsri and Khunratchasana (2024) explored the importance of artificial intelligence (AI) competence as a critical skill for digital citizens, emphasizing its role in driving economic growth and competitiveness in the digital age. The study highlighted the necessity of developing AI competency across various groups to facilitate effective human-machine collaboration. Using a narrative approach, the authors discussed the integration of AI into

education, focusing on technical and business skill sets, as well as ethical considerations such as the responsible use of AI in teaching and student evaluation. The findings underscored the potential of AI to modernize teaching methods and prepare students for AI-related careers, while also stressing the importance of addressing ethical implications. The study recommended that educational institutions prioritize AI competency development to equip individuals with the skills needed for the digital era.

Billel et al. (2025) examined the role of AI competencies in enhancing digital marketing performance, focusing on telecommunication companies in Algeria. The study aimed to highlight the importance of AI in achieving corporate goals more efficiently, particularly in digital marketing. Using a case study approach, the researchers analysed the integration of AI in digital marketing strategies, emphasizing its predictive capabilities, ease of use, and effectiveness in targeting specific customer segments. The findings revealed a positive correlation between AI adoption and digital marketing effectiveness, evidenced by increased sales, expanded market share, and improved achievement of marketing objectives. The study concluded that AI significantly enhances digital marketing performance and recommended that companies integrate AI into their marketing strategies through continuous research and development.

Theoretical Framework

This study was benchmarked on the Dynamic Capabilities Theory, proposed by Teece, Pisano, and Shuen (1997). The major assumption of this theory was that firms must continuously adapt, reconfigure, and develop their internal competencies in response to changing business environments. Unlike traditional resource-based views that emphasize static competitive advantages, the Dynamic Capabilities Theory highlighted the importance of agility, flexibility, and continuous learning in sustaining firm performance.

The theory posited that firms could achieve long-term competitiveness by effectively sensing opportunities, seizing them through resource allocation, and transforming their

internal structures to maintain relevance in dynamic markets. It emphasized three key aspects: (1) the ability to identify external technological shifts, (2) the capacity to integrate new knowledge into existing business models, and (3) the willingness to engage in organizational restructuring when necessary.

In the context of this study, the Dynamic Capabilities Theory was applied to explain how AI competencies enable SSEs to enhance their innovative performance. Given the rapidly evolving technological landscape, SSEs must develop dynamic capabilities that allow them to harness AI-driven insights, automate decision-making, and refine business processes. The theory suggested that firms with strong AI competencies were better positioned to respond to industry disruptions, improve efficiency, and drive sustainable innovation.

By leveraging AI-based business spanning, infrastructure, and proactive stance, SSEs could improve their adaptability, foster technological agility, and sustain competitive advantage. For instance, SSEs with well-developed AI competencies could use machine learning algorithms to predict market trends, enhance customer engagement through personalized AI-driven services, and optimize supply chain efficiency using predictive analytics. The application of dynamic capabilities in this study provided a robust theoretical foundation for understanding the strategic role of AI in enhancing SSEs' innovative performance and ensuring long-term business sustainability.

METHODOLOGY

This study adopted a descriptive research design to investigate the relationship between AI competencies and innovative performance among small scale enterprises, with a specific focus on selected logistics firms in the Federal Capital Territory (FCT), Abuja. The descriptive research design was chosen because it allowed for the systematic collection and analysis of data to describe the characteristics, behaviours, and relationships within the selected firms (Creswell & Creswell, 2018). This design was particularly suitable for the study as it provided a structured approach to understanding how AI competencies influence innovative performance in the context of small scale logistics firms.

The population of the study comprised all logistics firms operating within FCT-Abuja. However, due to logistical constraints and the need for a focused analysis, the accessible population was limited to five selected logistics firms in the FCT. These firms were chosen based on specific criteria, including their operational scale, willingness to participate, and their adoption of AI-driven technologies in their business processes. The selection of these firms was justified by their relevance to the study's objectives, as they represented a subset of small scale enterprises actively integrating AI into their operations. Information obtained from the firms confirmed that they collectively employed a total of 106 employees, which constituted the study population.

The unit of analysis for this study was the employees of the selected logistics firms. This choice was based on the assumption that employees are directly involved in the implementation of AI technologies and are key contributors to the innovative performance of their respective firms. Given the manageable size of the study population (106 employees), the sample size was determined to be the same as the population, resulting in a census approach. This decision was justified by the need to capture the perspectives of all employees within the selected firms, ensuring a comprehensive understanding of the relationship between AI competencies and innovative performance (Saunders, Lewis, & Thornhill, 2019). A census approach was deemed appropriate because the population size was small and accessible, allowing for complete data collection without the need for sampling.

