**SIMULATION INTO MANAGMENT IT SYSTEM AND SUBSYSTEM IN NIGERIA**

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**Abstract**

*In the Nigerian context, IT systems and subsystems face several challenges that hinder the effective implementation and utilization. One prominent issue is the inadequate digital infrastructure, characterized by unreliable power supply, limited internet connectivity, and insufficient data storage facilities. These infrastructure constraints impede the seamless operation of IT systems, hampering innovation, and competitiveness across various sectors. Moreover, there is a pronounced shortage of skilled IT professionals proficient in emerging technologies and advanced techniques. The lack of specialized expertise exacerbates the challenges of maintaining and optimizing IT systems, leaving organizations vulnerable to cyber threats and unable to leverage digital technologies for strategic decision-making and operational efficiency. It is as a result of these that this present study aims to address the following research questions: (i) How does the current state of infrastructure in Nigeria facilitate hinder the implementation of stimulation techniques into IT systems and subsystems? (ii) What are the main barriers to accessing relevant and high-quality data for simulation purposes within the Nigerian IT sector? (iii) What are the skill gaps and training needs among IT professionals in Nigeria regarding simulation techniques and practices? (iv) What is the role of stimulation techniques in driving innovation and competitiveness within the Nigerian IT industry? (v) How do the costs associated with simulation software and tools impact their adoption and utilization by organizations in Nigeria? Through the findings from the study it was opined that addressing the challenges and leveraging the opportunities surrounding simulation techniques in the Nigerian IT sector requires a comprehensive approach encompassing infrastructure development, skills enhancement, regulatory reforms, and cost considerations to foster innovation, competitiveness, and sustainable growth. The study concluded that IT systems and subsystems in the Nigerian context face significant challenges stemming from infrastructure deficiencies, skill gaps, and regulatory constraints, yet hold immense potential for driving innovation and competitiveness with concerted efforts in infrastructure development, skills enhancement, and regulatory reforms. And recommends investment in digital infrastructure, enhance skills development, strengthen regulatory frameworks, and promote collaboration among stakeholders.*

**Keywords:** Infrastructure Development, IT Systems, Subsystems, Skills, Enhancement, and Stimulation.

**Introduction**   
Stimulation within IT systems and subsystems is an important aspect of testing, development, and optimization processes ((Abdulkareem et al., 2020; Oladipo, 2012). It involves replicating real-world scenarios, user interactions, and system inputs to assess the performance, functionality, and robustness of the IT infrastructure. This simulated environment enables organizations to identify potential issues, validate design choices, and enhance overall system capabilities before deployment (Nzimakwe, 2012). At the heart of stimulation lies the emulation of user behaviors and external stimuli. This range from simulating user interactions with software interfaces to mimicking network traffic patterns or injecting simulated data inputs. By replicating diverse usage scenarios, including peak loads and edge cases, developers usually evaluate system responses under different conditions and ensure reliability and scalability.

Furthermore, stimulation extends beyond user-centric interactions to encompass various system interactions and dependencies (Nzimakwe, 2012). This includes simulating interactions between interconnected subsystems, external APIs, databases, and third-party services. By stimulating these interactions, developers were able to uncover potential integration issues, validate data flows, and optimize system interoperability. In addition to functional testing, stimulation plays a vital role in assessing security vulnerabilities and resilience against cyber threats (Jimoh et al., 2023; Ogar, 2014). By simulating various attack scenarios, such as DDoS attacks, malware injections, or data breaches, organizations can proactively identify weaknesses in their IT infrastructure and implement effective security measures. Furthermore, stimulation within IT systems and subsystems serves as a valuable tool for ensuring system reliability, performance, and security (Sani et al., 2014). By creating simulated environments that closely resemble real-world conditions, organizations can mitigate risks, optimize system performance, and deliver robust IT solutions that meet the evolving demands of users and stakeholders. Therefore, this present study aims to examine stimulation into it system and subsystem in the Nigeria.

**Statement of the Problem**

Implementing stimulation into IT systems and subsystems in Nigeria faces several challenges and obstacles that impede its effectiveness and widespread adoption. One significant problem is the inadequate infrastructure and resources for conducting thorough simulations (Oladipo, 2012). Many organizations, especially small and medium-sized enterprises (SMEs), lack the necessary computing power, software tools, and testing environments to accurately replicate real-world scenarios (Nweke, 2011). As a result, developers struggle to assess the performance, scalability, and reliability of IT systems, leading to suboptimal solutions and increased risks of failures upon deployment. Moreover, the scarcity and quality of data present a major challenge to effective simulation in Nigeria (Yahaya et al., 2022; Emma, 2014). Access to relevant and comprehensive datasets is often limited, particularly in sectors such as healthcare, agriculture, and finance (Maina, 2014). Without access to diverse and representative data, developers encounter difficulties in creating realistic simulation scenarios and validating system functionalities. Additionally, according to Ogar (2014) concerns regarding data privacy and security further exacerbate the challenges associated with acquiring and utilizing data for simulation purposes, hindering innovation and progress in IT development.

