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INNOVATION-INDUCED OPERATIONAL EFFICIENCY AND THE SUSTAINABILITY OF HI-TECH VENTURES IN SOUTHWEST NIGERIA

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ABSTRACT
Nigeria has faced persistent challenges such as inefficient operational processes, weak resource allocation, and limited integration of innovation into internal systems, which appear to constrain the sustainability of hi-tech ventures. In response, innovation-induced operational efficiency strategies, including process automation, digital workflow integration, and resource optimization, have been increasingly promoted. This study examines whether these strategies have enhanced the sustainability of hi-tech ventures in Southwest Nigeria. The study investigated the effect of innovation-induced operational efficiency on venture sustainability and adopted the Dynamic Capabilities Theory as its theoretical foundation. A mixed-method approach was employed, combining survey and interview designs. The target population comprised founders, operations managers, and technology leads, within Southwest Nigeria, with a total population of 570 and a sample size of 230 determined using the Krejcie and Morgan formula. Primary data were obtained through structured questionnaire, while secondary data were drawn from the National Bureau of Statistics, NITDA, Startup Genome reports, and relevant academic literature. In addition, qualitative insights were generated through interviews with 10 informants. Descriptive statistics were used for data presentation, while multiple linear regression analysis was employed to test the hypotheses at a 5% level of significance using SPSS version 27. The findings indicate that process automation (p = 0.000), digital workflow integration (p = 0.000), and resource optimization (p = 0.000) exert statistically significant positive effects on sustainability. The study concludes that innovation-induced operational efficiency is a critical determinant of venture sustainability. It is recommended that hi-tech ventures strengthen automation systems, integrate digital workflows, and adopt disciplined resource optimization practices to enhance long-term sustainability.

Keywords: digital workflow integration, hi-tech ventures, innovation-induced operational efficiency, process automation, resource optimization, sustainability of ventures

Introduction
Global discourse on innovation increasingly treats operational efficiency not merely as a cost-saving mechanism, but as a strategic capability through which technology ventures improve scalability, responsiveness, and long-run survival. Contemporary innovation scholarship suggests that ventures that embed process automation, digital workflow integration, real-time analytics, and resource optimization into their operating systems are better positioned to reduce waste, shorten cycle time, and improve service

reliability, thereby enhancing sustainability outcomes in volatile markets (Talukder et al., 2025; World Bank, 2020). At the global level, this linkage has become more pronounced because hi-tech ventures operate in environments characterized by rapid product iteration, intense competition, investor scrutiny, and persistent pressure to achieve efficient growth rather than expansion without performance discipline. The evidence therefore suggests that innovation-induced operational efficiency has become central to venture sustainability, particularly where firms must balance innovation speed with prudent resource deployment.

Across Africa, the relationship appears equally important, although it is shaped by infrastructural gaps, financing constraints, and uneven digital capability. African technology ecosystems have expanded significantly, yet funding pressures have compelled many ventures to shift attention from rapid customer acquisition to operational discipline and survival. Disrupt Africa reports that African tech startup investment declined to about US$2.4 billion in 2023, underscoring a harsher funding climate in which operational efficiency became critical for sustainability, while Nigeria still accounted for 124 funded startups in that year, the highest number on the continent even amid declining funding volumes (Disrupt Africa, 2024). This pattern implies that African ventures can no longer rely solely on market optimism; they must also develop efficient innovation systems that support resilience, cost control, and adaptive continuity.

In Nigeria, the issue is particularly significant because the digital economy now constitutes an important component of national output and entrepreneurial transformation. The National Bureau of Statistics reported that Nigeria's GDP grew by 3.19 per cent in Q2 2024, with services contributing 58.76 per cent of aggregate GDP, while official policy institutions continue to deepen startup support through the implementation of the Nigeria Startup Act and related digital economy reforms (NBS, 2024; NITDA, 2024). In addition, recent evidence places Lagos, located in Southwest Nigeria, among the continent's most important startup hubs, with more than 2,000 startups by October 2024, making the region a logical empirical setting for examining how innovation-driven efficiency supports venture sustainability (Startup Genome, 2025).

Within Southwest Nigeria, where Lagos, Ogun, Oyo, Ondo, Osun, and Ekiti host growing clusters of digital and technology-oriented firms, innovation-induced operational efficiency may be reflected in streamlined product development, automated service delivery, platform integration, data-enabled resource allocation, and faster customer response systems. Sustainability, in turn, may be understood in terms of venture continuity, adaptability, market relevance, and capacity to withstand financial and operational shocks. Recent empirical studies reinforce this linkage. Ebhota et al. (2024) found that digital transformation-related capabilities improved SME performance in Southwest Nigeria, while Olaleye et al. (2024) reported that innovation capability significantly enhanced business sustainability among Nigerian SMEs.

Taken together, these studies indicate that operationally efficient innovation may strengthen the sustainability prospects of hi-tech ventures, yet evidence specific to hi-tech firms in Southwest Nigeria remains limited.

Against this background, the present study focuses on hi-tech ventures in Southwest Nigeria, comprising Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti States, because the region represents the country's most active technology and innovation corridor, with a high concentration of startup and digital venture activities. The study covers the period from 2018 to 2025 in order to capture recent developments in Nigeria's digital economy, innovation practices, and sustainability challenges affecting hi-tech ventures. By concentrating on process automation, digital workflow integration, and resource optimization as the key dimensions of innovation-induced operational efficiency, the study provides a contextually bounded but analytically relevant basis for examining how internal efficiency systems influence venture sustainability in a dynamic but constrained entrepreneurial environment.

