SSR Journal of Multidisciplinary (SSRJM)
Volume 3, Issue 5, 2026 Homepage: https://ssrpublisher.com/ssrjm/ ISSN: 3049-1304

# Digital Innovation and Informal Sector Development: The Mediating Roles of Business Performance, Financial Inclusion and Spatial Infrastructure

Nwabuisi Nkechi Gift[1], Queen Amarachi Chibueze[2], Oshingbeme Gabriel Suru[3], Isikaku Eberechi Marvellous[4]

[1]Department of Business Administration, Ekiti State University, Nigeria, [2]Department of Mathematics, Statistics and Computer Science, Kaduna State Polytechnic, Nigeria, [3]Department of Geography and Planning, University of Lagos, Nigeria, [4]Department of Economics, Abia State University, Uturu, Nigeria

***Received:*** *11.04.2026* | ***Accepted:*** *26.05.2026* | ***Published:*** *31.05.2026*

***Corresponding Author:** Nwabuisi Nkechi Gift

**DOI:** *10.5281/zenodo.20473294*

**Abstract** **Original Research Article**

Digital innovation has become an important driver of business transformation, financial inclusion, productivity, and market expansion in developing economies. The informal sector remains a major source of employment and income generation, yet many informal enterprises continue to face challenges such as limited access to finance, poor infrastructure, weak record-keeping, low productivity, and restricted market reach. This study examined the impact of digital innovation on informal sector development in Nigeria. The study adopted a quantitative survey research design using questionnaire data obtained from 300 informal sector operators. Digital innovation was measured through indicators such as mobile banking, point-of-sale usage, social media marketing, e-commerce usage, mobile applications, digital payment systems, internet access, and digital record-keeping. Informal sector development was measured through business growth, income improvement, customer expansion, productivity, market access, financial inclusion, employment creation, and gradual formalization. Data were analysed using descriptive statistics, reliability analysis, Pearson correlation, and regression analysis. The findings showed that digital innovation adoption had a strong positive relationship with informal sector development. Regression results further revealed that digital innovation significantly improved business performance, financial inclusion, infrastructure-related outcomes, and economic outcomes. However, challenges such as high data costs, poor electricity supply, weak network connectivity, cyber fraud, limited digital skills, and inadequate government support negatively affected digital adoption. The study concludes that digital innovation can significantly promote informal sector development when supported by inclusive digital infrastructure, affordable internet access, digital literacy, cybersecurity protection, financial inclusion policies, and flexible regulatory frameworks.

**Keywords:** digital innovation, informal sector development, financial inclusion, digital payments, business performance, informal enterprises, Nigeria.



## 1. Introduction

The Digital innovation has become an important driver of business transformation, financial inclusion, and economic development, particularly in developing economies where small and informal enterprises play a major role in livelihood creation. Digital tools such as mobile banking, point-of-sale systems, social

media platforms, e-commerce applications, digital payment systems, and mobile applications have changed how businesses communicate with customers, receive payments, advertise products, and manage daily operations. According to UNCTAD (2024), digital transformation can support inclusive development when supported by access to infrastructure, digital skills, affordability, and effective governance. The informal sector remains a major source of employment and income in many developing countries. It includes traders, artisans, food vendors, transport operators, POS agents, online sellers, repairers, and other microenterprise operators who often function outside full formal regulation. The International Labour Organization (2024) notes that the informal economy contributes significantly to employment and income generation, although workers and business owners in the sector often face low earnings, weak protection, and limited access to formal services. Similarly, the World Bank (2024) identifies informality as a persistent development issue across many economies. In Nigeria, informal sector operators face several challenges, including limited access to credit, poor infrastructure, unstable electricity, weak digital skills, poor internet connectivity, and limited market access. Digital innovation offers opportunities to address some of these problems by improving financial transactions, expanding customer reach, supporting online marketing, and strengthening business record-keeping. Digital financial services are particularly important because they can improve access to savings, payments, and credit for underserved groups (World Bank, 2022). However, the benefits of digital innovation are not automatic, as high data costs, cyber fraud, low digital literacy, and poor network coverage may limit adoption among informal operators.

This study therefore examines the impact of digital innovation on informal sector development. It focuses on how digital tools influence business performance, financial inclusion, spatial access, productivity, income generation, and market expansion. The study is significant because it provides insight into how digital innovation can strengthen informal enterprises and contribute to inclusive economic development.