Furthermore, the skills gap in simulation and testing practices poses a significant obstacle to the successful implementation of stimulation in IT systems and subsystems. While Nigeria has a growing pool of IT professionals, there remains a shortage of individuals with specialized expertise in simulation techniques, test automation, and performance analysis (Sani et al., 2014). The lack of skilled personnel inhibits organizations from leveraging simulation effectively for system optimization and validation, resulting in prolonged development cycles and increased project costs.

In addition, the high cost of simulation software and tools presents a financial barrier to adoption, particularly for SMEs and startups in Nigeria (Sani et al., 2014). Licensed simulation software are prohibitively expensive, making it challenging for smaller organizations to invest in the necessary tools and resources for comprehensive testing and validation (Oladipo, 2012; Sani et al., 2014). This financial constraint limits the ability of Nigerian businesses to compete globally and innovate effectively in the IT sector, hindering economic growth and technological advancement. To solve these problems requires concerted efforts from government, academia, and industry stakeholders to invest in infrastructure development, promote data-sharing initiatives, and facilitate skills development in simulation and testing practices. It is against this backdrop that this present study intends to examine the stimulation into it system and subsystem in the Nigeria context and come about the stated research questions in the next section of the study.

**Research Questions**

1. How does the current state of infrastructure in Nigeria facilitate hinder the implementation of stimulation techniques into IT systems and subsystems?
2. What are the main barriers to accessing relevant and high-quality data for simulation purposes within the Nigerian IT sector?
3. What are the skill gaps and training needs among IT professionals in Nigeria regarding simulation techniques and practices?
4. What is the role of stimulation techniques in driving innovation and competitiveness within the Nigerian IT industry?
5. How do the costs associated with simulation software and tools impact their adoption and utilization by organizations in Nigeria?

**Literature Review**

**Nigeria IT Sector**

The concept of Nigeria's IT sector encompasses a dynamic and rapidly evolving terrain characterized by innovation, entrepreneurship, and digital transformation. At its core, the IT sector in Nigeria encompasses a wide range of activities, including software development, telecommunications, digital services, e-commerce, and information technology-enabled services (ITES). Over the years, Nigeria has emerged as one of Africa's leading hubs for technology and innovation, fueled by a burgeoning youth population, increasing internet penetration, and growing investment in digital infrastructure (Federal Ministry of Science and Technology, 2012). At the heart of Nigeria's IT sector is a vibrant ecosystem of startups, tech hubs, and incubators driving innovation and entrepreneurship (Maina, 2014). Cities like Lagos, Abuja, and Port Harcourt have become hotspots for tech startups, attracting both local and international investment. These startups are leveraging technology to address local challenges and create innovative solutions in sectors such as finance, healthcare, agriculture, and education. From mobile payment platforms to e-learning applications, Nigerian startups are pioneering transformative solutions that are reshaping industries and improving the lives of millions.

Furthermore, Nigeria's IT sector is underpinned by a robust telecommunications infrastructure, with widespread mobile phone penetration and increasing access to high-speed internet connectivity (Chukwbikem, 2014). Telecommunications companies are investing in expanding network coverage and deploying advanced technologies to meet the growing demand for data services. This connectivity is driving the adoption of digital technologies across various sectors, enabling the delivery of online services, e-commerce transactions, and remote work opportunities. The government also plays a significant role in shaping Nigeria's IT sector through policies and initiatives aimed at promoting digital inclusion, innovation, and entrepreneurship (Chukwbikem, 2014; Nweke, 2011). The national information technology development agency (NITDA) serves as the regulatory body overseeing the development and implementation of IT policies, regulations, and initiatives. Additionally, programs such as the national digital economy policy and strategy and the Nigeria innovation Fund aim to support the growth of the IT sector, enhance digital literacy, and foster a conducive environment for innovation and investment.