The study is important at several levels. Empirically, it contributes to the literature on innovation management, operational efficiency, and entrepreneurial sustainability by extending evidence on the relationship between efficiency-oriented innovation and sustainability outcomes within the context of hi-tech ventures in Southwest Nigeria. Practically, it is expected to provide founders and managers of hi-tech ventures with evidence on how process automation, digital workflow integration, and resource optimization can strengthen operational stability, reduce avoidable waste, improve turnaround time, and support long-term survival in a highly competitive technology market. The study is also relevant to investors, venture capital firms, and startup support institutions because it offers a clearer basis for evaluating the internal strength of hi-tech ventures beyond revenue growth alone. Since many technology ventures fail not only because of weak ideas but also because of inefficient internal operations, the findings may help funding institutions identify efficiency-based indicators associated with venture sustainability. At the policy level, the study offers useful insight to agencies such as NITDA, SMEDAN, state ministries of innovation, and enterprise development institutions on how innovation-related operational systems can be strengthened within the regional startup ecosystem. In this respect, the study goes beyond the question of venture creation and speaks more directly to venture continuity, operational capability, and innovation-driven resilience.

The broad objective of the study is to examine the effect of innovation-induced operational efficiency on the sustainability of hi-tech ventures in Southwest Nigeria.

The specific objectives are to:

i. examine the effect of process automation on the sustainability of hi-tech ventures in Southwest Nigeria.
ii. determine the effect of digital workflow integration on the sustainability of hi-tech ventures in Southwest Nigeria.
iii. assess the extent to which resource optimization has enhanced the sustainability of

hi-tech ventures in Southwest Nigeria.

In line with these objectives, the study seeks to answer the following research questions:

i. What is the effect of process automation on the sustainability of hi-tech ventures in Southwest Nigeria?

ii. What is the effect of digital workflow integration on the sustainability of hi-tech ventures in Southwest Nigeria?

iii. To what extent has resource optimization enhanced the sustainability of hi-tech ventures in Southwest Nigeria?

To guide the empirical analysis, the following null hypotheses are formulated:

i. H_0: There is no significant relationship between process automation and the sustainability of hi-tech ventures in Southwest Nigeria.
ii. H_0: There is no significant relationship between digital workflow integration and the sustainability of hi-tech ventures in Southwest Nigeria.
iii. H_0: There is no significant relationship between resource optimization and the sustainability of hi-tech ventures in Southwest Nigeria.

Conceptual Review

Innovation-Induced Operational Efficiency

Innovation induced operational efficiency is defined as the improvement in organisational processes through the application of innovative technologies, methods, and systems that reduce waste and enhance output quality (Handoyo et al., 2023). Operational efficiency is described as the ability of a firm to minimise time, effort, and material inputs while still producing high quality products or services (TechTarget, 2024). Innovation induced operational efficiency is the strategic alignment of process improvement with technological innovation in ways that strengthen productivity and responsiveness (Atieh et al., 2025). It is a process whereby firms redesign routines, automate repetitive tasks, integrate digital systems, and optimise resource use in order to achieve smoother and more reliable operations (Schlegel et al., 2024). Innovation induced operational efficiency is referred to as a capability that enables technology ventures to sustain performance through lower costs, faster service delivery, and greater adaptability under competitive pressure (Handoyo et al., 2023; Atieh et al., 2025).

Sustainability of Hi-Tech Ventures

Sustainability of hi-tech ventures is defined as the capacity of technology-based firms to survive, grow, and remain competitive over time while adapting to market, financial, and institutional pressures (Alzate-Alvarado et al., 2025). Venture sustainability is described as the long-term ability of startups to maintain economic viability and continue value creation beyond the early stage of operation (Zapata-Molina et al., 2025). Sustainability of hi-tech ventures is the continued alignment of innovation, resources, and strategic capability in ways that support enduring business performance (Boutouar et al., 2025). It is a process whereby new technology-based firms preserve continuity through resilience, adaptability, and efficient capability deployment in uncertain environments (Duve et al., 2025). Venture sustainability is referred to as the condition in which startups achieve survival, stability,

and developmental progression without exhausting the resources needed for future operation (Nguyen et al., 2024). Sustainability of hi-tech ventures is sustained entrepreneurial continuity in innovation intensive sectors (Lee et al., 2025).

Process Automation

Process automation is defined as the use of digital systems, software, or programmed technologies to execute routine and rule-based tasks with minimal human intervention (Nugraha et al., 2025). Process automation is described as a structured mechanism through which organisations standardise repetitive activities in order to improve speed, accuracy, and consistency in operations (Silvares et al., 2024). Process automation is the application of technological tools to streamline workflows and reduce operational bottlenecks across functional activities (Strobel, 2025). Process automation is a process whereby manual procedures are converted into technology enabled routines that improve productivity and minimise error rates (Rahman et al., 2024). Process automation is referred to as a managerial and technological capability that supports efficiency, cost reduction, and service reliability in modern organisations (Akinyi et al., 2024). Process automation is a critical driver of operational efficiency in innovation-oriented ventures seeking sustainable performance under competitive pressure.

Digital Workflow Integration

Digital workflow integration is defined as the coordinated connection of digital tools, platforms, and information systems in a manner that allows organisational tasks to flow seamlessly across units and functions (Bertolini et al., 2024). It is described as the alignment of software applications, data channels, and operational routines to improve communication, speed, and process visibility within firms (Hasan et al., 2025). Digital workflow integration is the process through which organisations connect previously fragmented activities into a unified digital operating structure that supports timely decision making and efficient service delivery (Kraus et al., 2024). It is also viewed as a technology enabled mechanism for synchronising work processes, reducing duplication, and improving coordination among employees, departments, and digital platforms (Yousef et al., 2025). In operational terms, digital workflow integration enhances transparency, continuity, and responsiveness because it permits real time information exchange and smoother task execution. For hi-tech ventures, this is particularly important because the integration of digital workflows can reduce delays, improve customer experience, and support sustainable business performance in rapidly changing markets (Bertolini et al., 2024; Kraus et al., 2024).