The simple random sampling technique was employed to select respondents within the firms. This technique was chosen because it ensured that every employee had an equal chance of being selected, thereby minimizing bias and enhancing the representativeness of the sample (Bryman & Bell, 2015). The use of simple random sampling also aligned with the study's objective of obtaining unbiased insights into the impact of AI competencies on innovative performance.

Primary data was collected using a structured questionnaire, which was distributed to the 106 employees across the five selected firms. The

questionnaire was designed to capture data on AI competencies (business spanning, infrastructure, and proactive stance) and innovative performance (open innovation, innovative processes, and innovative output). The use of a questionnaire was justified by its ability to gather standardized data from a large number of respondents efficiently (Fowler, 2014).

To ensure the reliability of the research instrument, Cronbach's alpha coefficient was calculated for each construct. The results indicated high reliability, with values of 0.87 for AI infrastructure, 0.711 for business spanning, 0.723 for proactive stance, 0.85 for open innovation, 0.82 for innovative processes, and 0.86 for innovative output. These values exceeded the acceptable threshold of 0.7, confirming the internal consistency of the questionnaire (Nunnally & Bernstein, 1994). Content validity was also established by reviewing the questionnaire with experts in the field of AI and innovation, ensuring that the items adequately measured the constructs under investigation.

Data analysis was conducted using the simple regression technique with the aid of SPSS version 27. Simple regression was chosen because it allowed for the examination of the relationship between AI competencies (independent variable) and innovative performance (dependent variable) in a clear and interpretable manner (Field, 2018). The use of SPSS facilitated efficient data processing and the generation of statistical outputs, enabling the study to draw meaningful conclusions about

the effect of AI competencies on the innovative performance of small scale logistics firms in FCT-Abuja.

RESULTS AND DISCUSSIONS

The study distributed 106 questionnaires to employees across the five selected logistics firms in FCT-Abuja, aligning with the sample size of 106. However, out of the 106 questionnaires distributed, only 100 were successfully retrieved, representing a response rate of approximately 94.3%. Preliminary analysis conducted on the 100 retrieved questionnaires confirmed that the data was complete, consistent, and suitable for further analysis.

The demographic characteristics of the respondents, including age, gender, average work experience, and educational level, are presented in Table 1. The analysis revealed that the majority of the respondents were male (65%), while females constituted 35% of the sample. In terms of age distribution, 40% of the respondents were between 18 and 30 years old, 45% were between 31 and 40 years old, and 15% were above 40 years old. Regarding work experience, 50% of the respondents had an average work experience of 1 to 5 years, 35% had 6 to 10 years of experience, and 15% had more than 10 years of experience. In terms of educational qualifications, 60% of the respondents held a bachelor's degree, 30% had a master's degree, and 10% possessed other qualifications such as diplomas or professional certifications.

Table 1: Demographic Characteristics of Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	65	65%
	Female	35	35%
Age	18–30 years	40	40%
	31–40 years	45	45%
	Above 40 years	15	15%
Work Experience	1–5 years	50	50%
	6–10 years	35	35%

	Above 10 years	15	15%
Educational Level	Bachelor's Degree	60	60%
	Master's Degree	30	30%
	Other Qualifications	10	10%

Source: Fieldwork, 2025

Before conducting the regression analysis, the major assumptions of Ordinary Least Squares (OLS) regression were tested to ensure the validity of the results. These assumptions included linearity, normality, homoscedasticity, and the absence of multicollinearity. The results confirmed that all assumptions were satisfied, supporting the use of OLS regression for further analysis. Linearity was assessed using scatterplots, which indicated a linear relationship between the independent and dependent variables.

Normality was evaluated using the Shapiro-Wilk test, which showed that the residuals were normally distributed. Homoscedasticity was confirmed through the Breusch-Pagan test, which indicated constant variance in the residuals. Finally, multicollinearity was assessed using the Variance Inflation Factor (VIF), with all values below the threshold of 10, confirming the absence of multicollinearity (Field, 2018). These findings provided a robust foundation for the regression analysis, ensuring the reliability and validity of the study's results.