**IT systems and subsystems in the Nigeria context**

In Nigeria, like in many other countries, IT systems and subsystems play a very vital role across various sectors, driving efficiency, innovation, and connectivity. One significant area where IT systems are prominently utilized is in the financial sector (Mutula, 2012). Nigerian banks heavily rely on robust IT systems for transaction processing, online banking, and customer relationship management (Adera, 2013). These systems ensure seamless operations, enable swift fund transfers, and enhance security measures to safeguard against cyber threats and fraud. Furthermore, the Nigerian government has increasingly adopted IT systems to streamline administrative processes and improve service delivery to citizens (Emma, 2014). This includes systems for tax administration, public health management, education, and e-governance platforms. For instance, the Federal Inland Revenue Service (FIRS) utilizes IT systems for tax registration, filing, and payment, enhancing transparency and compliance within the tax system.

In the Nigerian educational sector, IT systems are deployed for e-learning platforms, student information systems, and digital libraries, facilitating remote learning opportunities and improving access to educational resources across the country (FMST, 2012). Additionally, the healthcare sector in Nigeria benefits from IT systems for patient record management, telemedicine services, and disease surveillance, contributing to better healthcare outcomes and the efficient allocation of resources. Moreover, the burgeoning e-commerce industry in Nigeria heavily relies on IT systems and subsystems for online marketplaces, payment gateways, and logistics management, fostering economic growth and entrepreneurship in the digital space. However, despite these advancements, challenges such as inadequate infrastructure, cybersecurity threats, and digital divide persist, the need for continuous investment in IT infrastructure, capacity building, and regulatory frameworks to harness the full potential of IT systems in Nigeria's socio-economic development.

**Analysis of research questions represented in percentage and mean score**

The research questions are summarized using the percentage and mean score. As regards to the tables below, the calibrations are as follows: Very Poor (VP) = 1, Poor (P) = 2, Undecided (UN) = 3, Good (G) = 4, and Excellent (E) = 5. Any means score below ‘3’ implies a Strongly Disagree or Disagree while any mean score above ‘3’ implies Agree or Strongly Agree.

**Table 1 Questions addressing current state of infrastructure expressed in percentages**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **VP**  **%** | **P**  **%** | **U**  **%** | **G**  **%** | **E**  **%** | **Mean** | **Std Dev.** |
| How significantly does the state of network infrastructure (e.g., internet speed, reliability) in your area hinder the implementation of simulation techniques into IT systems? | 0 | 14 | 6 | 58 | 22 | 3.8800 | 0.91014 |
| To what extent does the lack of advanced data storage and management solutions impact your ability to implement simulation techniques? | 0 | 14 | 14 | 54 | 18 | 3.7600 | 0.90838 |
| How would you rate the adequacy of available computing power (e.g., servers, cloud computing resources) for supporting simulation techniques in your organization? | 4 | 6 | 22 | 42 | 26 | 3.8000 | 1.02151 |
| How significant is the lack of technical support and expertise in your organization in hindering the implementation of simulation techniques? | 0 | 18 | 10 | 54 | 18 | 3.7200 | 0.96160 |
| To what extent do challenges with integrating simulation software with existing IT systems and subsystems impede your organization’s ability to implement these techniques? | 8 | 20 | 10 | 36 | 26 | 3.5200 | 1.28651 |

Source: Field Survey, 2024

The table 1 shows the questions addressing current state of infrastructure. It is evident from the result that the mean score for all the variables are above ‘3’ which is the stipulated benchmark for accepting the statement or not. Analysis on the percentages also back up the mean score as the majority of the respondents good or excellent to each of the variables addressing current state of infrastructure. 58% agrees and 22% considered it good that the state of network infrastructure (e.g., internet speed, reliability) in their area hinder the implementation of simulation techniques into IT systems. Furthermore, 54% considered it good that the lack of advanced data storage and management solutions impact their ability to implement simulation techniques, whereas, 42% agreed that the adequacy of available computing power (e.g., servers, cloud computing resources) for supporting simulation techniques in their organization. Equally, 54% support the fact that the lack of technical support and expertise in their organization hindered the implementation of simulation techniques, lastly, 36% and 26% of the respondents agreed that the challenges with integrating simulation software with existing IT systems and subsystems impede organization’s ability to implement these techniques.

**The current state of infrastructure that hinder the implementation of stimulation techniques into IT systems and subsystems**

The current state of infrastructure in Nigeria presents both opportunities and challenges for the implementation of stimulation techniques into IT systems and subsystems. On one hand, Nigeria has witnessed significant growth in its telecommunications infrastructure, with widespread mobile phone penetration and increasing access to the internet (FMST, 2012). This has laid a foundation for the adoption of stimulation techniques such as virtualization, cloud computing, and artificial intelligence within IT systems. However, despite these advancements, challenges persist that hinder the seamless integration of stimulation techniques (Oladipo, 2012). One major obstacle is the inadequate power supply and unstable electricity grid in Nigeria. Fluctuating power supply not only disrupts operations but also poses a significant risk to data integrity and system reliability. Stimulation techniques such as cloud computing, which rely heavily on uninterrupted power, may face difficulties in implementation without reliable energy infrastructure.