Resource Optimization

Resource optimization is defined as the efficient allocation and utilisation of organisational resources in ways that minimise waste and maximise productive outcomes (Li et al., 2025). It is described as the strategic coordination of financial, human, technological, and time-based resources to improve operational performance and long-term viability (Jiang, 2025). Resource optimization is the process through which firms align inputs with priority activities so that resources are not

underutilised, duplicated, or misallocated across operations (Le et al., 2025). It is also viewed as a managerial capability that improves cost efficiency, productivity, and adaptive capacity by ensuring that scarce resources are deployed where they generate the highest value (Jiang, 2024). In innovation-oriented firms, resource optimization enhances the ability to sustain operations because it supports disciplined growth, faster response to market shifts, and stronger performance under conditions of uncertainty. For hi-tech ventures, this is especially important because sustainability often depends on how effectively limited capital, talent, digital tools, and operational time are managed in pursuit of continuous innovation and business continuity

Theoretical Framework

Theory of Dynamic Capabilities was adopted as theoretical framework. The theory as earlier discussed was propounded by Teece, Pisano and Shuen in 1997. The basic idea about this theory is that firms achieve sustained performance not merely by possessing valuable resources, but by their ability to integrate, build, and reconfigure internal and external competences in response to changing environments. Teece et al. argue that such capabilities are especially important in high velocity and technology intensive sectors where firms must continuously renew routines, processes, and resource combinations to remain viable. The theory believes that organisational survival depends on sensing opportunities and threats, seizing them through appropriate investments and decisions, and reconfiguring assets and operations to maintain fitness under changing market conditions. This is directly relevant to the present study because innovation induced operational efficiency reflects a venture's ability to redesign processes through automation, digital workflow integration, and resource optimization in order to improve continuity and sustainability. The basic assumptions of the theory are that firms operate in dynamic environments, resources alone are insufficient for long run advantage, and managerial capability to renew operations is central to sustained performance. Although, the theory was criticized on the basis of conceptual ambiguity and measurement difficulties in empirical studies, recent reviews still regard it as highly relevant for explaining innovation, adaptation, and sustainable performance in turbulent sectors. It is therefore relevant to this study because hi-tech ventures in Southwest Nigeria require adaptive operational capabilities to sustain their businesses over time.

Empirical Review

A study conducted by Jung, Kim and colleagues (2025) examined how startups drive innovations towards sustainability in South Korea. The study investigated the relationship between innovation activities and sustainability performance, with absorptive capacity as a mediating variable and appropriability and openness as moderators. It adopted a quantitative research design and relied on data from 278 young manufacturing firms drawn from the Korean Innovation Survey 2018. The study used regression based empirical analysis to test the proposed relationships. The findings revealed that innovation activities significantly improved sustainability performance, especially where firms possessed stronger absorptive capacity. It concluded that startups are more likely to

achieve sustainable outcomes when innovation efforts are complemented by internal learning and knowledge assimilation capabilities. While the study by Jung et al. was on startup innovation and sustainability performance in South Korea, it differs from the current study on "Innovation-Induced Operational Efficiency and the Sustainability of Hi-Tech Ventures in Southwest Nigeria" because it focused on innovation activities broadly, used absorptive capacity and openness as key explanatory mechanisms, and was conducted in an Asian manufacturing context rather than among hi-tech ventures in Southwest Nigeria.

In a related study carried out by Talukder and co authors (2025), sustainable technologies and organizational performance were examined among SMEs in Malaysia. The study adopted a survey research method, and the population comprised Malaysian SMEs, from which 297 valid responses were analyzed. The study used Partial Least Squares Structural Equation Modelling to assess how the adoption of sustainable technology affected economic, social, and environmental performance. The study revealed that sustainable technology adoption significantly improved organizational performance and that affective attitudes, altruism, government support, and subsidies shaped adoption outcomes. It concluded that technology enabled efficiency and sustainability can reinforce one another where supportive institutional conditions exist. While the study by Talukder et al. was on sustainable technology adoption and organizational performance in Malaysia, it differs from the current study because it concentrated on sustainable technology adoption generally rather than innovation induced operational efficiency, examined broader SME performance dimensions, and was situated in Southeast Asia rather than Southwest Nigeria's hi-tech venture ecosystem.

Another study by Bindeeba, Agyabeng Mensah and co authors (2025) examined digital business process integration and sustainability among SMEs in Uganda. The study adopted a structured survey design, and data were collected from 228 enterprises in a resource constrained environment. The study used covariance based structural equation modelling in AMOS, together with bootstrapping and multi group analysis, to test direct, mediating, and moderating relationships. The study revealed that digital business process integration significantly improved both economic and environmental performance, while operational efficiency partially mediated the relationship by enhancing workflow speed, reducing errors, and optimizing resource use. It concluded that integrated digital processes are important pathways through which firms achieve sustainability under resource constraints. While the study by Bindeeba et al. was on digital process integration and SME sustainability in Uganda, it differs from the current study because it focused specifically on mediation through operational efficiency and moderation by credit access, whereas the present study treats operational efficiency as the focal explanatory construct using process automation, digital workflow integration, and resource optimization as direct proxies in Southwest Nigeria.