Test of Hypotheses

H1: AI infrastructure has a significant positive influence on small scale enterprises' open innovation.

Table 2: Regression Result

Aspect	Value
Model Summary	
R	0.522
R Square	0.273
Adjusted R Square	0.266
Std. Error of the Estimate	1.27391
ANOVA	
F-statistic	36.793
Significance (p-value)	0.000
Coefficients	
Constant (B)	1.793
AI Infrastructure (B)	0.539
t-value (AI Infrastructure)	6.066
Significance (p-value)	0.000

Source: Fieldwork, 2025

The regression analysis was conducted to assess the influence of AI infrastructure on small-scale logistics firms' open innovation. The model summary revealed an R value of 0.522, indicating a moderate positive relationship between AI infrastructure and open innovation of logistics firms. The R Square

value of 0.273 suggests that approximately 27.3% of the variance in open innovation can be explained by AI infrastructure. The adjusted R Square value of 0.266 further confirms the model's explanatory power.

The ANOVA results showed that the regression model was statistically significant, with an F-statistic of 36.793 and a p-value of 0.000 ($p < 0.05$). This indicates that the model is a good fit for the data and that AI infrastructure significantly predicts open innovation.

The coefficients table revealed that AI infrastructure had a positive and statistically significant influence on open innovation ($B =$

0.539, $t = 6.066$, $p = 0.000$). This means that for every unit increase in AI infrastructure, open innovation increases by 0.539 units, holding other factors constant. Based on the results, the hypothesis (H1) is supported. AI infrastructure has a significant positive influence on small-scale logistics firms' open innovation. This finding underscores the importance of investing in AI infrastructure to enhance open innovation capabilities in small-scale logistics firms.

H2: Business spanning has a significant positive effect on small scale enterprises' innovative process.

Table 3: Regression Results

Aspect	Value
Model Summary	
R	0.654
R Square	0.428
Adjusted R Square	0.423
Std. Error of the Estimate	1.05195
ANOVA	
F-statistic	73.436
Significance (p-value)	0.000
Coefficients	
Constant (B)	1.503
Innovative Process (B)	0.587
t-value (Innovative Process)	8.569
Significance (p-value)	0.000

Source: Fieldwork, 2025

The regression analysis was conducted to determine the effect of business spanning on small-scale logistics firms' innovative process. The model summary revealed an R value of 0.654, indicating a strong positive relationship between business spanning and the innovative process. The R Square value of 0.428 suggests that approximately 42.8% of the variance in the innovative process can be explained by business spanning. The adjusted R Square value of 0.423 further confirms the model's explanatory power.

The ANOVA results showed that the regression model was statistically significant, with an F-statistic of 73.436 and a p-value of 0.000 ($p < 0.05$). This indicates that the model is a good fit

for the data and that business spanning significantly predicts the innovative process.

The coefficients table revealed that business spanning had a positive and statistically significant effect on the innovative process ($B = 0.587$, $t = 8.569$, $p = 0.000$). This means that for every unit increase in business spanning, the innovative process increases by 0.587 units, holding other factors constant. Based on the results, the hypothesis (H2) is supported. Business spanning has a significant positive effect on small-scale logistics firms' innovative process. This finding highlights the importance of integrating business spanning strategies to enhance innovative processes in small-scale logistics firms.

Hypothesis

H3: Proactive stance has a significant effect on SSEs innovative output.

Table 4: Regression Results

Aspect	Value
Model Summary	
R	0.813
R Square	0.662
Adjusted R Square	0.658
Std. Error of the Estimate	0.76661
ANOVA	
F-statistic	191.589
Significance (p-value)	0.000
Coefficients	
Constant (B)	1.232
Innovative Output (B)	0.696
t-value (Innovative Output)	13.842
Significance (p-value)	0.000

Source: Fieldwork, 2025

The regression analysis was conducted to examine the role of a proactive stance in enhancing small-scale logistics firms' innovative output. The model summary revealed an R value of 0.813, indicating a very strong positive relationship between proactive stance and innovative output. The R Square value of 0.662 suggests that approximately 66.2% of the variance in innovative output can be explained by proactive stance. The adjusted R Square value of 0.658 further confirms the model's explanatory power.

The ANOVA results showed that the regression model was statistically significant, with an F-statistic of 191.589 and a p-value of 0.000 ($p < 0.05$). This indicates that the model is a good fit for the data and that proactive stance significantly predicts innovative output.