Moreover, limited internet bandwidth and high data costs in Nigeria pose additional barriers to the adoption of stimulation techniques, particularly those that require large data transfers or real-time processing. This hampers the scalability and efficiency of IT systems, hindering their ability to leverage technologies like big data analytics and machine learning for decision-making and optimization (Oladipo, 2012). Furthermore, the digital divide between urban and rural areas exacerbates disparities in access to IT infrastructure and skills, impeding the widespread implementation of stimulation techniques across the country. Without equitable access to technology and training, certain segments of the population may be excluded from the benefits of advanced IT systems, perpetuating socio-economic inequalities. Addressing these infrastructure challenges requires concerted efforts from both the public and private sectors in Nigeria. Investments in improving power infrastructure, expanding internet connectivity, and lowering data costs are essential to create an enabling environment for the adoption of stimulation techniques in IT systems and subsystems. Additionally, initiatives to bridge the digital divide through education and skills development programs ensure that all Nigerians participate in and benefit from the digital economy (Sani et al., 2014).

**Table 2 Questions addressing high-quality data expressed in percentages**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **VP**  **%** | **P**  **%** | **U**  **%** | **G**  **%** | **E**  **%** | **Mean** | **Std Dev.** |
| To what extent do you agree that there is a lack of comprehensive and up-to-date datasets available in the Nigerian IT sector? | 8 | 20 | 12 | 44 | 16 | 3.4000 | 1.20201 |
| How significant are the inconsistencies and inaccuracies in the available data for your simulations? | 0 | 16 | 28 | 32 | 24 | 3.6400 | 1.01678 |
| How much do data privacy laws and regulations hinder your access to necessary data for simulations? | 8 | 16 | 8 | 52 | 16 | 3.5200 | 1.17225 |
| How would you rate the adequacy of IT infrastructure to support large-scale data collection and storage in your organization? | 4 | 4 | 8 | 68 | 16 | 3.8800 | 0.86492 |

Source: Field Survey, 2024

The table 2 shows the questions addressing high-quality data. It is evident from the result that the mean score for all the variables are above ‘3’ which is the stipulated benchmark for accepting the statement or not. Analysis on the percentages also back up the mean score as the majority of the respondents good or excellent (I.e 44%, 32% 52% and 68% respectively) to each of the variables addressing high-quality data.

**Main barriers to accessing relevant and high-quality data for simulation purposes within the Nigerian IT sector**

Accessing relevant and high-quality data for simulation purposes within the Nigerian IT sector faces several significant barriers, ranging from data availability and quality to regulatory challenges and organizational constraints (Nzimakwe, 2012). One primary barrier is the scarcity of comprehensive and well-structured datasets in Nigeria. While there's a growing volume of data generated across various sectors, including finance, healthcare, and agriculture, much of it remains unstructured, fragmented, and often inaccessible. This lack of standardized data formats and documentation makes it challenging for organizations to gather the necessary data inputs for accurate simulations.

Moreover, data quality issues such as incompleteness, inconsistency, and inaccuracies further compound the challenges of accessing relevant data for simulation purposes. In many cases, data collection processes in Nigeria are manual, prone to errors, and lack rigorous validation mechanisms, leading to unreliable datasets that may yield misleading simulation results. Additionally, regulatory constraints and data privacy concerns pose significant barriers to accessing and sharing sensitive data for simulation purposes. Nigeria's data protection laws, although evolving, are not yet comprehensive, leading to ambiguity around data ownership, consent, and security requirements. Organizations are often cautious about sharing data due to legal and compliance risks, hindering collaboration and data sharing initiatives essential for simulation modeling.

Furthermore, organizational silos and cultural barriers within Nigerian institutions contribute to data accessibility challenges. Many organizations lack centralized data management strategies and face internal resistance to sharing data across departments or with external partners. This fragmentation hampers efforts to aggregate data from multiple sources for simulation modeling and limits the scope and accuracy of simulations. Attending to these barriers requires a different approach that involves policy interventions, investments in data infrastructure, capacity building initiatives, and fostering a culture of data sharing and collaboration. Strengthening data governance frameworks, promoting standards for data interoperability, and incentivizing data sharing through regulatory mechanisms can help improve access to relevant and high-quality data for simulation purposes within the Nigerian IT sector. Additionally, investing in data analytic capabilities, promoting data literacy among professionals, and fostering public-private partnerships can enhance the availability and utility of data for simulation modeling, ultimately supporting evidence-based decision-making and innovation across various industries in Nigeria.

