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EDITORIAL COMMENT

On behalf of the Editorial Board of the Journal of Information and Communication Technology (JoICT), we are honored to present the Ninth Volume of this Journal, which represents the dedication, hard work, and scholarly contributions of many committed individuals. We would like to express our sincere gratitude to Mr. Adebayo Adedeji, the esteemed Dean of the School of ICT, for the privilege to serve on this Board. His support and encouragement have been instrumental in advancing the Journal and fostering a culture of academic excellence within the School.

Our heartfelt appreciation also goes to Dr. S.S. Umar, the Rector of Auchi Polytechnic, for his unwavering commitment to creating an enabling environment that promotes professional growth and career progression for all staff. His visionary leadership continues to inspire and drive our collective pursuit of educational advancement and excellence in research.

We would also like to recognize the invaluable contributions of our esteemed reviewers, whose critical assessments have ensured that each paper published in this volume meets the Journal's high standards. Likewise, we extend our deep appreciation to our dedicated Editorial Board and Advisory Board members for their tireless efforts in maintaining the quality and relevance of our publications. Your commitment and attention to detail have been pivotal in upholding the integrity of our work.

The contributions in this volume have met the rigorous standards required for publication, demonstrating the quality of research and innovation within our School. However, as we look to the future, we recognize that there is always room for improvement, and we are committed to continually raising the bar for our Journal's quality and impact.

In conclusion, we extend our profound gratitude to all who have supported this publication. Together, let us continue to build on this foundation of excellence and work towards even greater achievements in future volumes.

Best Regards,

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GREEN COMPUTING INITIATIVES FOR SUSTAINABLE DEVELOPMENT IN A DEVELOPING NATION

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Abstract

This paper examines the pivotal role of green computing initiatives in fostering sustainable development within developing nations. As these nations undergo rapid technological advancement, there is a pressing need to mitigate the environmental impact of information technology (IT) infrastructure. Through a comprehensive review of existing literature and case studies, this paper identifies key strategies for implementing green computing practices tailored to the specific challenges and opportunities present in developing contexts. Drawing upon examples from successful initiatives worldwide, the paper highlights the potential of energy-efficient hardware design, optimized data center management, renewable energy integration, and electronic waste recycling to reduce carbon emissions and resource consumption. Additionally, it discusses the importance of policy frameworks, public-private partnerships, and capacity-building efforts in driving the adoption of sustainable IT practices at the national and local levels. By embracing green computing principles, developing nations can not only mitigate environmental degradation but also promote economic growth, social equity, and technological innovation. This paper underscores the transformative potential of green computing initiatives in advancing the sustainable development agenda and calls for concerted action from governments, industry stakeholders, and civil society to realize this vision.

Keyword: Green Computing, IT, data center, electronic waste

1.0 INTRODUCTION

Green Computing Initiatives are pivotal in steering developing nations towards sustainable development in the modern era. As the world confronts escalating environmental challenges, integrating eco-friendly practices within computing technologies emerges as a beacon of hope. This introduction explores the transformative potential of Green Computing Initiatives in fostering sustainable development in developing nations.

In an era defined by rapid technological advancement and increasing environmental awareness, Green Computing Initiatives have emerged as a critical strategy for promoting sustainability. These initiatives encompass a spectrum of practices and policies aimed at minimizing the environmental impact of computing technologies throughout their lifecycle—from design and manufacturing to use and disposal. In developing nations, where economic growth often accompanies heightened resource consumption and environmental strain, the adoption of Green Computing Initiatives holds particular significance. By integrating energy-efficient hardware design, optimizing data center operations, promoting virtualization and cloud computing, and advocating for responsible e-waste management, these initiatives not only reduce carbon footprints but also enhance operational efficiency and cut costs.
Moreover, Green Computing Initiatives align with global commitments such as the United Nations Sustainable Development Goals (SDGs), particularly Goal 7 (Affordable and Clean Energy) and Goal 13 (Climate Action). They empower developing nations to leapfrog traditional, resource-intensive technological pathways, fostering a sustainable digital infrastructure that supports long-term economic and environmental resilience.

2.0 Strategies For Implementing Green Computing Practices

Implementing Green Computing practices involves a range of strategies aimed at reducing the environmental impact of computing technologies.

1. Energy-Efficient Hardware: One of the fundamental strategies is to use energy-efficient hardware components. This includes processors, servers, and other devices that are designed to consume less power while maintaining performance. For example, Intel has been developing processors with enhanced energy efficiency, such as their 10th Gen Intel® Core™ processors, which are optimized for lower power consumption without sacrificing computing power (Intel, 2023).
2. Virtualization and Consolidation: Virtualization allows multiple virtual machines to run on a single physical machine, thereby reducing the number of physical servers required. Companies like VMware have advanced virtualization technologies that help organizations consolidate their IT infrastructure, leading to significant energy savings and operational efficiencies (VMware, 2022).

3. Cloud Computing: Cloud computing services provide scalable and on-demand access to computing resources over the internet. For instance, Amazon Web Services (AWS) offers cloud services that promote energy efficiency through server consolidation and efficient data center operations (AWS, 2021).
4. Green Data Centers: Designing and operating energy-efficient data centers is crucial. Techniques such as using renewable energy sources, implementing advanced cooling technologies, and optimizing server placement can significantly reduce energy consumption. Google's data centers, for example, are designed to maximize energy efficiency through innovative cooling methods and renewable energy investments (Google, 2024).
5. E-Waste Management: Proper disposal and recycling of electronic waste (e-waste) are essential to minimize environmental impact. Initiatives like Dell's closed-loop recycling programs, where materials from recycled electronics are used in new products, contribute to reducing waste and conserving resources (Dell, 2020).

3.0 Challenges and Opportunities present in Developing Nations

Developing nations face a complex landscape of challenges and opportunities influenced by various socio-economic, political, and environmental factors. These nations, often characterized by lower income levels, inadequate infrastructure, and high population growth rates, encounter significant hurdles in their development trajectories. While developing nations face formidable challenges, they also have significant opportunities to advance through strategic investments, technological innovations, and policy reforms.

3.1 Challenges

1. Economic Inequality: Income disparities within developing nations often widen due to uneven economic growth, limited job opportunities, and insufficient social safety nets (World Bank, 2023).
2. Infrastructure Deficiencies: Poor infrastructure, including inadequate transportation networks, energy systems, and sanitation facilities, hinders economic productivity and quality of life (UNDP, 2021).
3. Political Instability: Developing nations frequently grapple with political unrest, corruption, and governance challenges, undermining institutional effectiveness and investor confidence (Freedom House, 2022).
4. Climate Change: Vulnerability to climate change impacts, such as extreme weather events and resource depletion, threatens agricultural productivity and exacerbates food insecurity (IPCC, 2021).
5. Healthcare Access: Limited access to healthcare services and sanitation facilities contributes to high morbidity rates and impedes human capital development (WHO, 2020).

3.2 Opportunities

1. Technological Advancements: Rapid technological adoption presents opportunities for leapfrogging traditional development barriers, especially in sectors like mobile banking, renewable energy, and e-commerce (UNESCO, 2023).
2. Human Capital Development: Investments in education and skill development can enhance workforce productivity and innovation capacity, fostering sustainable economic growth (OECD, 2024).
3. Global Partnerships: Collaboration with international organizations, NGOs, and global initiatives facilitates access to funding, expertise, and technology transfer, supporting development goals (United Nations, 2022).
4. Natural Resource Utilization: Sustainable management of natural resources, including renewable energy sources and biodiversity conservation, offers economic diversification and environmental sustainability opportunities (World Economic Forum, 2023).
5. Policy Reforms: Institutional reforms aimed at improving governance, reducing corruption, and enhancing regulatory frameworks can attract investment and promote economic stability (World Bank, 2021).

4.0 Energy-Efficient Hardware Design

Energy-efficient hardware design has become increasingly critical in recent years due to the growing awareness of environmental sustainability and the rising demand for energy-efficient computing solutions.

4.1 Examples of Energy-Efficient Hardware Design

1. Low-Power Processors: Manufacturers have developed low-power processors that optimize energy consumption without compromising computational performance. For instance, ARM's Cortex-A76AE processor incorporates advanced power management techniques, such as dynamic voltage and frequency scaling (DVFS), to adjust power usage based on workload demands (ARM, 2023).
2. Energy-Efficient GPUs: Graphics processing units (GPUs) are essential for tasks like gaming and AI applications but traditionally consume substantial power. NVIDIA's Turing architecture GPUs, introduced in 2020, feature energy-efficient designs like Tensor Cores for AI processing and improved power efficiency per compute unit, enabling significant energy savings in high-performance computing applications (NVIDIA, 2020).
3. Efficient Memory Technologies: Memory modules play a crucial role in overall system power consumption. Technologies like LPDDR5 (Low Power Double Data Rate) memory, introduced

by companies such as Samsung and Micron, offer higher data transfer rates at lower voltages compared to previous generations, reducing power consumption in mobile devices and data centers (Samsung, 2021).

4. Power-Efficient Data Centers: Data centers consume vast amounts of energy, making efficiency improvements crucial. Google's AI-driven data center cooling management, for example, uses machine learning to optimize cooling and reduce energy consumption by up to 30% (Google, 2022).
5. Smartphone Battery Life Enhancements: Smartphone manufacturers focus on improving battery life through energy-efficient hardware design. Apple's introduction of custom-designed M-series chips, starting with the M1 in 2020, integrates efficient processing and graphics capabilities while optimizing power consumption, extending battery life in devices like iPhones and iPads (Apple, 2020).