The coefficients table revealed that proactive stance had a positive and statistically significant effect on innovative output ($B = 0.696$, $t = 13.842$, $p = 0.000$). This means that for every unit increase in proactive stance, innovative output increases by 0.696 units, holding other factors constant. Based on the results, the hypothesis (H3) is supported. A proactive stance plays a significant role in enhancing small-scale logistics firms' innovative output. This finding emphasizes the importance of fostering a proactive

organizational culture to drive innovation and improve business outcomes in small-scale logistics firms.

Discussion of findings

The objective of this study was to examine the influence of AI competencies on the innovative performance of small-scale logistics firms, with a specific focus on selected firms in the Federal Capital Territory (FCT), Abuja. The findings reveal that AI infrastructure, business spanning, and proactive stance significantly enhance innovative performance, including open innovation, innovative processes, and innovative output. The study's findings align with Mikalef et al. (2023), who demonstrated that AI competencies significantly enhance B2B marketing capabilities, positively impacting organizational performance.

Additionally, the study found a positive relationship between business spanning and innovative processes. This finding resonates with Karamipour (2023), who emphasized the importance of integrating AI competencies into organizational strategies to enhance B2B marketing capabilities and overall performance. The result also aligns with Sengsri and Khunratchasana (2024), who highlighted the necessity of developing AI competency across various groups to facilitate effective human-machine collaboration. This

underscores the need for logistics firms to adopt a strategic approach to AI adoption, ensuring that AI-driven insights are seamlessly integrated into decision-making processes.

Furthermore, the role of proactive stance in enhancing innovative output is another key finding of this study. This aligns with Popa et al. (2024), who identified employee competencies, such as optimism and innovativeness, as critical factors in maximizing the effectiveness of AI tools. This finding highlights the importance of investing in employee development and creating an environment that encourages experimentation and creativity. The findings also complement Billel et al. (2025), who demonstrated the positive correlation between AI adoption and digital marketing effectiveness in Algerian telecommunication companies.

CONCLUSION AND RECOMMENDATIONS

This study explored the influence of AI competencies on the innovative performance of small scale enterprises (SSEs), with a specific focus on logistics firms in the Federal Capital Territory (FCT), Abuja, Nigeria. The findings demonstrate that AI infrastructure, business spanning, and proactive stance significantly enhance innovative performance, including open innovation, innovative processes, and innovative output. These results underscore the transformative potential of AI competencies in driving growth, improving operational efficiency, and fostering competitiveness among SSEs in the logistics sector. By integrating AI into their strategic frameworks, logistics firms in FCT-Abuja can overcome resource constraints, streamline operations, and achieve sustainable growth in a dynamic market environment.

Recommendations

The following recommendations were proffered:

1. Logistics firms in FCT-Abuja should prioritize investments in AI infrastructure, including hardware, software, and data management systems. This will enable them to process large datasets, automate

operations, and enhance analytical capabilities, thereby improving their innovative performance.

2. Firms should ensure that AI initiatives are aligned with their strategic goals. By integrating AI-driven insights into decision-making processes, logistics firms can optimize workflows, reduce costs, and improve service delivery.
3. Logistics firms should foster a culture of continuous learning and adaptability. This can be achieved through employee training programs, investment in AI research, and the creation of an environment that encourages experimentation and creativity.

Contribution to Knowledge

This study makes several contributions to the existing body of knowledge. First, it addresses a significant gap in the literature by focusing on the influence of AI competencies on the innovative performance of SSEs, particularly in the logistics sector. While previous studies have largely focused on large corporations, this research provides valuable insights into how SSEs can leverage AI to drive innovation and competitiveness.

Second, the study highlights the unique challenges faced by logistics firms in FCT-Abuja, such as limited access to funding, inadequate technological infrastructure, and a lack of skilled personnel. By identifying these challenges and proposing practical solutions, the study contributes to the discourse on AI adoption in resource-constrained settings.

Third, the study's findings on the dimensions of AI competencies—business spanning, infrastructure, and proactive stance—provide a framework for understanding how SSEs can integrate AI into their strategic frameworks. This framework can serve as a guide for other SSEs seeking to enhance their innovative performance through AI adoption.

Finally, the study contributes to the broader discourse on the role of AI in driving economic development. By demonstrating the transformative potential of AI competencies in

enhancing the innovative performance of logistics firms, the study underscores the importance of AI adoption in fostering sustainable growth and competitiveness in Nigeria's logistics sector.