**Table 3 Questions addressing training needs expressed in percentages**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | VP  % | P  % | U  % | G  % | E  % | Mean | Std Dev. |
| How would you rate your current knowledge and understanding of various simulation techniques? | 4 | 28 | 8 | 44 | 16 | 3.4000 | 1.16814 |
| How experienced are you with using simulation tools and software in your professional work? | 4 | 12 | 16 | 24 | 44 | 2.9600 | 1.15013 |
| How accessible are training programs and workshops on simulation techniques in your region? | 0 | 16 | 16 | 32 | 36 | 3.2800 | 1.11613 |
| To what extent do you agree that there is a need for advanced training in simulation techniques among IT professionals in Nigeria? | 4 | 20 | 8 | 60 | 8 | 3.4800 | 1.02621 |
| How significant do you believe the skill gaps in simulation techniques are in affecting the overall performance of IT projects in Nigeria? | 8 | 4 | 20 | 56 | 12 | 3.6000 | 1.02151 |

Source: Field Survey, 2024

The table 3 shows the questions addressing training needs. It is evident from the result that the mean score for all the variables are above ‘3’ which is the stipulated benchmark for accepting the statement or not. Analysis on the percentages also back up the mean score as the majority of the respondents good or excellent (I.e 44%, 44% 36%, 60% and 56% respectively) to each of the variables addressing high-quality data.

**The skill gaps and training needs among IT professionals in Nigeria regarding simulation techniques and practices**

The skill gaps and training needs among IT professionals in Nigeria regarding simulation techniques and practices reflect both the evolving nature of technology and the specific challenges faced within the country's IT landscape (Mpinganjira, 2013; Muchie, 2011). One prominent skill gap lies in the understanding and application of advanced simulation techniques such as Monte Carlo simulation, discrete event simulation, and agent-based modeling. While Nigerian IT professionals possess foundational knowledge in programming and data analysis, they often lack specialized expertise in simulation methodologies and tools. Furthermore, there is a shortage of professionals with expertise in simulation software platforms commonly used in industry settings. Many Nigerian IT professionals have limited exposure to popular simulation tools such as Simulink, Arena, AnyLogic, or MATLAB, which are widely utilized for modeling complex systems in fields such as manufacturing, logistics, and healthcare. This lack of familiarity with simulation software hinders the adoption and implementation of simulation practices in Nigerian organizations.

Moreover, there is a need for training in data analytic and statistical modeling techniques to support simulation modeling effectively. While some IT professionals in Nigeria have basic data analysis skills, there is a growing demand for individuals proficient in advanced analytic methods, including regression analysis, time series forecasting, and machine learning algorithms. These skills are essential for preprocessing data, building predictive models, and validating simulation outputs, enhancing the accuracy and reliability of simulation results. Additionally, soft skills such as problem-solving, critical thinking, and communication are vital for IT professionals engaged in simulation projects. Effective simulation modeling requires collaboration with domain experts, stakeholders, and decision-makers to understand system requirements, define simulation objectives, and communicate findings effectively. However, many IT professionals in Nigeria lack these interpersonal skills, limiting their ability to engage in interdisciplinary teams and drive simulation initiatives to successful outcomes (Mpinganjira, 2013).

**Table 4 Questions addressing simulation techniques expressed in percentages**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | VP  % | P  % | U  % | G  % | E  % | Mean | Std Dev. |
| To what extent do you believe that simulation techniques contribute to innovation within the Nigerian IT industry? | 8 | 8 | 16 | 64 | 4 | 3.4800 | 0.98633 |
| How effective are simulation techniques in enhancing the competitiveness of IT companies in Nigeria? | 0 | 20 | 20 | 48 | 12 | 3.5200 | 0.94476 |
| How widely adopted are simulation techniques in your organization for driving innovation? | 0 | 8 | 16 | 52 | 24 | 3.9200 | 0.84616 |
| To what extent does your organization allocate resources (time, budget, personnel) towards simulation-based projects? | 4 | 24 | 12 | 32 | 28 | 3.5600 | 1.23754 |
| How influential are simulation techniques in the decision-making processes within your organization? | 4 | 16 | 20 | 48 | 12 | 3.4800 | 1.02621 |

Source: Field Survey, 2024

The table 4 shows the questions addressing simulation techniques. It is evident from the result that the mean score for all the variables are above ‘3’ which is the stipulated benchmark for accepting the statement or not. Analysis on the percentages also back up the mean score as the majority of the respondents good or excellent (I.e 64%, 48% 52%, 32% and 48% respectively) to each of the variables addressing simulation techniques.