5.0 Optimized Data Center Management

Optimized data center management has become essential in recent years to enhance efficiency, reduce operational costs, and minimize environmental impact. This approach involves leveraging advanced technologies and strategies to improve resource utilization, energy efficiency, and overall performance of data centers.

5.1 Examples of Optimized Data Center Management

1. AI-Driven Cooling and Energy Management: Companies like Google and Facebook have implemented AI-driven algorithms to optimize cooling and energy management in their data centers. For instance, Google's DeepMind AI has been used to predict and adjust cooling systems, leading to significant energy savings without compromising server performance (Google AI Blog, 2021).
2. Virtualization and Containerization: Virtualization technologies, such as VMware and Microsoft Hyper-V, allow data centers to run multiple virtual machines on a single physical server. This reduces hardware requirements, leading to lower power consumption and better resource utilization. Containerization platforms like Docker further optimize resource allocation and application deployment, improving efficiency (VMware, 2023).
3. Renewable Energy Integration: Data centers are increasingly adopting renewable energy sources to power operations. For example, Apple's data centers are powered by 100% renewable energy, including solar and wind power, minimizing their carbon footprint (Apple, 2022).
4. Edge Computing Optimization: Edge computing involves processing data closer to the source, reducing latency and bandwidth usage. This optimization strategy not only improves performance but also reduces the load on central data centers, leading to overall energy savings.

Companies like Microsoft Azure and AWS offer edge computing solutions that enhance efficiency in data processing (Microsoft, 2020).

5. Efficient Hardware Design: As mentioned earlier, advancements in hardware design, such as energy-efficient processors and memory technologies, contribute to optimizing data center operations. For example, AMD's EPYC processors are designed for high performance with lower power consumption, making them suitable for data center applications (AMD, 2021).

6.0 Renewable Energy Integration

Renewable energy integration has gained momentum globally driven by environmental concerns, regulatory incentives, and technological advancements. This approach involves incorporating sustainable energy sources such as solar, wind, hydroelectric, and geothermal power into various sectors, including electricity generation, transportation, and industrial processes.

6.1 Renewable Energy Integration concepts

1. Utility-Scale Renewable Projects: Governments and utilities worldwide have invested in large-scale renewable energy projects. For example, the United States has seen significant growth in solar and wind installations supported by federal tax credits and state-level policies (U.S. Energy Information Administration, 2023).
2. Corporate Renewable Procurement: Many corporations are committing to sourcing electricity from renewable sources to meet sustainability goals and reduce carbon footprints. Companies like Google and Amazon have signed long-term power purchase agreements (PPAs) with renewable energy developers to power their data centers and operations (Google Sustainability Report, 2021).
3. Community and Distributed Energy Systems: Communities and businesses are increasingly adopting distributed energy systems, including rooftop solar panels and community-owned wind farms. These decentralized systems promote energy independence and resilience while reducing transmission losses (International Renewable Energy Agency, 2020).
4. Technological Innovations and Grid Integration: Advances in energy storage, smart grid technologies, and predictive analytics are enhancing the integration of intermittent renewable sources into existing power grids. Battery storage systems and demand-response technologies help manage fluctuations in renewable energy supply and improve grid stability (IEA, 2022).
5. Policy Support and Market Mechanisms: Governments worldwide are implementing policies such as feed-in tariffs, renewable portfolio standards, and carbon pricing to incentivize renewable energy adoption. These regulatory frameworks stimulate investment in renewable infrastructure and facilitate market competitiveness (European Commission, 2024).

7.0 Importance OF Policy Frameworks

Policy frameworks play a crucial role in guiding and regulating various aspects of societal development, economic activities, and environmental sustainability. These frameworks provide a structured approach to addressing complex issues, promoting innovation, and ensuring equitable outcomes across different sectors.

7.1 Importance of Policy Frameworks

1. Environmental Sustainability: Policies such as carbon pricing, emissions regulations, and renewable energy incentives are essential for mitigating climate change and promoting sustainable development (European Commission, 2023).
2. Economic Growth and Stability: Well-designed economic policies foster growth, job creation, and competitiveness. For instance, fiscal policies that support innovation and entrepreneurship can stimulate economic activity and attract investment (OECD, 2021).
3. Social Equity and Inclusion: Social policies address inequalities and promote inclusivity through measures like healthcare access, education reforms, and social safety nets (World Bank, 2022).
4. Technological Innovation: Policies that encourage research and development, intellectual property protection, and digital infrastructure investments drive technological innovation and competitiveness (UNESCO, 2020).
5. Global Governance and Cooperation: International policy frameworks facilitate cooperation on global challenges such as trade agreements, climate agreements (e.g., Paris Agreement), and humanitarian assistance (United Nations, 2024).

7.2 Examples of Effective Policy Frameworks:

- Paris Agreement: The international climate agreement aims to limit global temperature rise through coordinated efforts and national climate action plans (UNFCCC, 2020).
- European Green Deal: A comprehensive policy framework by the European Union focusing on climate neutrality, sustainable agriculture, and biodiversity preservation (European Commission, 2021).
- Digital Economy Policies: Countries like Singapore and South Korea have implemented policies supporting digital transformation, including digital infrastructure development and cybersecurity measures (IMF, 2023).

8.0 Importance of Public-Private Partnerships

Public-private partnerships (PPPs) are increasingly recognized as crucial mechanisms for addressing complex societal challenges, fostering innovation, and leveraging resources from both sectors to achieve sustainable development goals.

8.1 Importance of Public-Private Partnerships

1. Infrastructure Development: PPPs play a vital role in funding and managing large-scale infrastructure projects such as transportation networks, energy facilities, and public utilities. They enable governments to leverage private sector expertise and capital for timely and cost-effective project delivery (World Bank, 2021).
2. Innovation and Technology Deployment: Collaboration between public and private sectors encourages innovation and the adoption of advanced technologies in sectors like healthcare, education, and digital infrastructure. PPPs can accelerate the deployment of smart city solutions and digital transformation initiatives (OECD, 2023).
3. Risk Sharing and Efficiency: PPPs allocate risks between public and private partners based on their capabilities, fostering accountability and incentivizing efficient project management. Private sector involvement often brings rigorous performance metrics and incentives for timely project completion (IFC, 2022).
4. Service Delivery and Quality Improvement: In sectors such as healthcare and education, PPPs improve service delivery by introducing private sector management practices while maintaining public sector oversight and equity in access (World Economic Forum, 2020).
5. Sustainable Development: PPPs can support sustainable development goals by integrating environmental and social considerations into project planning and implementation. They facilitate investments in renewable energy, sustainable infrastructure, and climate-resilient technologies (United Nations, 2024).

8.2 Examples of Effective Public-Private Partnerships:

- Healthcare PPPs: Initiatives like the Global Fund to Fight AIDS, Tuberculosis and Malaria involve partnerships between governments, NGOs, and pharmaceutical companies to enhance healthcare access and combat diseases globally (Global Fund, 2021).
- Infrastructure Projects: The development of renewable energy projects through PPPs, such as offshore wind farms and solar energy parks, leverages private sector investment and expertise to expand renewable energy capacity (IEA, 2023).
- Education Initiatives: PPPs in education, such as school construction and management partnerships, improve educational outcomes by combining public funding with private sector innovation in curriculum development and technology integration (OECD, 2021).

9.0 Capacity-Building Efforts In Driving The Adoption Of Sustainable It Practices At The National And Local Levels

Capacity-building efforts to drive the adoption of sustainable IT practices at national and local levels have focused on enhancing knowledge, skills, and infrastructure to promote environmentally responsible

use of information technology. These efforts are crucial for mitigating the environmental impact of IT operations, reducing carbon footprints, and promoting sustainability in digital transformation.

9.1 Capacity-Building Efforts in Sustainable IT Practices

1. Training and Education Programs: Governments and organizations have implemented training and education initiatives to raise awareness and build capacity in sustainable IT practices. These programs target IT professionals, policymakers, and businesses to promote energy-efficient computing, electronic waste management, and sustainable procurement practices (UNEP, 2021).
2. Policy Development and Advocacy: National and local governments have developed policies and regulations that incentivize sustainable IT practices. This includes mandates for energy-efficient IT equipment, e-waste recycling programs, and green procurement policies that prioritize environmentally friendly products and services (European Commission, 2022).
3. Public-Private Partnerships (PPPs): Collaborative efforts between public and private sectors play a significant role in capacity-building for sustainable IT practices. PPPs facilitate knowledge sharing, technology transfer, and joint investment in green IT infrastructure, such as data centers powered by renewable energy and smart grid technologies (ITU, 2023).
4. Research and Innovation: Investment in research and innovation supports the development of sustainable IT solutions. This includes advancements in energy-efficient hardware design, cloud computing technologies that optimize resource utilization, and software solutions for environmental monitoring and management (Gartner, 2020).
5. Community Engagement and Awareness Campaigns: Local initiatives engage communities and businesses in adopting sustainable IT practices. Awareness campaigns promote behaviors like electronic device recycling, energy-saving practices in data centers, and the use of green IT certifications (Green ICT Foundation, 2024).