## 2. Literature Review

### 2.1 Digital Innovation

Digital innovation refers to the use of digital technologies to create new or improved products, services, processes, business models, and market opportunities. It includes mobile banking, digital payments, e-commerce, social media marketing, mobile applications, point-of-sale systems, and digital record-keeping. Digital innovation helps businesses improve transactions, reach customers, reduce costs, and strengthen operational efficiency (Nambisan et al., 2017; Yoo et al., 2012). In developing economies, digital innovation is important because it provides opportunities for small and informal enterprises to overcome barriers such as limited finance, weak market access, poor records, and low productivity (Bukht & Heeks, 2017; World Bank, 2016). UNCTAD (2024) also notes that digital transformation can support inclusive development when backed by infrastructure, affordability, skills, and effective governance.

### 2.2 Informal Sector Development

The informal sector consists of economic activities carried out by individuals or enterprises that are not fully registered, regulated, taxed, or protected by formal institutions. It includes traders, artisans, food vendors, transport operators, POS agents, online sellers, repairers, and other microenterprise operators. The sector provides employment and income but is often associated with low productivity, poor working conditions, weak social protection, and limited access to finance (Chen, 2012; International Labour Organization [ILO], 2024). Informal sector development refers to improvements in business growth, income generation, productivity, employment creation, market access, financial inclusion, and resilience. La Porta and Shleifer (2014) argue that informality remains a major feature of developing economies, while the World Bank (2024) identifies informality as a persistent global development issue. Therefore, improving informal sector performance is important for inclusive economic growth.

### 2.3 Digital Innovation and Business Performance

Digital innovation can improve informal business performance by increasing sales, improving customer relations, expanding market reach, and reducing transaction costs. Social media platforms allow informal businesses to advertise products at low cost, while mobile banking and POS systems make transactions easier and safer. Digital record-keeping also helps business owners monitor sales, expenses, and profits (Aker & Mbiti, 2010; Donner & Escobari, 2010). From a business administration perspective, digital innovation supports entrepreneurship, customer relationship management, competitiveness, and enterprise growth. Nambisan et al. (2017) explain that digital innovation changes the way firms create and deliver value. For informal enterprises, this means greater visibility, faster communication, and improved access to customers.

### 2.4 Digital Financial Inclusion

Financial inclusion refers to access to affordable and useful financial services such as payments, savings, credit, insurance, and remittances. Many informal sector operators lack access to formal finance because they do not have collateral, formal registration, credit histories, or audited records. Digital finance can reduce these barriers through mobile money, digital wallets, POS systems, and digital transaction records (Demirgüç-Kunt et al., 2022; Sahay et al., 2020). Digital financial services can help informal enterprises save money, receive payments, build transaction histories, and access credit. Jack and Suri (2014) found that mobile money improved financial resilience in Kenya. Similarly, the Bank for International Settlements (2024) shows that digital payment innovation is linked to productivity, growth, and informal economic activity.

### 2.5 ICT Adoption, Data, and Computer-Based Innovation

From the perspective of mathematics, statistics, and computer science, digital innovation is linked to ICT adoption, data use, mobile applications, digital platforms, and statistical measurement. Informal businesses that use digital systems generate data on sales, customers, payments, and business performance. These data can support business planning, financial decisions, and credit assessment (Heeks, 2017; Qureshi, 2015). Statistical tools such as correlation, regression, and factor analysis can be used to measure the relationship between digital innovation and informal sector development. Computer-based innovation also supports cybersecurity, mobile application use, online platforms, and digital communication systems.

### 2.6 Geography, Infrastructure, and Spatial Access

Digital innovation has a spatial dimension because access to digital tools depends on location, infrastructure, electricity, internet coverage, and market connectivity. Informal businesses in urban areas may benefit more from digital tools than those in rural or poorly connected areas. This can create spatial inequality in access to digital opportunities (Graham, 2019; Townsend, 2013). From a geography and planning perspective, digital infrastructure should be integrated into urban and regional planning. Informal enterprise clusters such as markets, transport hubs, and commercial streets require reliable electricity, internet access, and digital payment infrastructure. Kitchin (2014) also notes that data and digital infrastructure influence how cities and economic spaces are planned and governed.

### 2.7 Digital Innovation and Economic Development

Digital innovation contributes to economic development by improving productivity, income, employment, market access, and financial inclusion. It can reduce transaction costs, increase business efficiency, and help small businesses participate in wider markets. Goldfarb and Tucker (2019) argue that digital technologies reduce search, replication, transportation, tracking, and verification costs. For informal sector operators, these benefits can lead to increased sales, improved income, and stronger business growth. However, Acemoglu and Restrepo (2019) caution that technology can

also create unequal outcomes if workers and small enterprises are not adequately supported. Therefore, digital innovation must be accompanied by inclusive policy and skills development.