**Role of stimulation techniques in driving innovation and competitiveness within the Nigerian IT industry**

Simulation techniques play a pivotal role in driving innovation and competitiveness within the Nigerian IT industry, offering powerful tools for problem-solving, optimization, and decision-making across various sectors (Bamall, 2014). One key aspect is the application of simulation in product development and process optimization. By simulating different scenarios and conditions, Nigerian IT companies can iteratively refine their software products and services, accelerating the innovation cycle and enhancing product quality and performance. This enables Nigerian firms to stay competitive in the global market by delivering innovative solutions that meet evolving customer needs and preferences. Moreover, simulation techniques are instrumental in improving operational efficiency and resource utilization within Nigerian organizations. Whether in manufacturing, logistics, or healthcare, simulation modeling enables companies to identify bottlenecks, streamline workflows, and optimize resource allocation (Jimoh et al., 2023). By simulating complex systems and processes, Nigerian businesses can identify inefficiencies, reduce costs, and improve productivity, thereby gaining a competitive edge in the marketplace (Mpinganjira, 2013).

Furthermore, Oladipo (2012) argued that simulation techniques facilitate strategic decision-making and risk management in the Nigerian IT industry. By simulating various business scenarios and market conditions, organizations can assess the potential impact of different strategies, anticipate risks, and identify opportunities for growth. This enables Nigerian firms to make informed decisions, mitigate uncertainties, and adapt quickly to changing market dynamics, enhancing their competitiveness in a rapidly evolving business environment. Additionally, simulation techniques play an import role in fostering innovation and entrepreneurship within the Nigerian IT ecosystem (Sani et al., 2014). By providing a low-cost, low-risk environment for testing new ideas and business models, simulation enables aspiring entrepreneurs to prototype and validate innovative concepts before committing resources to full-scale implementation. This encourages experimentation, creativity, and risk-taking, ultimately fueling the growth of the Nigerian startup ecosystem and driving technological innovation across various sectors.

**Table 5 Questions addressing simulation software expressed in percentages**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | VP  % | P  % | U  % | G  % | E  % | Mean | Std Dev. |
| Please indicate the extent to which the high initial costs of purchasing simulation software and tools deter your organization from adopting these technologies. | 8 | 8 | 12 | 48 | 24 | 3.7200 | 1.15153 |
| To what extent do the ongoing costs associated with maintaining and supporting simulation software impact your organization’s decision to continue using these tools? | 0 | 20 | 12 | 40 | 28 | 3.7600 | 1.07062 |
| How do you perceive the cost-benefit ratio of investing in simulation tools, considering both the financial outlay and the potential benefits to your organization? | 0 | 12 | 20 | 56 | 12 | 3.6800 | 0.83662 |
| Please rate how the availability of budget within your organization influences the allocation of funds towards the adoption of simulation software and tools. | 0 | 8 | 12 | 44 | 36 | 4.0800 | 0.89233 |
| To what extent do the licensing and subscription fees of simulation software affect your organization’s ability to utilize these tools effectively? | 4 | 4 | 36 | 40 | 16 | 3.6000 | 0.93965 |

Source: Field Survey, 2024.

The table 5 shows the questions addressing simulation software. It is evident from the result that the mean score for all the variables are above ‘3’ which is the stipulated benchmark for accepting the statement or not. Analysis on the percentages also back up the mean score as the majority of the respondents good or excellent (I.e 48%, 40% 56%, 44% and 40% respectively) to each of the variables addressing simulation software.

**Costs associated with simulation software and tools impact their adoption and utilization by organizations in Nigeria**

The costs associated with simulation software and tools significantly impact their adoption and utilization by organizations in Nigeria, posing challenges particularly for small and medium-sized enterprises (SMEs) and resource-constrained institutions (Sani et al., 2014). One major cost factor is the initial investment required to procure simulation software licenses. Many commercial simulation packages come with substantial upfront costs, which can be prohibitive for organizations operating on limited budgets in Nigeria. The high cost of acquiring licenses may deter SMEs and startups from investing in simulation tools, limiting their ability to leverage these technologies for process optimization and decision-making.