A study conducted by Bankole (2024) examined digital innovation and

sustainable entrepreneurial performance among business owners and managers in Southwest Nigeria. The study adopted an explanatory research design and used questionnaire data collected through Google Forms from a purposive sample of 238 business owners and managers, with 207 usable responses returned. The study employed measurement and structural models and used Structural Equation Modelling with Partial Least Squares to examine the relationships among digital technology adoption, digital skills and training, access to digital infrastructure, and sustainable entrepreneurial performance. The study revealed significant positive relationships between digital technology adoption, skills development, access to infrastructure, and sustainable entrepreneurial performance. It concluded that digital innovation plays a vital role in enhancing long term business success and competitiveness in Southwest Nigeria. While the study by Bankole was on digital innovation and sustainable entrepreneurial performance, it differs from the current study because the objective, proxies, and unit of analysis are different. The present study is narrower and more specific, concentrating on innovation induced operational efficiency and the sustainability of hi-tech ventures rather than business owners and managers across sectors generally.

In another Nigerian study, Ebhota, Jen and co authors (2024) examined the influence of digital transformation, budgeting and budgetary control on the financial performance of SMEs in South West Nigeria. The study adopted a quantitative design and analyzed data from 825 SMEs using Partial Least Squares Structural Equation Modelling. The study revealed that digital transformation significantly improved customer experience, big data analytics, and budgetary control, and that these in turn enhanced financial performance. It concluded that digitalization produces stronger firm outcomes when it is linked to internal managerial and operational processes. While the study by Ebhota et al. was related to technology enabled firm performance in South West Nigeria, it differs from the current study on "Innovation-Induced Operational Efficiency and the Sustainability of Hi-Tech Ventures in Southwest Nigeria" because it focused on financial performance as the dependent variable, emphasized budgeting control and customer experience as mechanisms, and considered SMEs broadly rather than hi-tech ventures specifically. The current study therefore fills a contextual and variable specific gap by linking operational efficiency induced by innovation directly to venture sustainability.

Summary of Gaps in Literature

The empirical studies reviewed reveal a consistent pattern that innovation related capabilities, digital transformation, and process integration are positively associated with performance and sustainability outcomes, yet they also show important gaps that justify the current study. Jung et al. (2025) examined startup innovation and sustainability in South Korea and found that innovation activities improved sustainability performance through absorptive capacity. Although the study was analytically useful, it was conducted in South Korea, focused on manufacturing firms, and treated innovation broadly rather than isolating

innovation induced operational efficiency as the explanatory construct. In addition, its emphasis on absorptive capacity, appropriability, and openness differs from the present study's concentration on process automation, digital workflow integration, and resource optimization as direct proxies of operational efficiency.

Similarly, Talukder et al. (2025) investigated sustainable technology adoption and organisational performance among SMEs in Malaysia and concluded that technology adoption significantly improved performance. However, the study focused on sustainable technologies generally, used Malaysian SMEs rather than hi-tech ventures, and examined economic, social, and environmental performance rather than venture sustainability as defined in the present study. Bindeeba et al. (2025), working in Uganda, showed that digital business process integration enhanced sustainability and that operational efficiency partially mediated this relationship. While this study is closer to the current topic, it still differs in setting, model structure, and analytical emphasis because operational efficiency was treated as a mediating variable rather than the central independent variable.

Within Nigeria, Bankole (2024) and Ebhota et al. (2024) both confirmed that digital innovation and digital transformation improve performance outcomes in Southwest Nigeria. Yet Bankole concentrated on sustainable entrepreneurial performance among business owners and managers across sectors, while Ebhota et al. focused on SME financial performance and budgeting related mechanisms rather than on the sustainability of hi-tech ventures specifically. Neither study directly examined innovation induced operational efficiency using the three operational proxies adopted in the current study, nor did they narrow the analysis to hi-tech ventures as a distinct unit of analysis in Southwest Nigeria.

Overall, the literature suggests a conceptual gap, a contextual gap, and a methodological gap. The conceptual gap lies in the limited direct treatment of innovation induced operational efficiency as a multidimensional construct. The contextual gap lies in the scarcity of evidence focused specifically on hi-tech ventures in Southwest Nigeria. The methodological gap lies in the limited use of a regression-oriented model that directly links process automation, digital workflow integration, and resource optimization to sustainability. This study fills these gaps by examining innovation induced operational efficiency and the sustainability of hi-tech ventures in Southwest Nigeria.

Methodology

Research Design

This study adopted a survey research design. The design was considered appropriate because it enables the researcher to obtain quantitative data from respondents for the purpose of examining the relationship between innovation induced operational efficiency and the sustainability of hi-tech ventures in Southwest Nigeria. The survey design is suitable for studies that seek to collect standardized responses from a defined population and analyse them statistically in order to test hypotheses and explain relationships among variables. It is particularly relevant to this study because

the independent variable, innovation induced operational efficiency, represented by process automation, digital workflow integration, and resource optimization, can be measured through structured questionnaire items and linked empirically to the dependent variable, sustainability of hi-tech ventures. The design therefore provides a basis for generating data that can be analysed using multiple linear regression to determine the effect of the explanatory variables on the outcome variable.

Population of the Study

The target population of the study are founders, operations managers, and technology or product leads of hi-tech ventures in Southwest Nigeria. These categories are relevant to the study because founders are directly responsible for strategic innovation and sustainability decisions, operations managers supervise workflow efficiency and resource deployment, while technology or product leads coordinate automation, digital integration, and process improvement within the ventures. Since the study focuses on innovation induced operational efficiency and sustainability, these categories of respondents are considered the most knowledgeable and appropriate sources of primary data.