9.2 Examples of Capacity-Building Initiatives

- Green IT Certification Programs: Certifications like LEED (Leadership in Energy and Environmental Design) for Data Centers provide guidelines for designing and operating energy-efficient data centers, promoting sustainable practices (USGBC, 2021).
- National E-Waste Management Programs: Countries such as Japan and Germany have established comprehensive e-waste management frameworks, including collection, recycling, and disposal of electronic devices to minimize environmental impact (UNEP, 2023).
- Digital Skills Training: Programs like Cisco Networking Academy offer courses on sustainable IT practices, equipping students and professionals with skills in green networking, cybersecurity, and IoT solutions (Cisco, 2022).

10.0 Transformative Potential of Green Computing Initiatives In Advancing The Sustainable Development Agenda

Green computing initiatives hold significant transformative potential in advancing the sustainable development agenda by promoting energy efficiency, reducing carbon emissions, and minimizing environmental impact within the IT sector and beyond.

10.1 Transformative Potential of Green Computing Initiatives

1. Energy Efficiency and Carbon Footprint Reduction: Green computing focuses on optimizing energy use in IT operations through strategies like virtualization, energy-efficient hardware design, and data center cooling technologies. These initiatives aim to reduce energy consumption and greenhouse gas emissions associated with IT infrastructure (IDC, 2023).
2. Resource Conservation and Waste Reduction: Sustainable IT practices emphasize the responsible use of resources such as materials, water, and energy throughout the lifecycle of IT equipment. This includes eco-design principles for hardware and software, recycling programs for electronic waste (e-waste), and circular economy approaches to extend product life cycles (EPA, 2021).
3. Promotion of Renewable Energy Integration: Green computing encourages the adoption of renewable energy sources to power IT operations, such as solar, wind, and hydroelectric power. Integrating renewable energy into data centers and IT networks reduces reliance on fossil fuels and supports the transition to a low-carbon economy (IRENA, 2022).
4. Impact on Sustainable Development Goals (SDGs): By aligning with SDGs such as affordable and clean energy (SDG 7), climate action (SDG 13), and responsible consumption and production (SDG 12), green computing initiatives contribute to global efforts to achieve sustainable development (UN, 2020).
5. Business and Economic Benefits: Organizations that embrace green computing initiatives often realize cost savings through reduced energy bills, improved operational efficiency, and enhanced corporate sustainability credentials (Deloitte, 2024).

10.2 Examples of Transformative Green Computing Initiatives

- Google's Carbon-Free Operations: Google has committed to running all of its data centers and corporate campuses on carbon-free energy by 2030, leveraging renewable energy investments and innovative energy management strategies (Google Sustainability, 2023).
- Energy Star Certification: The Energy Star program certifies energy-efficient IT equipment and data centers, guiding consumers and businesses towards environmentally preferable purchasing decisions (EPA Energy Star, 2021).
- Circular Economy in IT: Initiatives like Dell's closed-loop recycling process for electronics demonstrate circular economy principles by using recycled materials in new product manufacturing,

reducing waste and environmental impact (Dell, 2022).

11.0 Conclusion

Green computing initiatives offer substantial potential for sustainable development in developing nations. By focusing on energy efficiency, resource conservation, and renewable energy integration, these initiatives can address critical challenges such as energy scarcity, environmental degradation, and economic inequality. In developing nations, where infrastructure and resource constraints are significant, green computing provides practical solutions to optimize energy use in IT operations. By adopting energy-efficient hardware, implementing virtualization and cloud computing technologies, and integrating renewable energy sources into data centers and networks, these countries can reduce their carbon footprint and mitigate environmental impact.

In conclusion, embracing green computing initiatives is crucial for achieving sustainable development goals in developing nations. By leveraging technological advancements and adopting environmentally responsible practices, these countries can build resilient infrastructure, promote inclusive growth, and ensure a sustainable future for generations to come.

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ADVANCEMENTS AND APPLICATIONS OF NATURAL LANGUAGE PROCESSING (NLP)

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Abstract

Natural Language Processing (NLP) has emerged as a transformative field at the intersection of artificial intelligence and linguistics, with profound implications for various domains including healthcare, finance, education, and communication. This paper provides a concise overview of recent advancements and applications in NLP, focusing on key techniques and their practical implications. The paper begins by discussing fundamental NLP tasks such as sentiment analysis, named entity recognition, and text summarization, highlighting the progress made in machine learning algorithms and deep learning architectures. It then explores cutting-edge research areas such as contextual word embeddings, pre-trained language models, and transformer-based architectures, which have significantly advanced the state-of-the-art in NLP tasks. Drawing upon real-world applications, the paper showcases the diverse uses of NLP technology, including chatbots for customer service, language translation systems and sentiment analysis for market research and social media monitoring. Furthermore, the paper discusses ongoing challenges and future directions in NLP research, including improving model interpretability, addressing bias and fairness issues, and advancing multilingual and cross-lingual NLP capabilities. By providing insights into the latest developments and applications, this paper aims to inspire further research and innovation in NLP, driving progress towards more intelligent, versatile, and accessible natural language processing systems.

Keywords: embedded, pre-trained, language, chatbots

1.0 Introduction

In Natural Language Processing (NLP), the primary goal is to enable computers to understand and process human language in a way that is meaningful and useful. This involves a range of techniques and approaches that handle the complexities inherent in natural languages. NLP tasks typically begin with the raw text as input. This text can come from various sources such as documents, social media posts, emails, or spoken conversations. The first step in NLP is to preprocess this text to make it suitable for analysis (Joshi et al.,2023). This preprocessing often includes tasks like text cleaning, where unnecessary characters, formatting, or noise are removed to ensure the text is in a usable format.

Once the text is cleaned and prepared, the next step involves transforming it into a structured format that the computer can work with effectively. This structured format might involve breaking the text into smaller units, such as words or phrases, known as tokens. This process is called tokenization. Tokens are fundamental units of analysis in NLP, and they enable various downstream tasks like part-of-speech tagging, named entity recognition, and sentiment analysis Brown et al., (2020).

Beyond tokenization, another crucial aspect of NLP is language modeling. Language models are statistical models that capture the patterns and structures of natural language. These models are trained on large amounts of text data to understand how words and phrases are used in context. Modern language models, such as BERT (Bidirectional Encoder Representations from Transformers) and GPT (Generative Pre-trained Transformer), have significantly advanced the capabilities of NLP by learning complex linguistic patterns and relationships(Lewis et al., 2020). In addition to modeling language, NLP also involves understanding and generating language. Understanding language involves tasks like syntactic parsing, which analyzes the grammatical structure of sentences, and semantic analysis, which seeks to understand the meaning of text. Chen et al., (2017) said that generating language involves tasks like machine translation, where systems translate text from one language to another, or text generation, where systems produce coherent and meaningful sentences.

2.0 Terminology used in NLP:

1. Tokenization: Breaking down text into smaller units such as words or sentences.
2. Text Normalization: Process of converting text into a standard form, such as converting "goes" and "going" to "go".
3. Part-of-Speech Tagging (POS): Assigning grammatical information to words, such as noun, verb, adjective, etc.
4. Named Entity Recognition (NER): Identifying and classifying named entities in text into predefined categories like names of persons, organizations, locations, etc.
5. Parsing: Analyzing the grammatical structure of sentences.

6. Word Embeddings: Mapping words or phrases from vocabulary to a vector of real numbers, capturing semantic meaning.
7. Sentiment Analysis: Determining the sentiment expressed in a piece of text, whether it is positive, negative, or neutral.
8. Machine Translation: Translating text or speech from one language to another automatically.
9. Chatbots and Conversational Agents: Developing systems that can understand and respond to natural language input from users.

3.0 Language Representation

Language representation in NLP involves transforming raw text into a format that computers can be analyze and process effectively. It is also the process of transforming raw text into a structured format that computers can understand and manipulate. This often starts with cleaning and preparing the text, ensuring it's free from unnecessary characters, and formatted correctly for further processing(Lample & Conneau, 2019). This transformation is crucial for enabling various NLP tasks such as text classification, sentiment analysis, and machine translation.

In our example sentence, the raw text is:

```
Natural Language Processing (NLP) is a branch of artificial
intelligence (AI) that focuses on enabling computers to
understand, interpret, and generate human language
```

After preprocessing, the text might be standardized to lowercase (although this is not always necessary depending on the task):

```
natural language processing (nlp) is a branch of artificial intelligence
(ai) that focuses on enabling computers to understand, interpret,
and generate human language
```

4.0 Text Normalization

Text normalization involves transforming text into a canonical (standard) form. It is also the process of transforming text into a more consistent, standardized format(Clark et al., 2020). This is essential for reducing lexical variation and ensuring that words are represented in a way that facilitates accurate analysis and understanding by NLP algorithms.

Text Normalization Techniques includes:

- Lowercasing: Convert all characters in the text to lowercase. This helps in standardizing and ensuring uniformity the text and treating words with different cases (e.g., "Word" and "word") as identical.
- Stemming: Removing affixes (prefixes and suffixes) from words to reduce them to their root form that is reducing words to their root form. This helps in reducing variations of words to their base form (e.g., "running" to "run").
- Lemmatization: Similar to stemming but ensuring resulting words are actual dictionary words. lemmatization ensures that the root form (lemma) is a valid word. It uses vocabulary analysis and morphological analysis to transform words (e.g., "better" to "good").
- Removing Stop words: Removing common words (e.g., "the", "and", "is") that do not contribute much to the meaning of the text. This reduces noise and improves the efficiency of NLP algorithms.
- Tokenization: Segmenting text into tokens (words or subwords) is a form of normalization that breaks down sentences into smaller units for further processing. Tokenization is therefore the process of breaking down text into smaller units called tokens(Peters et al., 2018). These tokens can be words, phrases, or even individual characters, depending on the specific task or analysis required.