### 2.8 Challenges of Digital Innovation Adoption

Despite its benefits, digital innovation adoption among informal sector operators is limited by high data costs, poor electricity supply, weak network coverage, low digital literacy, cyber fraud, lack of trust, and limited access to smartphones. These barriers can reduce the positive impact of digital innovation on informal sector development (Asongu & Nwachukwu, 2018; Sahay et al., 2020). Platform dependency is another concern. Informal businesses that depend heavily on social media or digital platforms may face risks such as account restrictions, platform charges, algorithm changes, and unequal bargaining power. Wood et al. (2019) note that digital platform work may create flexibility but can also expose workers to insecurity and algorithmic control.

### 2.9 Theoretical Framework

This study is anchored on four theories. First, the Technology Acceptance Model explains that users adopt technology when they perceive it as useful and easy to use (Davis, 1989). This applies to informal operators who adopt mobile banking, POS systems, and social media marketing when they believe these tools improve business performance. Second, the Diffusion of Innovation Theory explains how new technologies spread within a social system over time (Rogers, 2003). In the informal sector, operators may adopt digital tools after observing benefits among competitors or peers. Third, Financial Inclusion Theory explains how access to financial services improves economic participation and business development (Demirgüç-Kunt et al., 2022). Digital finance supports informal enterprises by improving access to payments, savings, and credit. Fourth, the Resource-Based View argues that firms perform better when they possess valuable and useful resources (Barney, 1991). Digital tools can serve as business resources that improve customer access, record-keeping, transactions, and competitiveness.

### 2.10 Empirical Review

Previous studies show that digital technologies improve business performance and economic participation. Aker and Mbiti (2010) found that mobile phones support economic development in Africa by reducing communication and information costs. Donner and Escobari (2010) found that mobile phones improve coordination and customer communication among micro and small enterprises. Jack and Suri (2014) showed that mobile money improved household financial resilience in Kenya. Demirgüç-Kunt et al. (2022) also emphasized the importance of digital payments in expanding financial inclusion. In addition, the Bank for International Settlements (2024) found that digital payment innovation is associated with economic growth, productivity, and informal economic activity. Studies on digital labour and platforms also show mixed outcomes. Graham et al. (2017) and Wood et al. (2019) found that digital platforms create income opportunities but may also expose workers to insecurity, weak protection, and algorithmic control. This suggests that digital innovation can promote informal sector development, but only when supported by infrastructure, skills, trust, and fair regulation.

### 2.11 Gap in Literature

Existing studies have examined digital innovation, financial inclusion, and informal sector development, but many focus on only one dimension, such as business growth or digital finance. Fewer studies combine business administration, statistics/computer science, geography/planning, and economics in one framework. This study addresses that gap by examining digital innovation as a business, technological, spatial, and economic development tool for informal sector development.

## 3. Methodology

### 3.1 Research Design

This study adopted a quantitative survey research design to examine the impact of digital innovation on informal sector development. The

design was considered appropriate because the study measured respondents' opinions using structured questionnaire items and analysed the relationship between digital innovation and informal sector outcomes through statistical techniques.

### 3.2 Population of the Study

The population of the study consisted of informal sector operators in Nigeria. These included traders, food vendors, POS/mobile money operators, artisans, online sellers, transport operators, tailors, hairdressers, barbers, phone/computer repairers, and other self-employed microenterprise operators.

### 3.3 Sample Size and Sampling Technique

The study used a sample size of 300 respondents. A purposive sampling technique was adopted because the study focused on informal sector operators who were involved in business activities and had relevant experience with digital tools such as mobile banking, POS systems, social media, digital payments, and online communication platforms.

### 3.4 Source of Data

The study used primary data collected through a structured questionnaire. Each respondent represented one informal sector operator. The data covered demographic information, digital innovation adoption, business performance, financial inclusion, infrastructure and spatial access, economic outcomes, and challenges of digital adoption.

### 3.5 Measurement of Variables

The independent variable was digital innovation, measured through mobile banking, POS usage, social media marketing, e-commerce usage, mobile applications, digital payment systems, internet access, and digital record-keeping. The dependent variable was informal sector development, measured through business growth, increased sales, income improvement, customer expansion, productivity, market access, financial inclusion, employment creation, and gradual formalization. Moderating factors included electricity supply, internet affordability, digital literacy, network coverage, business location, cybersecurity concerns, and government support.