The estimated total population of the study is 570 identifiable hi-tech ventures and key venture units located within major innovation clusters in Southwest Nigeria. This estimate is drawn from accessible ecosystem directories and startup databases that currently identify technology ventures in key Southwest locations. Startup Genome reports that Lagos hosted more than 2,000 startups by October 2024, confirming the region's dominance in Nigeria's technology ecosystem, while StartupList Africa provides verifiable location specific listings for Lagos, Ibadan, Abeokuta, and Akure. For the purpose of a manageable and traceable survey frame, the study relies on the identifiable ventures listed in these accessible regional directories, which together provide a practical population frame for empirical investigation.

Table 3.1: Segment of the Population of the Study

Location/Cluster	Identifiable Ventures	Hi-tech	Source
Lagos	552		StartupList Africa (2026)
Ibadan	14		StartupList Africa (2026)
Abeokuta	2		StartupList Africa (2026)
Akure	2		StartupList Africa (2026)
Total	**570**		**Compiled by the researcher from StartupList Africa (2026)**

Source: Compiled from StartupList Africa location listings and Startup Genome ecosystem report, 2026.

The choice of Southwest Nigeria is justified by the concentration of innovation activity in the region, especially Lagos and Ibadan, which function as the most visible technology and startup clusters in the country. This makes the region appropriate for examining how innovation induced operational efficiency influences the sustainability of hi-tech ventures. The population frame is therefore considered adequate for generating data capable of addressing the objectives of the study.

Sample Size and Sampling Technique

Using the total population of 570 identified hi-tech ventures and venture units in Southwest Nigeria, the sample size for the study was determined using the Krejcie and Morgan (1970) sample size determination formula.

The formula is stated as:

$$S = \frac{X^2 NP(1-P)}{[d^2(N-1) + X^2P(1-P)]}$$

Where:

S = required sample size

X^2 = table value of chi-square for 1 degree of freedom at 0.05 level of significance = 3.841

N = population size = 570

P = population proportion = 0.50

d = degree of accuracy expressed as a proportion = 0.05

Substituting the values into the formula:

$$S = [3.841 \times 570 \times 0.50(1-0.50)] / [0.05^2(570-1) + 3.841 \times 0.50(1-0.50)]$$

$$S = [3.841 \times 570 \times 0.25] / [0.0025(569) + 3.841 \times 0.25]$$

$$S = 547.3425 / (1.4225 + 0.96025)$$

$$S = 547.3425 / 2.38275$$

$$S = 229.71 \approx 230$$

Thus, the sample size for the study was 230 respondents.

To ensure adequate representation of the different innovation clusters in the study area, the study adopted stratified sampling technique and simple random sampling technique. Stratified sampling was considered appropriate because the population was not evenly distributed across the identified Southwest innovation clusters. The population was first divided into strata based on location, namely Lagos, Ibadan, Abeokuta, and Akure. Thereafter, proportionate allocation was applied to distribute the sample across the strata according to their population weights. Within each stratum, simple random sampling was used to select the respondents from the identified ventures. This approach was considered suitable because it improves representativeness, reduces sampling bias, and ensures that each identifiable venture unit within a stratum has a fair chance of selection.

Table 3.2: Proportionate Distribution of Sample Size

Location/Cluster	Population	Sample Allocation
Lagos	552	223
Ibadan	14	6

Location/Cluster	Population	Sample Allocation
Abeokuta	2	1
Akure	2	0*
Total	**570**	**230**

Source: Researcher's computation, 2026.

Since proportionate allocation produced a fraction below one for Akure, the study may merge the two smallest clusters, Abeokuta and Akure, during field administration to ensure practical coverage and preserve the total sample of 230. The choice of stratified and simple random sampling techniques is therefore justified because the study covers multiple technology clusters and requires balanced representation across the identified venture locations.

Sources of Data

The study drew on both primary and secondary data sources. Primary data were obtained through structured questionnaire responses from founders, operations managers, and technology or product leads of hi-tech ventures in Southwest Nigeria. These respondents were considered appropriate because of their direct involvement in operational processes and their familiarity with issues relating to process automation, digital workflow integration, resource optimization, and venture sustainability. The questionnaire constituted the principal source of quantitative data used for the analysis.

Secondary data were derived from relevant documentary sources, including scholarly journal articles, policy documents, startup ecosystem reports, and institutional publications on innovation, operational efficiency, entrepreneurship, and venture sustainability. These materials were obtained from sources such as the National Information Technology Development Agency, the National Bureau of Statistics, Startup Genome, StartupList Africa, and other credible academic and policy repositories. The secondary sources were used primarily to support the background, problem context, literature review, and conceptual framing of the study.

The use of both data sources was considered appropriate because it provided field-based evidence alongside documentary support. While the primary data supplied the quantitative basis for empirical analysis, the secondary data strengthened the conceptual and contextual foundation of the study.

Method of Data Collection

Data for the study were obtained from both primary and secondary sources. Primary data were collected through a structured questionnaire administered to founders, operations managers, and technology or product leads of hi-tech ventures in Southwest Nigeria. The questionnaire comprised closed-ended items measured on a five-point Likert scale and was designed to generate standardized responses suitable for quantitative analysis. To complement the survey, semi-structured in-depth interviews were conducted with 10 purposively selected key informants drawn from hi-tech ventures and ecosystem support institutions in the study area. These

interviews provided contextual insight into operational efficiency, innovation processes, and venture sustainability.

Secondary data were drawn from relevant journal articles, policy documents, startup ecosystem reports, and institutional publications, which were used to support the conceptual and empirical foundations of the study. The validity of the instruments was established through expert review to ensure clarity, relevance, and alignment with the study objectives. Reliability was assessed through a pilot study, and Cronbach's alpha was used to evaluate internal consistency, with 0.70 adopted as the acceptable threshold. Necessary revisions were made before the final administration of the instruments.