4.1 Tokenization of our Sentence

1. Word-Level Tokenization: In this approach, the sentence is split into individual words.

```
Natural Language Processing (NLP) is a branch of artificial
intelligence (AI) that focuses on enabling computers to
understand, interpret, and generate human language
```

Becomes

```
Tokens: ["natural", "language", "processing", "nlp", "is",
"a", "branch", "of", "artificial", "intelligence", "ai", "that",
"focuses", "on", "enabling", "computers", "to", "understand",
",", "interpret", "," , "and", "generate", "human",
"language", "."]
```

2. Sentence-Level Tokenization: Alternatively, the sentence can be tokenized into sentences. However, for simplicity, we focus on word-level tokenization in this example

> Natural Language Processing (NLP) is a branch of artificial intelligence (AI) that focuses on enabling computers to understand, interpret, and generate human language

Becomes

> Tokens: ["Natural Language Processing (NLP) is a branch of artificial intelligence (AI)", "focuses on enabling computers to understand, interpret, and generate human language"]

5.0 Part-of-Speech (POS) Tagging

Part-of-Speech (POS) tagging is a fundamental task in Natural Language Processing (NLP) that involves assigning grammatical information to words in a sentence. It assigns grammatical information (such as noun, verb, adjective, etc.) to each word in a sentence(Devlin et al., 2019). This information includes identifying the part of speech (such as noun, verb, adjective, etc.) and other grammatical categories like tense, number, case, etc. POS tagging plays a crucial role in many downstream NLP tasks such as syntactic parsing, named entity recognition, and machine translation. POS tagging is a foundational component of NLP that enhances our ability to analyze and understand text more deeply. Advances in machine learning and deep learning continue to improve the accuracy and efficiency of POS tagging systems, contributing to broader advancements in natural language understanding and processing.

5.1 Purpose of POS Tagging

1. Grammatical Analysis: POS tagging helps in understanding the syntactic structure of sentences by categorizing words according to their syntactic roles.
2. Disambiguation: Many words in natural language can have multiple meanings depending on their context. POS tagging helps disambiguate these meanings by considering the surrounding words.
3. Feature Engineering: POS tags serve as useful features for various NLP applications such as text classification, information retrieval, and sentiment analysis.

5.2 Techniques and Approaches POS

1. Rule-based Tagging: This approach uses handcrafted rules based on linguistic principles and patterns to assign POS tags (Strubell et al, 2019). For example, a rule might state that words ending in "-ed" are likely past tense verbs.
2. Stochastic Tagging: Also known as probabilistic tagging, this approach uses statistical models to assign POS tags based on the probability of a word having a particular tag given its context(Yang et al., 2019). Hidden Markov Models (HMMs) and Conditional Random Fields (CRFs) are commonly used for stochastic tagging.
3. Deep Learning Approaches: Recent advances in deep learning have led to the development of neural network-based POS tagging models, which learn representations of words and contexts to predict POS tags(Wang et al., 2019). Examples include bidirectional Long Short-Term Memory networks (BiLSTMs) and Transformer models.

5.3 Process of POS Tagging

1. Tokenization: The sentence is first tokenized into individual words or tokens.
2. Feature Extraction: Features such as word identity, suffixes, prefixes, and context (surrounding words) are extracted to aid in POS tagging.
3. Tagging Process: Using a trained POS tagging model or rules, each word in the sentence is assigned a POS tag from a predefined tagset (e.g., noun, verb, adjective, etc.).

5.4 An Example of POS Tagging

Consider the sentence:

```
"She sells seashells by the seashore."
```

After tokenization, the words are:

```
["She", "sells", "seashells", "by", "the",
"seashore", "."]
```

The POS tagging might result in:

- She (PRON): pronoun
- sells (VERB): verb
- seashells (NOUN): noun
- by (ADP): adposition (preposition or postposition)
- the (DET): determiner
- seashore (NOUN): noun
- . (PUNCT): punctuation mark

5.5 Applications of POS Tagging

1. Syntactic Parsing: POS tags are used as input features for parsing algorithms to analyze the grammatical structure of sentences.
2. Named Entity Recognition (NER): POS tags help identify potential named entities (e.g., proper nouns) within text.
3. Machine Translation: POS tags aid in generating accurate translations by preserving syntactic structure.
4. Information Retrieval: POS tags can be used to improve search queries and retrieve relevant information more effectively.

5.6 Challenges in POS Tagging

1. Ambiguity: Some words can have multiple possible POS tags depending on context.
2. Out-of-Vocabulary Words: POS tagging models may struggle with words not seen during training.
3. Language-specific Challenges: Different languages have different POS tagsets and grammatical rules, requiring language-specific models and resources.

6.0 Named Entity Recognition (NER)

Named Entity Recognition (NER) is a crucial task in Natural Language Processing (NLP) that involves identifying and classifying named entities (such as names of persons, organizations, locations, dates, etc.) within a body of text. NER plays a significant role in extracting structured information from unstructured text data, enabling applications ranging from information retrieval to question answering systems (Ruder, & Howard , 2018)

NER helps in extracting specific entities from text, which can be further analyzed or used for downstream tasks. It links extracted entities to a knowledge base or database, providing additional context or information. It Improves Search and Retrieval that is NER enhances search engine capabilities by enabling precise retrieval of documents or information related to specific entities. Named Entity Recognition continues to be a critical area of research and development in NLP, with ongoing efforts to improve accuracy, handle ambiguity, and adapt to diverse languages and domains. Advances in deep learning, especially with transformer models like BERT and GPT, have significantly boosted NER performance, enabling more accurate and efficient extraction of named entities from text data(Liu et al., 2019).

6.1 Techniques and Approaches

NER can be approached using different techniques, including:

1. Rule-based Approaches: These rely on handcrafted rules and patterns to identify named entities based on linguistic and contextual clues.
2. Statistical and Machine Learning Approaches: These involve training models on annotated datasets where each word in a sentence is labeled with its entity type. Common algorithms include Conditional Random Fields (CRFs), Support Vector Machines (SVMs), and deep learning models like Recurrent Neural Networks (RNNs) or Transformer-based architectures.

6.2 Process of Named Entity Recognition

1. Tokenization: Like many NLP tasks, the first step is to tokenize the text into individual words or tokens.
2. Part-of-Speech (POS) Tagging: POS tags are assigned to each token, which helps in identifying potential named entities (e.g., proper nouns).
3. Feature Extraction: Features such as word embeddings, POS tags, and context windows around words are extracted to train NER models.
4. Named Entity Classification: Using annotated data, machine learning models learn to classify each token into predefined categories (e.g., PERSON, ORGANIZATION, LOCATION).

6.3 An Example of Named Entity Recognition

Consider the following sentence:

"Elon Musk is the CEO of SpaceX, which is headquartered in Hawthorne, California. SpaceX was founded in 2002."

After tokenization and POS tagging, the sentence might look like this:

Tokens

```
["Elon", "Musk", "is", "the", "CEO", "of", "SpaceX", ",", "which", "is",
"headquartered", "in", "Hawthorne", ",", "California", ".", "SpaceX",
```

POS Tags:

```
["PROPN", "PROPN", "VERB", "DET", "NOUN", "ADP", "PROPN",
"PUNCT", "DET", "VERB", "VERB", "ADP", "PROPN", "PUNCT", "PROPN",
"PUNCT", "PROPN", "VERB", "VERB", "ADP", "NUM", "PUNCT"]
```

Named Entity Recognition Output:

Using a trained NER model, the entities in the sentence can be recognized and classified:

- PERSON: "Elon Musk"
- ORGANIZATION: "SpaceX"
- LOCATION: "Hawthorne, California"
- DATE: "2002"

6.4 Applications of Named Entity Recognition

1. Information Retrieval: Enhances search engines by enabling precise retrieval of documents or information related to specific entities.
2. Question Answering Systems: Helps in extracting answers from text by identifying relevant named entities mentioned in questions.
3. Document Summarization: Entities can be used as key information for summarizing documents or articles.

6.5 Challenges in Named Entity Recognition

1. Ambiguity: Some entities can have multiple possible categories or meanings depending on context.
2. Variability: Named entities can vary widely in terms of formatting (e.g., different spellings or abbreviations).
3. Named Entity Types: Different languages and domains may have different types of named entities, requiring adaptation and customization of NER models.

7.0 Word Embeddings

Word embeddings are a type of word representation that allows words with similar meanings to have a similar representation. Techniques like Word2Vec, GloVe, and FastText are commonly used to generate word embeddings, which are crucial for many NLP tasks, including semantic similarity and information retrieval (Vaswani et al., 2017). Word embeddings in Natural Language Processing (NLP) allows words to be represented as dense vectors of real numbers. These vectors capture semantic relationships between words based on their usage in context. Word embeddings have revolutionized how words are represented and processed in NLP tasks such as language modeling, sentiment analysis, and machine translation.

7.1 Purpose of Word Embeddings

Word embeddings address several challenges with traditional approaches to word representation, such as one-hot encoding or sparse representations:

1. Semantic Similarity: Words with similar meanings are represented by vectors that are closer together in the embedding space.
2. Contextual Meaning: Word embeddings capture nuances in meaning based on how words are used in different contexts.
3. Efficiency: Dense vector representations are computationally efficient compared to sparse representations like one-hot encoding.