### 3.6 Validity and Reliability

The questionnaire was subjected to content validity to ensure that the items were consistent with the study objectives, research questions, and reviewed literature. The items were designed to capture the major dimensions of digital innovation and informal sector development. Reliability was tested using Cronbach's Alpha. Cronbach's Alpha was used to determine the internal consistency of the questionnaire items. A reliability coefficient of 0.70 and above was considered acceptable for the study.

### 3.7 Model Specification

The study used regression analysis to examine the effect of digital innovation on informal sector development. The model is specified as:

$$\mathbf{ISD = \beta_0 + \beta_1 DIA + \beta_2 FI + \beta_3 ISA + \beta_4 CDA + \varepsilon}$$

Where:

| Symbol | Meaning |
|---|---|
| ISD | Informal Sector Development |
| DIA | Digital Innovation Adoption |
| FI | Financial Inclusion |
| ISA | Infrastructure and Spatial Access |
| CDA | Challenges of Digital Adoption |
| $\beta_0$ | Constant |
| $\beta_1$–$\beta_4$ | Regression coefficients |

| Symbol | Meaning |
|---|---|
| ε | Error term |

The simplified direct model is:

$$ISD = \beta_0 + \beta_1 DI + \varepsilon$$

Where **DI** represents digital innovation and **ISD** represents informal sector development.

### 3.8 Method of Data Analysis

Data were analysed using descriptive and inferential statistics. Descriptive statistics included frequency, percentage, mean, and standard deviation. These were used to summarize respondents' demographic characteristics and the major study variables. Inferential statistics included correlation and regression analysis. Correlation analysis was used to determine the strength and direction of the relationship between digital innovation and informal sector development. Regression analysis was used to determine the extent to which digital innovation predicts informal sector development.

### 3.10 Ethical Consideration

Respondents were informed that the study was for academic purposes only. Participation was voluntary, and responses were treated with confidentiality. No sensitive personal information was required from respondents, and the data were used strictly for research and analysis.

## 4. Results and Data Analysis

### 4.1 Demographic Profile of Respondents

The study analysed responses from 300 informal sector operators. The demographic characteristics considered were gender, age, educational qualification, business type, smartphone access, internet access, and frequency of digital tool usage.

**Table 1: Gender Distribution of Respondents**

| Gender | Frequency | Percentage |
|---|---|---|
| **Male** | 146 | 48.7% |
| **Female** | 154 | 51.3% |
| **Total** | **300** | **100%** |

Table 1 shows that female respondents were slightly more represented than male respondents. Females accounted for 51.3%, while males accounted for 48.7% of the sample.

**Table 2: Age Distribution of Respondents**

| Age Bracket | Frequency | Percentage |
|---|---|---|
| **Below 20 years** | 14 | 4.7% |
| **20–29 years** | 97 | 32.3% |

| | | |
|---|---|---|
| **30–39 years** | 84 | 28.0% |
| **40–49 years** | 61 | 20.3% |
| **50 years and above** | 44 | 14.7% |
| **Total** | **300** | **100%** |

Table 2 shows that most respondents were between 20 and 39 years, representing 60.3% of the sample. This implies that most informal sector operators in the study were young and economically active individuals.

**Table 3: Educational Qualification of Respondents**

| Educational Qualification | Frequency | Percentage |
|---|---|---|
| **No formal education** | 7 | 2.3% |
| **Primary education** | 27 | 9.0% |
| **Secondary education** | 95 | 31.7% |
| **NCE/OND** | 68 | 22.7% |
| **HND/B.Sc.** | 78 | 26.0% |
| **Postgraduate** | 25 | 8.3% |
| **Total** | **300** | **100%** |

Table 3 shows that most respondents had at least secondary education. This suggests that many informal sector operators had the basic literacy required to understand and use digital tools.

**Table 4: Business Type of Respondents**

| Business Type | Frequency | Percentage |
|---|---|---|
| **Trading** | 60 | 20.0% |
| **Food vending/catering** | 40 | 13.3% |
| **POS/mobile money** | 36 | 12.0% |
| **Online selling** | 33 | 11.0% |
| **Artisan/craft work** | 32 | 10.7% |
| **Hairdressing/barbing** | 28 | 9.3% |
| **Tailoring/fashion design** | 25 | 8.3% |
| **Transport business** | 25 | 8.3% |

| | | |
|---|---|---|
| **Phone/computer repairs** | 21 | 7.0% |
| **Total** | **300** | **100%** |

Table 4 shows that trading had the highest representation, with 60 respondents, representing 20.0% of the sample. This was followed by food vending/catering, POS/mobile money operations, online selling, and artisan/craft work.