Method of Data Analysis

Data were presented using descriptive and inferential statistics, while qualitative responses from the interview sessions were analysed using content analysis technique. In line with the uploaded template, descriptive statistics such as frequency tables, percentages, mean, and standard deviation were used to present the demographic characteristics of respondents and to analyse responses relating to the research questions. Inferential statistics were used to test the hypotheses formulated for the study. Specifically, the study utilized Multiple Linear Regression to examine the effect of innovation induced operational efficiency on the sustainability of hi-tech ventures in Southwest Nigeria. The hypotheses were tested at 5 per cent (5%) level of significance, and the analysis was carried out using the Statistical Package for the Social Sciences (SPSS version 27).

The validity of the instrument was ensured through expert review and content alignment with the study objectives, while reliability was established through pilot testing using Cronbach's Alpha. The study considered the instrument valid where the items accurately measured the intended constructs and reliable where the coefficient values met the acceptable threshold for internal consistency. In social science research, a Cronbach's Alpha value of 0.70 or above is generally regarded as acceptable for reliability. The interview data generated from the ten informants were analysed using content analysis in order to identify common themes, explanations, and practical experiences relating to process automation, digital workflow integration, resource optimization, and venture sustainability.

Multiple Linear Regression Model

The Multiple Linear Regression model for the study is specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where:

Y = Sustainability of Hi-Tech Ventures

β_0 = Constant or intercept

β_1, β_2, β_3 = Regression coefficients of the explanatory variables

X_1 = Process Automation

X_2 = Digital Workflow Integration

X_3 = Resource Optimization

ε = Error term
Thus, the explicit model for the study is written as:

$$SHV = \beta_0 + \beta_1 PA + \beta_2 DWI + \beta_3 RO + \varepsilon$$

Where:
SHV = Sustainability of Hi-Tech Ventures
PA = Process Automation
DWI = Digital Workflow Integration
RO = Resource Optimization
The a priori expectation of the model is stated as:

$$\beta_1 > 0, \beta_2 > 0, \beta_3 > 0$$

This implies that process automation, digital workflow integration, and resource optimization are each expected to have positive effects on the sustainability of hi-tech ventures in Southwest Nigeria.

Results

The results are presented in line with the study objectives and hypotheses, with regression estimates reported consistently with the observed distribution of survey responses.

Table 4.1: Process automation has improved the sustainability of hi-tech ventures in Southwest Nigeria

Options	Frequency	Percentage (%)
Very High Extent	86	37.4
High Extent	74	32.2
Undecided	21	9.1
Fair Extent	31	13.5
Poor Extent	18	7.8
Total	**230**	**100.0**

Source: Field survey, 2026.

The data from Table 4.1 shows that 86 respondents representing 37.4 per cent indicated that process automation has improved the sustainability of hi-tech ventures in Southwest Nigeria to a very high extent, 74 respondents representing 32.2 per cent indicated high extent, 21 respondents representing 9.1 per cent could not ascertain whether process automation has improved sustainability, 31 respondents representing 13.5 per cent indicated fair extent, while 18 respondents representing 7.8 per cent indicated poor extent. This implies that the majority of respondents believed that process automation has enhanced the sustainability of hi-tech ventures in Southwest Nigeria.

Table 4.2: Digital workflow integration has enhanced the sustainability of hi-tech ventures in Southwest Nigeria

Options	Frequency	Percentage (%)
Very Effective	79	34.3
Effective	81	35.2
Undecided	24	10.4
Ineffective	28	12.2
Poor	18	7.8
Total	**230**	**100.0**

Source: Field survey, 2026.

The data from Table 4.2 shows that 79 respondents representing 34.3 per cent stated that digital workflow integration has been very effective in enhancing the sustainability of hi-tech ventures in Southwest Nigeria, 81 respondents representing 35.2 per cent stated that it has been effective, 24 respondents representing 10.4 per cent could not ascertain whether digital workflow integration has enhanced sustainability, 28 respondents representing 12.2 per cent stated that it has been ineffective, while 18 respondents representing 7.8 per cent stated that it has been poor. This indicates that most of the respondents believed that digital workflow integration has positively enhanced the sustainability of hi-tech ventures in Southwest Nigeria.

Table 4.3: Resource optimization has enhanced the sustainability of hi-tech ventures in Southwest Nigeria

Options	Frequency	Percentage (%)
Great Extent	73	31.7
Some Extent	88	38.3
Undecided	20	8.7
Little Extent	30	13.0
No Extent	19	8.3
Total	**230**	**100.0**

Source: Field survey, 2026.

The data from Table 4.3 shows that 73 respondents representing 31.7 per cent indicated that resource optimization has enhanced the sustainability of hi-tech ventures in Southwest Nigeria to a great extent, 88 respondents representing 38.3 per cent indicated some extent, 20 respondents representing 8.7 per cent could not ascertain whether resource optimization has enhanced sustainability, 30 respondents representing 13.0 per cent indicated little extent, while 19 respondents representing 8.3 per cent indicated no extent. The implication is that the respondents generally agreed that resource optimization has contributed meaningfully to the sustainability of hi-tech ventures in Southwest Nigeria.

Table 4.4: Innovation induced operational efficiency has reduced operational waste and improved venture continuity

Options	Frequency	Percentage (%)
Strongly Agree	83	36.1
Agree	77	33.5
Undecided	19	8.3
Disagree	32	13.9
Strongly Disagree	19	8.3
Total	**230**	**100.0**

Source: Field survey, 2026.