7.2 Techniques for Word Embeddings

1. Word2Vec is a popular technique for learning word embeddings introduced by Mikolov et al. It uses a shallow neural network to predict words in context (Skip-gram model) or predict context words given a target word (Continuous Bag of Words, CBOW model).
2. GloVe (Global Vectors for Word Representation) is another popular method that learns word embeddings by factorizing the word co-occurrence matrix. It focuses on capturing global word-word co-occurrence statistics.
3. FastText: FastText extends Word2Vec by considering subword information. It represents each word as a bag of character n-grams, allowing it to handle out-of-vocabulary words and morphologically rich languages better.
4. BERT (Bidirectional Encoder Representations from Transformers):is a transformer-based model that uses masked language modeling to learn bidirectional representations of words and sentences. While BERT primarily learns contextual embeddings, its output can also be used as static word embeddings.

7.3 An Example of Word Embedding's using Word2Vec

Step 1: Training Word2Vec Model

Assume we have a corpus of text data containing various sentences. We tokenize and preprocess this text (remove stopwords, punctuation, etc.) and then train a Word2Vec model on this corpus.

- sentences =

```
[["apple", "is", "a", "fruit"], ["banana", "is", "also", "a",
"fruit"], ["dog", "is", "an", "animal"]]
```

- model =

```
Word2Vec(sentences, vector_size=100, window=5,
min_count=1, sg=1)
```

- vector_size: Dimensionality of the word vectors (e.g., 100).
- Window: Maximum distance between the current and predicted word within a sentence.
- min_count: Ignores all words with a total frequency lower than this.
- sg: Training algorithm: 1 for skip-gram; 0 for CBOW.

Step 2: Using Word Embeddings

After training, we can obtain word embeddings for specific words and explore their semantic relationships:

```
vector = model.wv['fruit']   Get embedding for the word 'fruit'

similar_words = model.wv.most_similar('fruit')   Find words similar to 'fruit'

print("Embedding for 'fruit':", vector)

print("Words similar to 'fruit':", similar_words)
```

Output:

```
Embedding for 'fruit': [0.123, -0.456, ..., 0.789]

Words similar to 'fruit': [('apple', 0.85), ('banana', 0.82), ('animal', 0.76), ('dog', 0.72)]
```

7.5 Applications of Word Embeddings

1. Semantic Similarity: Determine similarity between words based on their vector representations.
2. Named Entity Recognition (NER): Improve entity recognition by leveraging contextual embeddings.
3. Sentiment Analysis: Analyze sentiments by considering semantic meaning captured in embeddings. For instance a sentiment analysis application that processes customer reviews. Tokenization would be used to break down each review into tokens (words or phrases), allowing the system to analyze the sentiment expressed by individual words or combinations of words. This analysis helps businesses understand customer feedback more effectively, identify trends, and make data-driven decisions to improve products or services
4. Machine Translation: Improve translation quality by preserving semantic context of words.

7.6 Challenges in Word Embeddings

1. Ambiguity: Words with multiple meanings may have embeddings that blend these meanings, leading to ambiguity.
2. Domain-specificity: Word embeddings trained on general corpora may not capture domain-specific nuances effectively.
3. Out-of-vocabulary Words: Handling words not seen during training requires special techniques like subword embeddings (FastText).

8.0 Conclusion

The advancements in Natural Language Processing have not only expanded the capabilities of machines to understand and process human language but have also paved the way for transformative applications across industries. From enhancing communication and information access to revolutionizing healthcare and legal sectors, NLP continues to drive innovation and efficiency. As research and development in NLP progress, addressing challenges like ethical considerations and improving model interpretability will be crucial for its responsible and beneficial integration into various aspects of society and industry.

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN INFORMATION SHARING IN BUSINESS AND MODERN OFFICE

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Abstract

The rapid advancement of technology has brought about the integration of Artificial Intelligence (AI) into various aspects of workplace. AI is revolutionizing modern office, industries, and transforming the way tasks are performed, leading to both opportunities and challenges for organizations and employees. In the age of globalization, offices are increasingly recognizing the importance of *information sharing* for competitive advantages. The *knowledge sharing* landscape in offices has witnessed a revolutionary change with the advent of Artificial Intelligence (AI). This technology is becoming indispensable for offices and industries that aim to make their *knowledge sharing* more efficient and impactful. This paper delved into the role of AI in the workplace, exploring its challenges poses as well as the opportunities it creates in sharing information. The paper examined the advancements in AI technology, discuss the potential information sharing in office industries and possibilities of job displacement and the new job roles/skills demanded by AI.

Keyword: Artificial Intelligence; Information Sharing in Business and Modern Office

Introduction

The foundation of information sharing lies in the efficient capturing and storing of data. Before the advent of computer information has often be stored manually by input and categorization, which is normally time-consuming and prone to errors. AI algorithms excel automatically capture data from diverse source like emails, social media interactions, customer reviews, and more. One of the most promising aspects of AI on information *sharing* is Generative AI. Unlike other types of AI that are designed to classify or analyze data, Generative AI aims to create data that resembles the data it was trained on. This technology has shown it prowess in various domains, from creating realistic images and videos to generating human-like text. Imagine having an AI tool that can not only curate articles but also generate new content based on existing data. Generative AI algorithms can analyze organization's existing information base, identify gaps or areas for improvement, and then generate new articles (Ajay 2023). Generative AI can also help in maintaining the quality and relevance of information and then update it or flag it for manual review. AI cannot only generate new articles based on existing content, it also allows for a high degree of customization. Organizations can feed specific guidelines or focus areas into the system, ensuring that the generated content aligns with the information goals. By employing AI, companies can make their information sharing systems more dynamic and adaptive. It allows for a more organic and real-time information aligning it with the ever-changing needs of the organization and its employees. Sharing data can help to gather a significant amount of data to train robust and highly predictive AI models, which could have a profound impact in workplace, such as decision-making processes (Mikalef and Gupta, 2021). The exchange of information can occur either internally, that is, within a single organization, or externally among multiple organizations numerous factors come into play when organizations consider sharing their data with external parties, which include revenues and quality of customers. Nevertheless, sharing data, entails considerable challenges from a privacy standpoint and necessitates compliance with regulatory frameworks.

The Evolution of Artificial Intelligence

Artificial intelligence began with the development of computer. The idea to create a thinking machine had existed for several years before, the breakthrough of AI with the creation of the first digital computers in the 1940s. However, with the development of the microprocessor in 1970, it became progressively possible to have the computer in smaller sizes as is presented in laptops, mobile phones (palmtops), smart watches and quantum computers. AI development was further heightened with the development of the internet in 1990. Today, approximately 70% of the world population uses online for one business or the other

Technology is changing our world at an astonishing pace! Its sweeping changes can be found everywhere and they can be found everywhere and they can be described as both thrilling, and at the same time terrifying (Bughin, J., Hazan, E. Ramaswamy S., Chui, M., Allas, T., Dahlstrong, P. et al, 2017). Although people in many parts of the world are still trying to come to terms with earlier technological revolutions along with their sweeping social and educational implications – which are still unfolding, they have been awoken to the reality of yet another digital revolution – the AI revolution (Alansari, M., 2020)

Artificial intelligence (AI) technology refers to the ability of a digital computer or computer-controlled robot to perform tasks that would otherwise have been carried out by humans. AI systems are designed to have the intellectual process that characterize humans, such as the ability to reason, discover meaning, generate, or learn from past experience. With AI technology, vast amounts of information and text can be processed for beyond any human capability. AI can also be used to produce a vast variety of new content (Chaudhary, A., Islam, T., Ali, H. F., Jamil, S., 2021)

To get any information, connection and news among other things, the first point of call is the internet. In fact, there are many people who do not remember a time before search engines were available. From its development in 1998, Google has become the household name for research in information gathering because it is fast, simple to use and has the propensity to generate quality result in terms of relevance and decency. Google has integrated AI into its software, and has voice searches, picture searches and has greatly reduced manual efforts needed to obtain information. Technically, if one owing a computer device, he/she have all the information you need in the world, even without the need for formal education. All an individual need is time and data to access them. Clearly, this new device could lead to a world that may deemphasize formal education.

Artificial Intelligence in information sharing and Modern Office

The use of Artificial Intelligence in information sharing in business and modern office has transcended the use as office assistance. With the rapid development of science and technology, artificial intelligence technology has been infiltrated in all walks of life. Therefore, the concept of AI capability is put forward, which refers to the ability of a firm to select, orchestrate, and leverage its AI-specific resources. Artificial intelligence (AI) is the modeling of AI functions by computers, particularly computer systems. Expert systems, NLP, voice recognition, and machine vision are some specific uses of AI. Due to the immense potential that this technology has for information sharing in businesses and modern office, there has been a recent explosion in AI-led initiatives. These initiative ranges from developing proactive customer services solutions like chatbots or predictive analytics for better decision-making, to the most recent revolution – the ChatGPT.

"AI is revolutionizing the everyday processes in information sharing in business and modern organization and offices and changing the very core of how information flow and how business is done in modern office, education, retail, healthcare, and manufacturing, enabling real-real time collaboration and enhancing the efficiency of information distribution. Business adopting AI-driven tools for information management can increase productivity particularly if manager can focuses on transforming their business through innovative technologies. Business utilizing AI can automated routine knowledge through the information sharing processing, resulting to low time spent on administrative tasks giving office managers room to focus on high-impact activities and encouraging a culture of innovation in modern office. Decisions which used to take months because of manual processing and data inputs are now being carried out in a few minutes as the machines can measure, identify patterns, create data models, categorize the requirements, and indicate the risks with phenomenal accuracy and precision (Bughin et al., 2017). Additionally, AI can interpret large amounts of data across the business organization, allowing targeted interventions that can improve competence and align skills with organization objectives. By bridging these strong tools, organizations not only improve their internal and external information-sharing frameworks but also drive overall business success in a competitive environment.