### 4.2 Access to Digital Tools

**Table 5: Smartphone and Internet Access of Respondents**

| Variable | Yes | No |
|---|---|---|
| **Smartphone access** | 268 — 89.3% | 32 — 10.7% |
| **Internet access** | 234 — 78.0% | 66 — 22.0% |

Table 5 indicates that most respondents had access to digital devices and internet services. About 89.3% had smartphone access, while 78.0% had internet access. This suggests that many informal sector operators were in a position to adopt digital innovation for business activities.

**Table 6: Frequency of Digital Tool Usage**

| Usage Frequency | Frequency | Percentage |
|---|---|---|
| **Never** | 10 | 3.3% |
| **Rarely** | 23 | 7.7% |
| **Sometimes** | 65 | 21.7% |
| **Often** | 111 | 37.0% |
| **Very often** | 91 | 30.3% |
| **Total** | **300** | **100%** |

Table 6 shows that 67.3% of respondents used digital tools either often or very often. This indicates a high level of digital tool usage among informal sector operators.

### 4.3 Descriptive Statistics of Study Variables

**Table 7: Descriptive Statistics of Study Variables**

| Construct | Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| **Digital Innovation Adoption** | 4.22 | 0.37 | High |
| **Business Performance** | 4.43 | 0.30 | High |
| **Financial Inclusion** | 4.41 | 0.30 | High |
| **Infrastructure/Spatial Access** | 3.45 | 0.45 | Moderate |
| **Economic Outcomes/ISD** | 4.47 | 0.28 | High |
| **Challenges of Digital Adoption** | 3.79 | 0.31 | High |
| **Overall Informal Sector Development** | 4.20 | 0.24 | High |

Table 7 shows that digital innovation adoption was high, with a mean score of 4.22. This implies that informal sector operators frequently used digital tools such as mobile banking, POS systems, social media platforms, digital payments, and online communication tools. Business performance recorded a mean of 4.43, indicating that respondents agreed that digital innovation improved sales, customer relations, competitiveness, and business operations. Financial inclusion had a mean score of 4.41, suggesting that digital financial services improved payment convenience, savings, transaction security, and access to financial opportunities. Infrastructure and spatial access had a moderate mean score of 3.45, indicating that internet connectivity, electricity supply, and business location still affected digital innovation adoption. Economic outcomes/informal sector development had the highest mean score of 4.47, showing that respondents perceived digital innovation as useful for income generation, productivity, market expansion, and employment creation.

### 4.4 Reliability Analysis

**Table 8: Reliability Analysis of Study Constructs**

| Construct | Number of Items | Cronbach's Alpha | Interpretation |
|---|---|---|---|
| **Digital Innovation Adoption** | 8 | 0.560 | Weak |
| **Business Performance** | 6 | 0.301 | Weak |
| **Financial Inclusion** | 6 | 0.282 | Weak |
| **Infrastructure/Spatial Access** | 6 | 0.349 | Weak |
| **Economic Outcomes/ISD** | 7 | 0.377 | Weak |
| **Challenges of Digital Adoption** | 8 | 0.041 | Very weak |

Table 8 shows that the Cronbach's Alpha values were below the acceptable threshold of 0.70. This indicates weak internal consistency among the questionnaire items. Therefore, the questionnaire should be reviewed and refined in future studies. Some items may need to be

removed, reworded, or regrouped to improve reliability. However, the dataset remains useful for pilot analysis and for demonstrating the relationship between digital innovation and informal sector development.

### 4.5 Correlation Analysis

**Table 9: Correlation Between Study Variables and Informal Sector Development**

| Variable | Correlation with Informal Sector Development | p-value | Interpretation |
|---|---|---|---|
| **Digital Innovation Adoption** | 0.861 | < 0.001 | Strong positive relationship |
| **Business Performance** | 0.706 | < 0.001 | Strong positive relationship |
| **Financial Inclusion** | 0.657 | < 0.001 | Strong positive relationship |
| **Infrastructure/Spatial Access** | 0.652 | < 0.001 | Strong positive relationship |
| **Economic Outcomes** | 0.707 | < 0.001 | Strong positive relationship |
| **Challenges of Digital Adoption** | -0.113 | 0.050 | Weak negative relationship |

Table 9 shows that digital innovation adoption had a strong positive relationship with informal sector development, with r = 0.861 and p < 0.001. This means that higher digital innovation adoption is associated with higher informal sector development. Business performance, financial inclusion, infrastructure/spatial access, and economic outcomes also had positive and significant relationships with informal sector development. However, challenges of digital adoption had a weak negative relationship, suggesting that barriers such as high data costs, poor electricity, weak network service, and cyber fraud may reduce the benefits of digital innovation.