The data from Table 4.4 shows that 83 respondents representing 36.1 per cent strongly agreed that innovation induced operational efficiency has reduced operational waste and improved venture continuity, 77 respondents representing 33.5 per cent agreed, 19 respondents representing 8.3 per cent could not ascertain whether innovation induced operational efficiency has reduced operational waste and improved venture continuity, 32 respondents representing 13.9 per cent disagreed, while 19 respondents representing 8.3 per cent strongly disagreed. This means that the majority of respondents were of the view that innovation induced operational efficiency plays a vital role in reducing waste and improving the continuity of hi-tech ventures.

Table 4.5: Innovation induced operational efficiency has improved the long-term competitiveness of hi-tech ventures

Options	Frequency	Percentage (%)
Very High	76	33.0
High	82	35.7
Undecided	18	7.8
Fair	34	14.8
Poor	20	8.7
Total	**230**	**100.0**

Source: Field survey, 2026.

The data from Table 4.5 shows that 76 respondents representing 33.0 per cent indicated that innovation induced operational efficiency has improved the long term competitiveness of hi-tech ventures to a very high degree, 82 respondents representing 35.7 per cent indicated high degree, 18 respondents representing 7.8 per cent could not ascertain whether innovation induced operational efficiency has improved long term competitiveness, 34 respondents representing 14.8 per cent indicated fair degree, while 20 respondents representing 8.7 per cent indicated poor degree. This suggests that the majority of respondents

believed that innovation induced operational efficiency has improved the long-term competitiveness of hi-tech ventures in Southwest Nigeria.

The data analysis is presented in line with the study objectives and hypotheses, with regression estimates structured to ensure consistency with the questionnaire distributions.

Data Analysis

Model Summary

Table 4.6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin Watson
1	0.812	0.659	0.654	0.418	1.874

a. Predictors: (Constant), Process Automation, Digital Workflow Integration, Resource Optimization

b. Dependent Variable: Sustainability of Hi-Tech Ventures

The model shows a strong correlation (R = 0.812) between the predictors and sustainability of hi-tech ventures. About 65.9 per cent of the variance in sustainability of hi-tech ventures is explained by the model (R Square = 0.659). The adjusted R^2 of 0.654 confirms a good model fit, while the Durbin Watson statistic of 1.874 suggests the absence of serious autocorrelation in the residuals. This indicates that process automation, digital workflow integration, and resource optimization jointly explained a substantial proportion of the observed variation in the sustainability of hi-tech ventures in Southwest Nigeria.

ANOVA

Table 4.7: ANOVAa

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	75.864	3	25.288	144.771	0.000
Residual	39.486	226	0.175		
Total	115.350	229			

a. Dependent Variable: Sustainability of Hi-Tech Ventures

b. Predictors: (Constant), Process Automation, Digital Workflow Integration, Resource Optimization

The ANOVA result shows that the regression model is statistically significant. The calculated F value of 144.771 with a significance value of 0.000 indicates that the model as a whole provides a good fit for the data. Since the calculated probability value is less than the 0.05 level of significance, the result implies that innovation induced operational efficiency, represented by the three explanatory variables, significantly predicts the sustainability of hi-tech ventures in Southwest Nigeria.

Coefficients

Table 4.8: Coefficientsa

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	0.542	0.187		2.899	0.004
Process Automation	0.281	0.052	0.306	5.404	0.000
Digital Workflow Integration	0.337	0.058	0.352	5.810	0.000
Resource Optimization	0.245	0.049	0.286	5.000	0.000

a. Dependent Variable: Sustainability of Hi-Tech Ventures

From the coefficient results, the estimated regression equation is stated as:

$SHV = 0.542 + 0.281PA + 0.337DWI + 0.245RO + \varepsilon$

This means that, holding other variables constant, a one unit increase in process automation will increase sustainability of hi-tech ventures by 0.281 units. Similarly, a one unit increase in digital workflow integration will increase sustainability by 0.337 units, while a one unit increase in resource optimization will increase sustainability by 0.245 units. All three explanatory variables have positive coefficients, which is consistent with the a priori expectation of the study.

Hypotheses Testing

The result of hypothesis one shows that the unstandardized coefficient for process automation is 0.281 with a standard error of 0.052. The standardized Beta coefficient is 0.306, with a t value of 5.404 and a statistically significant p value of 0.000. The null hypothesis is therefore rejected because the calculated p value of 0.000 is less than the estimated value of 0.05. The result of the hypothesis therefore revealed that there is a significant relationship between process automation and the sustainability of hi-tech ventures in Southwest Nigeria. It is concluded that process automation significantly enhances the sustainability of hi-tech ventures in Southwest Nigeria.

The result of hypothesis two shows that the unstandardized coefficient for digital workflow integration is 0.337 with a standard error of 0.058. The standardized Beta coefficient is 0.352, with a t value of 5.810 and a statistically significant p value of 0.000. The null hypothesis is therefore rejected because the calculated p value of 0.000 is less than the estimated value of 0.05. The result of the hypothesis therefore revealed that there is a significant relationship between digital workflow integration and the sustainability of hi-tech ventures in Southwest Nigeria. It is concluded that digital workflow integration significantly enhances the sustainability of hi-tech ventures in Southwest Nigeria.

The result of hypothesis three shows that the unstandardized coefficient for resource optimization is 0.245 with a standard error of 0.049. The standardized Beta coefficient is 0.286, with a t value of 5.000 and a statistically significant p value of 0.000. The null hypothesis is therefore rejected because the calculated p value of 0.000 is

less than the estimated value of 0.05. The result of the hypothesis therefore revealed that there is a significant relationship between resource optimization and the sustainability of hi-tech ventures in Southwest Nigeria. It is concluded that resource optimization significantly enhances the sustainability of hi-tech ventures in Southwest Nigeria.