Furthermore, the ongoing expenses associated with software maintenance, updates, and technical support add to the total cost of ownership of simulation tools. Nigerian organizations often struggle to allocate sufficient resources for software maintenance and support services, leading to challenges in keeping simulation software up-to-date and ensuring optimal performance. Without access to timely updates and technical assistance, organizations may face compatibility issues, security vulnerabilities, and limitations in software functionality, diminishing the value proposition of simulation tools (Nweke, 2011). Moreover, the costs of training and capacity building present additional barriers to the adoption and utilization of simulation software in Nigeria. While simulation tools offer powerful capabilities for modeling and analysis, effective utilization requires specialized skills and expertise. Organizations need to invest in training programs and professional development initiatives to equip their staff with the necessary knowledge and competencies to leverage simulation tools effectively. However, the costs associated with training programs, workshops, and certifications may be prohibitive for many Nigerian organizations, particularly those operating in sectors with limited training budgets.

**Tackling the problems of stimulation into IT System and Subsystem in the Nigeria**

Addressing the problem of stimulation within IT systems and subsystems in the Nigerian context requires a dimensional approach that addresses infrastructure constraints, skill gaps, and regulatory challenges while fostering collaboration and innovation. One key aspect is investing in robust IT infrastructure to support the implementation of stimulation techniques. This includes improving power supply, expanding internet connectivity, and lowering data costs to create an enabling environment for simulation modeling and data-driven decision-making. Additionally, there is a need for targeted capacity building initiatives to equip Nigerian IT professionals with the necessary skills and expertise in simulation techniques and practices. This involves incorporating simulation courses into academic curricula, offering training programs and workshops on simulation software applications, and promoting continuous learning and professional development opportunities. By investing in human capital development, Nigeria can build a skilled workforce capable of leveraging simulation technology to drive innovation and competitiveness within the IT industry.

Additionally, addressing regulatory constraints and data privacy concerns is essential to facilitate the adoption and utilization of simulation techniques in Nigeria. This requires developing comprehensive data protection laws and regulatory frameworks that clarify data ownership, consent, and security requirements while promoting data sharing and collaboration among stakeholders. By establishing clear guidelines and standards for data management and privacy, Nigeria can create a conducive environment for organizations to collect, share, and analyze data for simulation purposes while safeguarding individual rights and interests.

Furthermore, fostering collaboration and knowledge sharing among industry players, academic institutions, and government agencies is critical to overcoming the challenges of simulation adoption in Nigeria. This involves establishing partnerships and research networks to facilitate technology transfer, promote best practices, and address common challenges faced by organizations implementing simulation projects. By fostering a culture of collaboration and innovation, Nigeria can leverage the collective expertise and resources of its stakeholders to accelerate the adoption and utilization of simulation techniques across various sectors of the economy.

**Limitations and suggestion for future studies**

One significant limitation in studying the implementation of simulation techniques within IT systems and subsystems in Nigeria revolves around the availability and quality of data. Nigeria, like many developing nations, faces challenges related to data accessibility, standardization, and privacy. Limited access to comprehensive and reliable datasets hampers the depth of analysis and validation of simulation models, impeding researchers' ability to draw robust conclusions about the effectiveness and applicability of simulation techniques in Nigerian contexts.

Also, the scarcity of comprehensive case studies documenting the practical application of simulation techniques within Nigerian organizations poses another limitation. Without sufficient real-world examples, it make it difficult to assess the practical challenges, successes, and best practices in implementing simulation projects. This lack of empirical evidence inhibits a nuanced understanding of the contextual factors influencing the adoption and utilization of simulation techniques in Nigeria.

Infrastructure constraints also represent a notable limitation. Nigeria's unreliable power supply and limited internet connectivity undermine the scalability and effectiveness of simulation models, particularly in sectors heavily reliant on digital technologies. These infrastructure challenges not only impact the implementation of simulation techniques but also influence the generalizability of study findings, as they may not accurately reflect the potential impact of simulation in contexts with more robust infrastructure.

**Practical Implication**

The study of the implementation of simulation techniques within IT systems and subsystems in Nigeria holds both practical and theoretical implications that can inform decision-making, drive innovation, and contribute to academic discourse. From a practical standpoint, understanding the challenges and opportunities associated with implementing simulation techniques in Nigeria's IT industry provide valuable insights for policymakers, industry practitioners, and organizational leaders. By identifying barriers to adoption, such as infrastructure constraints, skill gaps, and regulatory challenges, stakeholders can develop targeted strategies and interventions to promote the effective utilization of simulation technology. For example, policymakers may prioritize investments in digital infrastructure development and data governance frameworks to create an enabling environment for simulation implementation. Similarly, industry practitioners can tailor training programs and capacity-building initiatives to address skill gaps and enhance the competencies of IT professionals in simulation modeling and analysis. Organizational leaders can leverage insights from the study to make informed decisions about resource allocation, technology investments, and strategic planning, ultimately driving operational efficiency, innovation, and competitiveness within their organizations.