In today's fast-paced business environment, the integration of Artificial Intelligence (AI) has emerged as a transformative catalyst for enhancing collaborative and information sharing within business organizations. McKinsely (2023) reported that business that have adopted AI-driven can increase in team productivity and engagement. As AI technologies evolve, their potential to revolutionize knowledge is becoming increasingly evident. Business organizations using AI can power information management systems that can lead to reduction in time spent searching for information, permitting office workers to focus on higher-value tasks. AI has emerged as a transformative force in enhancing communication and streamlines information flow. Company that implement AI-enhanced communication tools experience increase in productivity, primarily due to improved information sharing and reduced miscommunication. By leveraging AI to automate mundane tasks, workers can unlock their potential, enabling them to focus on strategic thinking and innovation. AI-driven automation not only enhances workers productivity but also elevates their overall experience, creating a virtuous cycle that propels business growth. As businesses embrace these transformative technologies, they lay the groundwork for sustainable innovation, ensuring they remain resilient in competitive market while benefiting from the collective intellect of their workforce.

Benefits of Information Sharing in Modern Office

In specific circumstances, collaborative efforts and sharing information can be advantageous companies, even when they are competing companies. The practice of collaborating with competitors,

known as co-petition, is especially helpful for firms seeking to innovate as they allow for pooling resources to reach a goal that an individual firm may not be able to reach on its own. However, it is important to acknowledge that the benefits of collaboration may be imbalanced among all parties involved. It is therefore desirable to produce a mechanism to encourage offices and companies to participate in collaborative information analyses, while ensuring a fair balance of input and benefits among all workers. From an economic perspective, data sharing directly impacts the efficiency and effectiveness of technology. AI helps to access a significant amount of high-quality information capable of making accurate predictions. This, in turn, leads to better decision-making and ultimately to an overall improvement in the economic performance of the company, collecting diverse data can be costly, especially if it involves acquiring additional resources and dedicating more time to the process. Therefore, it is important to weigh the benefits of using a particular data set against the costs of collecting and using it. The weighing can help to ensure that data are used in cost-effective and efficient manner. Many businesses invest a considerable amount of time and financial resources into acquiring, managing, and analyzing data which then could be used for further tasks such as training AI models. If several organizations cooperate with each other to develop better AI models, then it is reasonable that those that provide more resource toward the collaboration receive relatively better models than their counterparts.

AI Technology

Machine Learning and Deep Learning: Machine learning is a subset of AI that enables computers to learn and improve from experience without being explicitly programmed. Deep learning, on the other hand, is a more advanced form of machine learning that utilizes neural networks to process and understand complex data. These advancements have paved the way for AI applications such as predictive analytics, image recognition, and voice assistants.

Natural Language Processing: Natural Language processing (NLP) enables computers to understand and interpret human language. This technology has led to the development of virtual assistants like Siri and Alexa, which can understand voice commands and carry out tasks based on natural language inputs. NLP has also improved customer service through chatbots that provide instant and personalized support.

Computer Vision: Computer vision allows machines to analyse and understand visual information from images and videos. This technology enables AI-powered systems to recognize objects, detect anomalies, and even perform tasks like facial recognition. Computer vision has found applications in areas like autonomous vehicles, surveillance, and quality control in manufacturing. However, it is important to note that AI also creates new job opportunities and can augment human capabilities.

Challenges of AI in the Workplace

Challenges to AI adoption in the workplace in Nigeria, including unreliable electricity, limited internet access, and inadequate digital infrastructure, power outages remains a significant constraint, over reliance on foreign technology providers could pose risk related to data privacy and governance.

Job Displacement and Automation: One of the concerns surrounding AI in the workplace is the potential displacement of workers. As AI becomes more capable of performing repetitive and routine tasks, there is a risk of job automation using robots, particularly in industries such as manufacturing, transportation, and customer service. A number of studies have argued that AI and robots will take over 50 per cent of human jobs in the next 30 years. This is due to the exponential advancements in robotics, quantum computing and AI.

Privacy and Data Security Risks: AI relies on data to function effectively, therefore it raises concerns about the privacy and security of personal information. Modern offices must take precautions to ensure proper data sharing among workers and clients, ethical use of AI, and safeguard against data misuse. It is also critical that business know what they are getting into when embracing AI. That means doing comprehensive background research and ensuring that they choose tools that meet their needs and adhere to privacy best practices. To mitigate these concerns, establish ethical guidelines for generative AI use within organization. Promote transparency by clearly indicating when content is generated by AI. Striking a balance between data utilization and protection is important in the AI-driven workplace.

Advantages of AI in the Workplace

AI Increased Efficiency and Productivity: AI technology can streamline workflows by automating repetitive tasks, and resource allocation which will lead to increase operational efficiency and productivity. By harnessing the power of AI, businesses can supercharge productivity, agility, and customer experience, with AI leaders outperforming their peers by a remarkable 3.4 times, according to McKinsey.

New Job Roles and Skill Development: While AI may replace some job functions, it also creates new job roles that require human interaction and problem-solving skills. As AI technology advances, there will be a demand for individuals who can develop and manage the systems as well as up skilling to adapt to the evolving workplace. As AI transforms the business landscape, companies that embrace this technology are experiencing unprecedented growth, innovation, and efficiency.

Enhanced Decision-Making and Innovation: AI can analyse vast amounts of information, identify patterns and provide offices with insights for decision-making. AI-powered tools can help by generating new ideas, predicting market trends, and improving product development. The combination of human creativity and AI capabilities can lead to significant advancements across various offices. AI's application are diverse, including personalized customer interactions, fraud detection, and 24/7 support through chatbots, showcasing its potential to transform business operations and drive success.

By leveraging AI-powered predictive analytics, businesses can make data-driven decisions. Moreover, automating routine tasks with AI frees up resources, enabling organizations to focus on strategic initiatives.

Strategies for Adapting AI in the Workplace

Preparing for the future of work means being proactive in acquiring new skills and knowledge, workers should embrace lifelong learning and stay updated with the latest trends and developments in their field. They should start thinking about how to implement policies that can sustain such advancement. This ensures that they remain adaptable and can harness the benefits of AI to enhance their work.

Organizations must play a crucial role in fostering a culture of lifelong learning, by providing training and development opportunities for workers and creating a supportive environment for continuous learning. Conferences and workshops programmes as well as mentorship initiatives can further facilitate the integration of AI in the workplace.

In conclusion, the integration of Artificial Intelligence in the workplace brings about a multitude of opportunities and challenges. While AI technology enables increased efficiency in information and innovation, it also poses challenges such as job displacement. Organizations must focus on reskilling their workforce to adapt to the changing nature of work using AI to foster a culture of lifelong learning in modern office workflows and collaborating effectively between humans and AI. Office worker can navigate the future of work with AI and utilize its potential to create a more sustainable and prosperous workplace.

Conclusion

In addressing challenges that have hindered business organizations' economic progress for decades, business organizations stand to benefit billions economic boast powered by artificial intelligence.

AI has the potential to generate billion in productivity gains, cost savings, time savings, and increased revenues for organization. AI is poised to gain billion in productivity, cost savings, time savings, and increased revenues across business organization due to its proactive AI strategy.

Business organization population and growing workforce present a unique opportunity and with the right investments in digital infrastructure and skills, business organization can position itself as a global in AI. Business organization should act swiftly to close the digital divide and harness AI for sustainable development because business organization cannot afford to be left behind.

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ETHICAL STANDARD IN SECRETARIAL PROFESSION IN THE ERA OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

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ABSTRACT

The secretarial profession has come of age and secretaries have been described as the alter ego (other self) of their bosses. This is so because secretaries can think, speak and act for their bosses. Bosses place a high premium on the secretaries and leave the details of their daily routine to secretaries to perfect. This therefore requires that the boss will need good and reliable persons as secretaries, trusted and well-groomed personalities to be relied on. In this era of information and communication technology when every business transaction is carried out instantly and at a jet speed, any attempt to have a secretary who is fraudulent, greedy and unreliable as a confident can ruin the boss and his business. This paper examined the role of ethical standard in the secretarial profession, the duties of secretaries and the impact of technology on the secretarial profession. The paper concluded that ethical standard should be emphasized in secretarial training. It recommends amongst others that proper scrutiny of students who want to engage in the secretarial profession.

Key Words: Secretary, Ethics, Information and Communication Technology.

Introduction

Secretaries or administrative assistants are hired to relive their employers of a great deal of work, especially the details of office procedure and other matters that do not require the employer's personal involvement. They act as a liaison between their boss and the rest of the organization. Sometimes, they act as a buffer. Depending on the size of the organization, they also be called on to perform tasks normally outside the secretarial role in sales, banking, billing, payroll, accounting, advertizing etc. Everything they do for their employer must duplicate as closely as possible that the employer would have done, if not absorbed in work at couldn't be delegated. While every business person dreams of having the perfect secretary or administrative assistant, every secretary or administrative assistant dreams of having the perfect boss. Hopefully, they will become so well adjusted to each other to carry part of the load in harmony (Stroman, Wilson and Wauson 2019).