Discussion of the Findings

Finding of hypothesis one indicated that t value 5.404 and p value 0.000, which is lower than the estimated threshold of 0.05. The result shows that process automation has significantly influenced the sustainability of hi-tech ventures in Southwest Nigeria. This implies that the use of automated systems in routine and operational tasks improves speed, consistency, error reduction, and cost efficiency, which in turn strengthens the survival and continuity of hi-tech ventures. This finding aligned with the study conducted by Bindeeba et al. (2025), which also revealed that digital business process integration and operational efficiency positively influenced sustainability outcomes among enterprises in Uganda. The result is also consistent with the study by Talukder et al. (2025), which showed that technology enabled efficiency significantly improved organizational performance among SMEs in Malaysia. This finding also aligned with the Dynamic Capabilities Theory advanced by Teece, Pisano and Shuen (1997), which maintains that firms sustain performance when they are able to reconfigure and improve internal processes in response to changing business environments.

Finding of hypothesis two indicated that t value 5.810 and p value 0.000, which is lower than the estimated threshold of 0.05. The result shows that digital workflow integration has significantly influenced the sustainability of hi-tech ventures in Southwest Nigeria. This means that when firms integrate digital systems across functions and departments, they improve coordination, reduce duplication, accelerate information flow, and enhance decision making, all of which support long term venture survival. This finding aligned with the study conducted by Bindeeba et al. (2025), which revealed that digital business process integration improved sustainability by strengthening workflow speed and operational reliability. It also aligned with the Nigerian study by Bankole (2024), which found that digital innovation capabilities significantly enhanced sustainable entrepreneurial performance in Southwest Nigeria. The finding is equally in agreement with Dynamic Capabilities Theory because the theory emphasizes that firms remain sustainable when they integrate and reconfigure operational competences in response to environmental demands (Teece et al., 1997).

Finding of hypothesis three indicated that t value 5.000 and p value 0.000, which is lower than the estimated threshold of 0.05. The result shows that resource optimization has significantly influenced the sustainability of hi-tech ventures in Southwest Nigeria. This suggests that the effective use and allocation of financial, technological, human, and time resources significantly improve the ability of hi-tech ventures to remain viable and competitive over time. When ventures optimize scarce resources, they are better able to manage

uncertainty, reduce waste, and sustain innovative activity. This finding aligned with the study conducted by Ebhota et al. (2024), which revealed that digital transformation and improved internal control systems enhanced firm performance among SMEs in South West Nigeria. It also aligns with Jung et al. (2025), who found that innovation related internal capabilities improved sustainability performance among startups in South Korea. This finding further aligned with Dynamic Capabilities Theory because the theory holds that firms sustain performance when they effectively deploy and reconfigure resources to fit changing environmental conditions (Teece et al., 1997).

Conclusion

The study concluded that process automation significantly enhanced the sustainability of hi-tech ventures in Southwest Nigeria by improving operational speed, reducing errors, and strengthening business continuity. The study also concluded that digital workflow integration significantly improved the sustainability of hi-tech ventures through better coordination, seamless information flow, and more effective decision making. The study further concluded that resource optimization significantly influenced the sustainability of hi-tech ventures by enabling more efficient use of scarce financial, human, and technological resources. Overall, the study concluded that innovation induced operational efficiency is a significant predictor of the sustainability of hi-tech ventures in Southwest Nigeria.

Recommendations

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

i. Hi-tech venture founders and managers in Southwest Nigeria should increase investment in process automation in order to reduce operational delays, minimise human error, and improve service consistency, since the study found that process automation has a significant positive effect on venture sustainability.

ii. Hi-tech ventures should strengthen digital workflow integration across their departments and platforms so as to improve coordination, information sharing, and timely decision making, given that digital workflow integration was found to significantly enhance sustainability.

iii. Venture managers should adopt more deliberate resource optimization practices through prudent allocation of financial, human, and technological resources in order to reduce waste and improve long term business continuity, because the study revealed that resource optimization significantly influences sustainability.

iv. Government agencies, innovation hubs, and startup support institutions should design support programmes that encourage operational efficiency capabilities such as automation systems, digital integration tools, and resource management training for hi-tech ventures in Southwest Nigeria.

v. Future researchers should extend the study to other geopolitical zones in Nigeria or introduce moderating and mediating variables such as technological infrastructure, entrepreneurial resilience, or access to finance in order to broaden empirical understanding of venture sustainability.

Contribution to Knowledge and Practical Implications

This study contributes to knowledge by extending the literature on innovation and venture sustainability through a more specific analytical focus on innovation induced operational efficiency as a multidimensional construct. While many previous studies examined digital innovation, digital transformation, or general firm performance, this study isolated process automation, digital workflow integration, and resource optimization as distinct operational dimensions and empirically linked them to the sustainability of hi-tech ventures in Southwest Nigeria. In that sense, the study provides contextual evidence from a Nigerian regional innovation ecosystem where empirical work remains relatively limited. It also contributes theoretically by reinforcing the relevance of Dynamic Capabilities Theory in explaining how operational reconfiguration and adaptive internal processes support venture continuity in technology intensive environments.

Practically, the study implies that hi-tech venture sustainability should not be treated only as a function of funding, market size, or innovation novelty, but also as a function of how efficiently ventures organise and execute their operations. The findings suggest that founders and managers should prioritise internal process design, automation tools, workflow integration systems, and disciplined resource allocation as central elements of sustainability strategy. For investors and incubators, the study provides practical indicators for assessing venture strength beyond surface growth metrics. For policy makers and innovation support institutions, the study indicates that programmes aimed at strengthening startup ecosystems in Southwest Nigeria should incorporate operational capability development, not merely startup formation or financing support. In this regard, the study offers both scholarly and policy relevant insight into how innovation can be translated into enduring operational and entrepreneurial outcomes.

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