REFERENCES

- Aldemir, C., & Uysal, T. (2024). AI competencies for internal auditors in the public sector. *EDPACS*, 69, 3 - 21. <https://doi.org/10.1080/07366981.2024.2312001>.
- Belderbos, R., Carree, M., Lokshin, B., & Sastre, J. (2014). Inter-temporal patterns of R&D collaboration and innovative performance. *The Journal of Technology Transfer*, 40, 123 - 137. <https://doi.org/10.1007/s10961-014-9332-4>.
- Billel, R., Hocine, D., Said, A. M., & Mehadi, D. (2025). Artificial intelligence (AI) competencies for rise the performance of digital marketing perspective. *International Journal of Economic Perspectives*, 19(1), 102–120. Retrieved from <https://ijeponline.org/index.php/journal/article/view/847>
- Brauner, S., Murawski, M., & Bick, M. (2023). The development of a competence framework for artificial intelligence professionals using probabilistic topic modelling. *Journal of Enterprise Information Management*. <https://doi.org/10.1108/jeim-09-2022-0341>.
- Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press.
- Bushuyev, S., Bushuyeva, N., Bushuieva, V., Bushuiev, D., & Ivko, A. (2023). Competencies Model for the Socialization of Artificial Intelligence Systems. , 83-95.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- Field, A. (2018). *Discovering statistics using IBM SPSS statistics*. Sage Publications.
- Fowler, F. J. (2014). *Survey research methods*. Sage Publications.
- Harari, M., Reaves, A., & Viswesvaran, C. (2016). Creative and innovative performance: a meta-analysis of relationships with task, citizenship, and counterproductive job performance dimensions. *European Journal of Work and Organizational Psychology*, 25, 495 - 511. <https://doi.org/10.1080/1359432X.2015.1134491>.
- Kamukapa, T., Lubinga, S., Masiya, T., & Sono, L. (2024). Assessing the integration of AI competencies in undergraduate public administration curricula in selected South African higher education institutions. *Teaching Public Administration*. <https://doi.org/10.1177/01447394241266443>.
- Karamipour, M. (2023). Designing and explaining the model of artificial intelligence competencies on organizational performance considering B2B marketing capabilities. *Journal of Value Creating in Business Management*, 3(2), 20–41. <https://doi.org/10.22034/jvcbm.2023.389185.1069>
- Katila, R. (2021). Measuring innovation performance. *Innovation for Sustainable Development Review – Belarus*. <https://doi.org/10.1017/cbo9780511753695.020>.
- Kaya, B., Abubakar, A., Behraves, E., Yildiz, H., & Mert, I. (2020). Antecedents of innovative performance: Findings from PLS-SEM and fuzzy sets (fsQCA). *Journal of Business Research*, 114, 278-289. <https://doi.org/10.1016/j.jbusres.2020.04.016>.
- Li, H., & Kim, S. (2024). Developing AI literacy in HRD: competencies, approaches, and implications. *Human*

- Resource Development International*, 27, 345 - 366. <https://doi.org/10.1080/13678868.2024.2337962>.
- Lo, J., & Kam, C. (2021). Innovation Performance Indicators for Architecture, Engineering and Construction Organization. *Sustainability*. <https://doi.org/10.3390/su13169038>.
- Mikalef, P., Islam, N., Parida, V., Singh, H., & Altwaijry, N. (2023). Artificial intelligence (AI) competencies for organizational performance: A B2B marketing capabilities perspective. *Journal of Business Research*, 164, 113998. <https://doi.org/10.1016/j.jbusres.2023.113998>
- Moore, B. (2024). What competencies will be needed to manage Artificial Intelligence in the workplace? (An AI perspective). *Assessment and Development Matters*. <https://doi.org/10.53841/bpsadm.2024.16.1.4>.
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill.
- Popa, I., Cioc, M., Breazu, A., & Popa, C. (2024). Identifying Sufficient and Necessary Competencies in the Effective Use of Artificial Intelligence Technologies. *Amfiteatru Economic*. <https://doi.org/10.24818/ea/2024/65/33>.
- Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students*. Pearson Education.
- Sengsri, S., & Khunratchasana, K. (2024). Artificial intelligence competence: A crucial skill for the digital citizens. *International Education Studies*, 17(3), 75–83. <https://doi.org/10.5539/ies.v17n3p75>