### 4.6 Regression Analysis

**Table 10: Regression Result for the Effect of Digital Innovation on Business Performance**

| Variable | Coefficient | t-value | p-value |
|---|---|---|---|
| **Constant** | 2.472 | 15.438 | < 0.001 |
| **Digital Innovation Adoption** | 0.464 | 12.295 | < 0.001 |

**Table 11: Model Summary for Digital Innovation and Business Performance**

| Model Statistic | Value |
|---|---|
| **$R^2$** | 0.337 |
| **Adjusted $R^2$** | 0.334 |
| **F-statistic** | 151.179 |
| **p-value** | < 0.001 |

Tables 10 and 11 show that digital innovation adoption had a positive and significant effect on business performance. The coefficient of 0.464 means that a one-unit increase in digital innovation adoption leads to a 0.464-unit increase in business performance. The $R^2$ value of 0.337 indicates that digital innovation explains 33.7% of the variation in business performance.

**Table 12: Regression Result for the Effect of Digital Financial Services on Financial Inclusion**

| Variable | Coefficient | t-value | p-value |
|---|---|---|---|
| **Constant** | 3.625 | 29.694 | < 0.001 |
| **Mobile Banking** | 0.075 | 3.438 | 0.001 |
| **POS Usage** | 0.112 | 5.044 | < 0.001 |

**Table 13: Model Summary for Digital Financial Services and Financial Inclusion**

| Model Statistic | Value |
|---|---|
| **$R^2$** | 0.128 |
| **Adjusted $R^2$** | 0.122 |
| **F-statistic** | 21.740 |
| **p-value** | < 0.001 |

Tables 12 and 13 show that mobile banking and POS usage had positive and significant effects on financial inclusion. POS usage had a stronger coefficient than mobile banking, suggesting that POS systems contributed more strongly to payment convenience and financial access among informal sector operators.

**Table 14: Regression Result for the Effect of Infrastructure and Spatial Access on Informal Sector Development**

| Variable | Coefficient | t-value | p-value |
|---|---|---|---|
| **Constant** | 2.982 | 36.109 | < 0.001 |
| **Infrastructure/Spatial Access** | 0.352 | 14.856 | < 0.001 |

**Table 15: Model Summary for Infrastructure/Spatial Access and Informal Sector Development**

| Model Statistic | Value |
|---|---|
| **$R^2$** | 0.425 |
| **Adjusted $R^2$** | 0.424 |
| **F-statistic** | 220.698 |
| **p-value** | < 0.001 |

Tables 14 and 15 show that infrastructure and spatial access had a positive and significant effect on informal sector development. The coefficient of 0.352 means that improved infrastructure and spatial access increase informal sector development. The $R^2$ value of 0.425 indicates that infrastructure and spatial access explain 42.5% of the variation in informal sector development.

**Table 16: Regression Result for the Effect of Digital Innovation on Economic Outcomes**

| Variable | Coefficient | t-value | p-value |
|---|---|---|---|
| **Constant** | 2.283 | 16.248 | < 0.001 |
| **Digital Innovation Adoption** | 0.518 | 15.644 | < 0.001 |

Table 16 shows that digital innovation adoption had a positive and significant effect on economic outcomes. The coefficient of 0.518 indicates that increased digital innovation adoption improves income generation, productivity, market expansion, and employment opportunities in the informal sector.

### 4.7 Multiple Regression Analysis

**Table 17: Multiple Regression Result for Predictors of Informal Sector Development**

| Variable | Coefficient | t-value | p-value |
|---|---|---|---|
| **Constant** | 1.071 | 13.779 | < 0.001 |
| **Digital Innovation Adoption** | 0.394 | 30.905 | < 0.001 |
| **Financial Inclusion** | 0.188 | 12.245 | < 0.001 |
| **Infrastructure/Spatial Access** | 0.215 | 24.189 | < 0.001 |
| **Challenges of Digital Adoption** | -0.029 | -2.345 | 0.020 |

Table 18 shows that the model was statistically significant. The $R^2$ value of 0.929 indicates that the independent variables jointly explained 92.9% of the variation in informal sector development. Digital innovation adoption, financial inclusion, and infrastructure/spatial access had positive and significant effects on informal sector development. Challenges of digital adoption had a negative and significant effect, meaning that barriers to digital adoption reduce informal sector development.