As a result of the unique position secretaries occupy in an organization, it is important that they put up good ethical behavior. According to Hill (2020), ethical people are those who recognize the difference between right and wrong and consistently to set an example of good conduct. In a business setting, being ethical means applying principles of honesty and fairness to relationship with co-workers and customers. Ethical individuals make an effort to treat everyone with whom they come in contact as

they would want to be treated themselves. Hill (2020) further observed that consumers may let a company take advantage of them once, but if they believe they have been treated unfairly, such as being overcharged, they will not be repeat customers. Having a loyal customer base is one of the keys to long-rage business success because servicing an existing customer doesn't involve marketing cost, as does acquiring a new one. A company's reputation for ethical behavior can help it create a more positive image in the market place, which can bring in new customers, particularly in this age of social networking when dissatisfied customers can quickly disseminate information about the negative experience they had.

As noted by Onikute (2021), the world in the 21st century has witnessed a great change in the dimension of office functions as a result of information and Communication Technology (ICT). She observed that in the past, secretarial functions were to take dictations, type letters and memos with manual typewriter and dispatch them through the recording on dispatch book by a clerk and then taken to offices of the recipients within the organization. The practice incurred cost of purchasing of materials, hiring employees and procuring machines to effectively carry out these functions. She emphasized that the practice had caused misplacement, delay and even loss of documents due to fatigue and boredom of repetition.

According to Nna (2019), today's world is characterized by technological dynamism, which has permeated every facet of our lives. The office is not left out in these innovations sees everywhere around us. There is a complete change in the work process. Every activity in today office has a touch of the technological "wind fire" that has turn almost everything around.

The Concept of Ethics

Taylor (2018) cited in Ferrell fraedrich and Ferrell (2021) defined ethics as inquiry into the nature and grounds of morality where the term morality is take to mean moral judgment, standard and rules of conduct. It has also been called the study and philosophy of human conduct, with emphasis in determining right and wrong. The America heritage dictionary defined ethics as the study of the general nature of moral and specific moral choice, moral philosophy and the rules or standards governing the conduct of the member of a profession. According to okoduwa and onoyovwi (2013), ethics is synonymous with morality. It is prevalent in all profession as it guides, regulate, direct, modified and controls the actions and inactions of people at work in work place. McNamara (2021) observed that a person who knows difference between write and wrong and chooses right is moral. A moral person whose morality is reflected in his willingness to do the right thing – even if it is hard or dangerous is ethical. He noted that ethics are moral values in action.

Gracyk (2019) identified four principles of ethics:

a) The principle of Respect for Autonomy: An obligation to respect the decision made by other people concerning their own lives. This is also called the principle of human dignity. It gives us negative duty not to interfere with the decisions of competent adults, and a positive duty t empower others for whom we are responsible. It has to do with honesty in our dealings with others and obligation to keep promises.
b) The principle of Beneficence: An obligation to bring about good in all our actions. Taking positive steps to prevent harm to others.
c) The principle of Nonmaleficence: An obligation not increase risk or harm to others. It is wrong to waste resources that could be used for good.
d) The principle of justice: An obligation to provide others with whatever they are or deserve. In public life, we have an obligation to treat all people equally, fairly and impartially.

According to Oster (2016), one of the most fundamental business ethical issues is trust between a company and its customers. In the complex, global business environment of the 21st century, companies of very size face a multitude of ethical issues. Business has the responsibility to develop codes of conduct and ethics that every member of the organization must abide by and put into action. Fundamental ethical issues include concepts such as dignity and trust, but more complex issues include accommodating diversity, decision making, compliance and governance.

The Secretary and Office Professional Ethics

According to Ana Carolina (2019), the ethics of a secretary are moral principles relating to the job that you will be bound by. These requirements are automatically taken on board when you accept any position as a secretary and you will be expected to uphold them at all times. She highlighted the following as secretarial professional ethics:

1) Confidentiality: - Always keep information private and confidential about the firm you work for and its clients. Never repeat sensitive information even if you are in a discussion where everyone is wondering what is happening an you know. Always be trusted.
2) Honesty. – Do not take the credit for something you did not do and do not let someone else enjoy the credit for something you did. Always tell the truth. Be more credible with your boss and fellow workers.
3) Loyalty.- Always be loyal to your boss and company. Never sell them out at any cost. If you display your loyalty you will receive same in return.

4) Reliability.- Show that you are reliable. Be punctual for work and meetings at all times and remember, always take the relevant documentation with you to the meetings. Ensure every task you are given is completed on time and to the best of your ability.
5) Responsible:- Prove you are responsible by setting priorities and carrying out tasks in a timely manner. Always meet deadlines when they are given.
6) Work Unsupervised:- Always keep your work up-to-date and be productive. Meet deadlines, priorities and priorities.
7) Be Co-operative:- Always assist and share your expertise with your colleagues whenever it is possible. Always be happy to carry out duties asked of you but also know when to say "No"
8) Be Flexible:- Do not hold tenaciously to closing time. If at 4 .m. and your boss needs an important mail typed and faxed, immediately do it .
9) Multi-Skilling:- Learn as much as possible about computer programmers and other positions in the organization.
10) Bribery:- Never be tempted to accept gifts or favors from internal or external clients. Always follow your company's procedures and policies.

The Principles of Information Technology

As observed by seen (2021), the most effective way to learn a subject is to master the basic facts of that subject and to understand the principle underlying those facts. He defined a principle as a fundamental rule, guideline or motivation idea that, when applied to a situation, produces a desirable result. Focusing on principles rather than on a particular situation or set of facts prepares you to deal with a variety of problems and opportunities.

Senn (2020) noted that the first principle of information technology describe the purpose of information technology. Information technology's great usefulness is an aid to solving problems, unlocking creativity, and making people more effective than they would be if they did not apply information technology to their activities.

They second principle to the effective application of information technology according to seen (2020) is the principle of high-touch/high-touch. The more "high-tech" the information you are considering the more important it is to consider the "high-touch" aspects of the matter – that is, "the people side". Always fit information to [people rather than asking people to adjust to information technology.

The Secretary and Information and Communication Technology (ICT)

Information and Communication Technology (ICT) is concerned with the aspect of managing and processing information through the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information. It is the receiving, handling and processing of information through electronic and communication gadgets like computers, camera, telephone, etc.

When ICT is used in offices, they typically introduce the use of computer processing to automate routine tasks that workers had previously performed manually. The ways of conducting business did not really change; they just speeded up. Office workers who will practice good ethics, organized, show dedication to their jobs and look at every detail of any transactions are therefore needed. If the activities of a business were in a mess as a result of disorganization or faulty procedures, automation will accomplish nothing more then speeding up the mess (senn, 2018).

As observed by Onikute (2019), ICT has changed the working abilities of office manager and technologist. ICT has replaced shorthand writing and transcription, note filing of documents in jackets and office communication through notes, letters, memos, messengers etc. The traditional writing of shorthand with paper and pencil has been replaced with modern ICT equipment such as digital recording and webcam for recording voices and video of the speakers. Transcribing using manual typewriter for has been replaced with computers which can process mail at a great speed, editing, proofreading, different choice type fonts and production of as many original copies of a document as possible.

Filling has also been simplified by ICT. The use of file cabinets, jackets and tags are now replaced by computer Hard disks, CD-ROMs, flash drives that can store thousands of documents as possible. They can be stored and used over and over again with ease.

Communication is simplified through the use of GSM, E-mail, telephones, text messages etc. Messages are delivered instantly and feedback is immediate. In the conduct of corporate executive meetings, the traditional method of arranging venue and inviting participants from far and near, booking hotel accommodations, travelling expenses from one country to another have been replaced with video-conferencing where all the facilities to capture speech and photographs are installed in participants offices and meetings are held with different participants in their various offices in different locations.

Conclusion

Information and Communication Technology is changing the way we work, the way we live, and the way we play. We are in the midst of a revolution –a digital revolution. There is no limit to the imaginative ways ICT can help in day-to-day activities, whether personal or business related. It all begins with the creation of innovative ideas. The same ICT that offers tremendous advantages can be

misused, either through carelessness or through outright underhandedness. Even though companies are able to move information electronically at lightning speed, some still respond to customer information request at a snail- like pace. Then there are electronic interlopers who eavesdrop on private conversation and snoop into sensitive records.

The role of the secretary in the era of ICT cannot be understand. In addition to efficiency and accuracy in service delivery, ICT can easily create room for fraudulent activities. This why ethical people who recognize the different between right and wrong and consistently strive to set an example of good conduct should assume secretarial position. also as the first point of contact in a organization the secretary has a lot to do in creating a good impression of the organization in the minds of visitors. People must use the ICT facilities in a good manner so that it can positively contribute to organization success.

Suggestions for Way Forward

From the conclusion above, the following recommendations have been made:

- Admission of student for training in the secretarial professions should b by choice. A situation where people change course and study secretarial courses as a last resort should be discouraged. Only those who are prepared for the profession ab initio should be encouraged into it.
- The speed of ICT usage is also the same speed at which fraud can be committed using ICT. Since creating innovations also include the responsibility to provide safeguards against their unintended, hurtful uses, people considered for secretarial positions must have notable people in the society as referees who they may not want to disgrace.
- Ethics and morals should be built into the curriculum and given prompt attention.
- Bosses should not "over-expose" their business to secretaries due to laziness.

There should be some reservations and bosses should adequately monitor the activities for their secretaries for the purpose of check and balance.