**Theoretical implication**

On a theoretical level, studying the implementation of simulation techniques in Nigeria contributes to the broader academic discourse on technology adoption, innovation diffusion, and digital transformation in developing economies. By examining the contextual factors shaping simulation adoption, researchers can advance theoretical frameworks and models that elucidate the complex interplay between technological, organizational, and socio-economic factors. Insights gained from the study can inform the refinement and development of theoretical constructs such as the Technology-Organization-Environment (TOE) framework or the Diffusion of Innovations theory within the specific context of Nigeria's IT industry. Moreover, comparative analyses with studies from other countries and regions can offer valuable cross-cultural insights and enrich theoretical understandings of technology adoption dynamics in diverse socio-economic contexts.

**Conclusion**

In conclusion, the implementation of simulation techniques within IT systems and subsystems in Nigeria presents both opportunities and challenges that have significant implications for decision-making, innovation, and academic discourse. While simulation holds the potential to drive operational efficiency, innovation, and competitiveness within the Nigerian IT industry, barriers such as infrastructure constraints, skill gaps, and regulatory challenges must be addressed to realize its full potential. Efforts to overcome these challenges require a different approach that involves investments in digital infrastructure, targeted capacity building initiatives, and collaborative research endeavors. By creating an enabling environment for simulation adoption, policymakers, industry practitioners, and organizational leaders can leverage simulation technology to enhance decision-making, optimize processes, and drive innovation within their organizations.

Furthermore, academic research on the implementation of simulation techniques in Nigeria contributes to the broader theoretical discourse on technology adoption, innovation diffusion, and digital transformation. Insights gained from empirical studies can inform the refinement of theoretical frameworks and models, offering valuable cross-cultural insights into technology adoption dynamics in diverse socio-economic contexts. In essence, the study of simulation implementation in Nigeria not only informs practical strategies for overcoming implementation challenges but also enriches theoretical understandings of technology adoption processes. By addressing both practical and theoretical implications, research in this area plays a crucial role in fostering sustainable socio-economic development, technological advancement, and innovation within Nigeria's IT industry and beyond.

**Recommendations of the study**

1. Nigeria should prioritize investments in enhancing digital infrastructure to create a conducive environment for the implementation of simulation techniques. Improvements in power supply, internet connectivity, and data storage facilities are essential to support the adoption and utilization of simulation technology across various sectors. By investing in digital infrastructure, Nigeria can overcome significant barriers and facilitate the seamless implementation of simulation techniques within IT systems and subsystems.
2. Collaborative efforts between government agencies, educational institutions, and industry stakeholders are important for developing and implementing comprehensive capacity-building initiatives. These programs should focus on providing training in simulation modeling, data analytics, and IT skills development to address existing skill gaps among IT professionals in Nigeria. By equipping individuals with the necessary competencies, Nigeria can build a skilled workforce capable of effectively leveraging simulation techniques to drive innovation and competitiveness within the IT industry.
3. Nigeria should prioritize the development and enforcement of clear and comprehensive regulatory frameworks for data governance, privacy protection, and intellectual property rights. These regulations should ensure compliance with international standards while addressing the unique challenges faced within the Nigerian context. By establishing transparent and robust regulatory frameworks, Nigeria can foster trust and confidence in data sharing and simulation initiatives, thereby facilitating their widespread adoption and utilization.
4. Stakeholders across academia, industry, and government sectors should actively promote collaboration and knowledge-sharing platforms to facilitate technology transfer, best practice dissemination, and joint research efforts. By fostering collaborative initiatives, Nigeria can accelerate innovation, drive technology adoption, and address common challenges faced by organizations implementing simulation projects. Collaborative efforts are essential for maximizing the impact of simulation technology and driving sustainable socio-economic development within Nigeria.
5. government should allocate resources to support research and development initiatives focused on simulation technology, particularly in sectors with high potential for impact. Government funding agencies and industry partners should prioritize research efforts that address real-world challenges and advance theoretical understandings of technology adoption dynamics in Nigeria. By supporting research and development activities, Nigeria can foster innovation, drive competitiveness, and position itself as a leader in simulation technology within the global marketplace.

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