## 5. Discussion, Conclusion and Recommendations

### 5.1 Discussion of Findings

This study examined the impact of digital innovation on informal sector development. The findings showed that digital innovation adoption was high among informal sector operators, with a mean score of 4.22. This indicates that many informal businesses now use digital tools such as mobile banking, POS systems, social media platforms, digital payment systems, and mobile applications in their business activities. The result supports the argument that digital innovation is becoming an important tool for informal enterprise development. Through digital tools, informal businesses are able to communicate with customers, receive payments, advertise products, maintain simple records, and expand their market reach. This finding agrees with Aker and Mbiti (2010), who observed that mobile technologies can reduce communication costs and improve economic activities in Africa. It also supports Donner and Escobari (2010), who found that mobile phone use improves coordination and customer communication among micro and small enterprises. The study also found that digital innovation had a positive and significant effect on business performance. The regression result showed that digital innovation adoption significantly improved business performance, with $\beta = 0.464$ and $p < 0.001$. This means that increased use of digital tools leads to improved sales, customer relations, competitiveness, and business operations among informal sector operators. This finding supports Nambisan et al. (2017), who argued that digital innovation changes how firms create and deliver value. The findings further showed that digital financial services significantly improved financial inclusion. Mobile banking and POS usage had positive and significant effects on financial inclusion. This suggests that digital financial tools help informal businesses receive payments, reduce dependence on cash, improve transaction convenience, and increase access to financial opportunities. This is consistent with Demirgüç-Kunt et al. (2022), who emphasized that digital payments are important for expanding financial inclusion, especially among underserved populations. Infrastructure and spatial access were also found to significantly influence informal sector development. The result showed that infrastructure and spatial access had a positive and significant effect on informal sector development, with $\beta = 0.352$ and

$p < 0.001$. This implies that informal businesses located in areas with better internet connectivity, electricity supply, and digital infrastructure are more likely to benefit from digital innovation. This supports the view that digital transformation is not only about technology adoption but also about the availability of supportive infrastructure.

The study also found that digital innovation had a positive and significant effect on economic outcomes. The regression result showed $\beta = 0.518$ and $p < 0.001$, indicating that digital innovation improves income generation, productivity, market expansion, and employment opportunities. This finding agrees with Goldfarb and Tucker (2019), who argued that digital technologies reduce transaction, search, and coordination costs, thereby improving economic efficiency. However, the study found that challenges of digital adoption had a negative effect on informal sector development. These challenges include high cost of internet data, poor electricity supply, poor network coverage, cyber fraud, low digital literacy, and limited government support. This means that barriers to digital adoption reduce the ability of informal businesses to benefit from digital innovation. This finding supports Sahay et al. (2020), who noted that fintech and digital finance require supportive regulation, infrastructure, and consumer protection to produce inclusive outcomes.

Overall, the findings indicate that digital innovation plays an important role in informal sector development. However, its impact depends on the availability of infrastructure, affordability of digital services, digital literacy, trust, cybersecurity, and supportive government policies.

### 5.2 Conclusion

This study concluded that digital innovation has a significant positive impact on informal sector development. The findings showed that informal sector operators who adopt digital tools are more likely to experience improved business performance, better financial inclusion, increased income, wider market access, improved productivity, and stronger customer relationships.

The study also concluded that digital innovation is not limited to business growth alone. It also affects financial inclusion, spatial access, economic outcomes, and gradual formalization of informal enterprises. Mobile banking, POS systems, social media marketing, e-commerce platforms, digital payment systems, mobile applications, and digital record-keeping can help informal businesses become more efficient and competitive.

However, the study also concluded that the benefits of digital innovation are limited by several challenges. Poor electricity supply, high data costs, weak internet connectivity, low digital literacy, cyber fraud, and lack of government support reduce the effectiveness of digital innovation in the informal sector.

Therefore, digital innovation can promote informal sector development, but only when supported by inclusive infrastructure, digital skills training, affordable internet access, cybersecurity protection, financial inclusion policies, and flexible regulatory frameworks.

### 5.3 Recommendations

Based on the findings of the study, the following recommendations are made:

1. **Government should improve digital infrastructure.**

   Government should invest in stable electricity, affordable internet, and reliable network coverage, especially in markets, business clusters, transport hubs, and rural communities where informal businesses are concentrated.

2. **Digital literacy training should be provided for informal sector operators.**

   Training should focus on mobile banking, POS usage, social media marketing, digital record-keeping, cybersecurity awareness, and online customer engagement.

3. **Financial institutions should design products for informal businesses.**

Banks, fintech companies, and microfinance institutions should provide flexible financial products that use digital transaction records as alternative evidence of creditworthiness.

4. **Cybersecurity protection should be strengthened.**

   Informal sector operators should be educated on how to avoid online fraud, fake transfers, phishing, and unsafe digital transactions.

5. **Government should support affordable access to digital tools.**

   Policies should encourage lower data costs, affordable smartphones, and access to digital payment infrastructure for small and informal businesses.

6. **Urban and regional planners should include informal enterprises in digital planning.**

   Markets, roadside business clusters, and informal trade zones should be included in infrastructure planning so that informal businesses can access internet, electricity, and payment systems.

7. **Digital platforms should create fair conditions for informal businesses.**

   Social media platforms, e-commerce platforms, and delivery platforms should ensure transparent charges, dispute resolution, and fair access for microenterprises.

8. **Simplified formalization policies should be introduced.**

   Government should encourage informal businesses to gradually formalize through simple registration systems, low tax burdens, training support, and access to finance.

### 5.4 Contribution to Knowledge

This study contributes to knowledge by examining digital innovation and informal sector development from an interdisciplinary perspective. Unlike studies that focus only on business performance or financial inclusion, this study considered business, technological, spatial, and economic dimensions of informal sector development.

The study also contributes by showing that digital innovation affects informal sector development through business performance, financial inclusion, infrastructure/spatial access, and economic outcomes. This makes the study relevant to business administration, computer science/statistics, geography and planning, and economics.

## References

Acemoglu, D., & Restrepo, P. (2019). Automation and new tasks: How technology displaces and reinstates labor. *Journal of Economic Perspectives, 33*(2), 3–30.

Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives, 24*(3), 207–232.

Asongu, S. A., & Nwachukwu, J. C. (2018). Comparative human development thresholds for absolute and relative pro-poor mobile banking in developing countries. *Information Technology & People, 31*(1), 63–83.

Bank for International Settlements. (2024). *Digital payments, informality and economic growth*. BIS Working Papers.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120.

Bukht, R., & Heeks, R. (2017). Defining, conceptualising and measuring the digital economy. *Development Informatics Working Paper Series*.

Chen, M. A. (2012). *The informal economy: Definitions, theories and policies*. Women in Informal Employment: Globalizing and Organizing.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.

Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). *The Global Findex Database 2021: Financial inclusion, digital payments, and*

*resilience in the age of COVID-19*. World Bank.

Donner, J., & Escobari, M. X. (2010). A review of evidence on mobile use by micro and small enterprises in developing countries. *Journal of International Development, 22*(5), 641–658.

Goldfarb, A., & Tucker, C. (2019). Digital economics. *Journal of Economic Literature, 57*(1), 3–43.

Graham, M. (2019). *Digital economies at global margins*. MIT Press.

Graham, M., Hjorth, I., & Lehdonvirta, V. (2017). Digital labour and development: Impacts of global digital labour platforms and the gig economy on worker livelihoods. *Transfer: European Review of Labour and Research, 23*(2), 135–162.

Heeks, R. (2017). *Information and communication technology for development*. Routledge.

International Labour Organization. (2024). *Statistics on the informal economy*. ILOSTAT.

Jack, W., & Suri, T. (2014). Risk sharing and transaction costs: Evidence from Kenya's mobile money revolution. *American Economic Review, 104*(1), 183–223.

Kitchin, R. (2014). *The data revolution: Big data, open data, data infrastructures and their consequences*. SAGE.

La Porta, R., & Shleifer, A. (2014). Informality and development. *Journal of Economic Perspectives, 28*(3), 109–126.

Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital innovation management: Reinventing innovation management research in a digital world. *MIS Quarterly, 41*(1), 223–238.

Qureshi, S. (2015). Are we making a better world with information and communication technology for development? *Information Technology for Development, 21*(4), 511–522.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Sahay, R., von Allmen, U. E., Lahreche, A., Khera, P., Ogawa, S., Bazarbash, M., & Beaton, K. (2020). *The promise of fintech: Financial inclusion in the post COVID-19 era*. International Monetary Fund.

Townsend, A. M. (2013). *Smart cities: Big data, civic hackers, and the quest for a new utopia*. W. W. Norton.

UNCTAD. (2024). *Digital Economy Report 2024: Shaping an environmentally sustainable and inclusive digital future*. United Nations Trade and Development.

Wood, A. J., Graham, M., Lehdonvirta, V., & Hjorth, I. (2019). Good gig, bad gig: Autonomy and algorithmic control in the global gig economy. *Work, Employment and Society, 33*(1), 56–75.

World Bank. (2016). *World Development Report 2016: Digital dividends*. World Bank.

World Bank. (2024). *Informal Economy Database*. World Bank Group.