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THE IMPACT OF TECHNOLOGY ON NIGERIA: CHALLENGES AND PROSPECTS

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Abstract

Technology is the core of the foundation of society. The change in technological innovation within the social structure leads to changes in social organization or value systems altering or modifying social institutions and societies from time to time. It prompts developmental policies accounting for the transformation of society from one phase of development to another. So, technology changes the way of society either positively or negatively. This paper examines the Impact of Technology on Nigeria: Challenges and Prospects. As Nigeria continues to evolve in the digital age, the adoption of technology in communication, agriculture, education, health and governance has significantly influenced her structures and daily life. This paper adopts secondary source of data collection. Drawing from historical developments and current trends, the paper highlights the transformative role of technology in driving the nation development. It also discusses the negative social implications of rapid technological changes such as job displacement, cybercrime, and ethical concerns. The paper concludes that technological advancements have civilized society by enhancing connectivity, healthcare, and economic growth, while also posing risks like job displacement and cybersecurity challenges that require responsible governance, digital literacy, and inclusive policies which Nigeria must key in to avoid economic delay. This paper recommends amongst others, that government should take quick initiative to providing a framework for the advancement of technology and integrate it into the main stream of the development

strategies of the country and to take appropriate measure to mitigate the risks which new technological advancements may pose in order to sustain future development and growth.

Keywords: Technology, Impact, Challenges, Prospects

Introduction

Technology has profoundly transformed society in numerous ways. Its rapid advancement has brought about significant changes that affect our daily lives, social structures, and global interactions.

The level of a country's involvement in the adaptation of technological innovations decides its competitiveness globally and informs the vibrant socio-economic growth and development of the country. Thus, human and national sustainable developments are determined largely by the level of indigenous technological research capacity, which should be brought to bear on policy making and implementation and any country without these ideals will undoubtedly remain underdeveloped for a long time to come (Adeniyi, 1999).

Modern society has become completely dependent on technology, which has completely changed social interactions, work habits, and cultural standards. In the contemporary world, digital technologies such as artificial intelligence, blockchain, and biotechnology continue to reshape economies, governance, and interpersonal relationships. Additionally, global interconnectedness through the internet and social media has transformed communication, political activism, and cultural exchange in modern society (Shirky, 2008).

Like in many other nations, Nigeria has seen a dramatic shift in the way people live, work, and interact with one another as a result of technology breakthroughs. As a follow up, Oyelaran, Oyeyinka and Lal (2019) contend that, Nigeria is witnessing increase in technology-driven entrepreneurship, with companies using digital platforms to provide inventive solutions and generate job chances. Thus, the country creative ability and advanced technological innovations have put her on a sound technological fronting almost like the other technologically developed countries of the world. However, all societal segments are not equally affected by technology's economic effects. Issues such as digital divide, privacy concerns, and ethical considerations in artificial intelligence (AI) have become central to discussions on technology and society (Zuboff, 2019).

So, while technological advancements have significantly improved productivity, connectivity, and access to information, they have also introduced challenges such as job displacement, social fragmentation, and data privacy concerns (Zuboff, 2019). The rapid automation of industries has led to fears of unemployment and economic inequality, as traditional jobs are replaced by artificial intelligence (AI) and machine learning systems (Kenney & Zysman, 2016). Given these challenges, there is a need for a balanced approach to technology adoption, one that maximizes its benefits while mitigating its adverse effects on society.

The primary purpose of this study is to examine the impact of technology on various aspects of Nigeria such as the economy, communication, government, education, and social interaction. The paper highlights government policies on technology innovations, identifies the challenges involved in the implementation of technological innovations policy and provides recommendations that could terminate the challenges in order to enhance sustainable technological advancement cum socio-economic development of Nigeria.

Conceptual Clarification

Technology

Technology is defined as the making, modification, knowledge of tools, machines, techniques, crafts, systems, methods of organization and usage in order to solve problems, improve pre-existing solutions to problems, achieve goals or perform specific tasks. Bennett (2011) simplified it as a collective description or the advancements, abilities, creations, undertakings, views, and knowledge of a singular group of persons, the human-kind. Technology refers to the application of scientific knowledge for practical purposes, especially in industry. It encompasses the tools, systems, and methods developed to solve problems, enhance efficiency, and improve human life (Arthur, 2019). From simple tools such as the wheel to complex computer systems and artificial intelligence, technology shapes the way individuals interact with the world around them. According to Dusek (2016), technology is not only a collection of artifacts but also includes the knowledge and processes used to create and operate them.

Technology influences nearly every aspect of modern life, from communication and healthcare to education and transportation. While it has provided numerous benefits, including convenience and productivity, it also raises ethical and societal concerns such as privacy breaches, digital divide, and job displacement. As Feenberg (2010) notes, technology is not neutral—it carries the values and interests of the society that creates and uses it. Therefore, a critical approach to technology development and implementation is necessary to ensure its benefits are equitably distributed.

Impact

Impact, according to researchers and authors, refers to the measurable and observable effects that an action, policy, intervention, or phenomenon has on individuals, groups, systems, or society at large. Creswell (2014) explains impact as the observable and measurable outcomes that result from a specific intervention or program, particularly within the context of research and evaluation. Similarly, the Organisation for Economic Co-operation and Development (OECD, 2002) defines impact as the positive and negative, direct and indirect, long-term effects produced by a development intervention, whether intended or unintended. These definitions emphasize the importance of assessing the actual changes that occur as a result of specific actions or influences, rather than merely assuming or predicting outcomes. To this end the impact of technology on Nigeria is crucial for policy makers, business moguls, educators and individuals who have to maximize the benefits of technology, while addressing its negative consequences.

Challenge

A challenge is a task or situation that tests someone's abilities (Oxford English Dictionary, 2021). Challenge are obstacles or difficult situations that test an individual's or organization's skills, determination, and adaptability. Hornby (2015) defines a challenge as a new or difficult task that requires effort and ability to overcome, emphasizing its role in personal and professional development. Bandura (1997) adds that challenges are critical for building self-efficacy, as they push individuals to believe in their capacity to succeed despite adversity. Together, these perspectives highlight that while challenges may hinder progress, they also offer valuable opportunities for growth and transformation.

Prospect

Prospect is defined as the chances of being successful, especially in a job or career (Oxford Advanced Learner's Dictionary, 2015). Prospects refer to the possibility or likelihood of a future event occurring, particularly in terms of success, growth, or improvement. According to Hornby (2015), prospects are the chances of being successful, especially in a job or career, highlighting their connection to future opportunities and achievements. From a psychological standpoint, Bandura (1997) emphasizes that individuals' expectations of future outcomes—what he terms "outcome expectations"—play a central role in motivation and behavior. When people believe that favorable prospects lie ahead, they are more likely to set ambitious goals and persist in their efforts to achieve them. Thus, prospects influence both decision-making and long-term planning across personal and professional domains.

Historical Development of Technological Advancements in Nigeria

Technology has evolved from the mastery of fire by the early man in the late stone age to the production of simple iron tools such as the wheel in the metal age to complex computer systems, the electronics, nuclear weapons and artificial intelligence of this generation, which shape the way individuals and organizations interact with the world around them. To enhance her industrial development and be able to measure up with the demands of the global technological advancement, the Federal Government of Nigeria adopted an all-inclusive operational policy and the provision of a local framework to mobilize the interventions. To this end, Mashi, Inkari and Yaro (2014) stated in their study that the Federal government formulated the following technological policies in the country which include amongst others:

- Understanding the principles of construction processes, dynamics of technology and models of dissemination;
- developing intellectual processes of technology and the relations with other systems in the country;
- producing technologically literate people for the acquisition of skills such as instrumentation, production, maintenance, creativity, designing and communication; and
- producing a critical mass technopreneur that can innovate the country out of dependence on foreign technologies and services (2014).

They claimed that scientific institutions in Nigeria emerged during the colonial period around mid-1950's during which the National Research Council (NRC) was established. The main objectives of the council were amongst others: The integration of Technology under the National Economic policy; reforms of the early 1970's with emphasis on Technological innovation; the creation of institutional framework for science and technology; and the promotion of National science and Technological policy.

The formulation and implementation of the policy was reviewed by the government in 1986, 1998 and 2003 respectively, with more emphasis on 2003 in order to expedite technological innovation and fosters the nation's development. As part of the policy implementation process, the government established reform centres and institutions. The centres include amongst others:

- Industrial Research Council of Nigeria (IRCN) by Decree No 3 of 1971,
- Medical Research Council of Nigeria (MRCN) by Decree No 1 of 1972,
- Agricultural Research Centre of Nigeria (ARCN) by Decree No 25 of 1973,
- National Science Research Council of Nigeria (NSRCN) by Decree No 9 of 1973, etc (Kaduna and Eseduwo, 2020).

The research institutions include amongst others:

- Federal Institute of Industrial Research Oshodi (FIRO), Lagos, 1956
- National Institute for Medical Research (NIMR), Lagos, 1977
- Nigeria Building and Road Research Institute (NBRR), Otta, Ogun State, 1978
- National Technology Development Centre via National Science and Technology Act of 1980
- National institute for Pharmaceutical Research and Development (NIPRD), Aboye in 1987 etc (Kalama and Eseduwo, 2020)

The federal government also inaugurated 46 Federal Polytechnics and Federal Colleges of Education (FCE) councils on April 20, 2021 for ICT and other innovation technologies in furtherance of the implementation of the policy on technological advancement in Nigeria (Vanguard, 2021).

The above stated research centres and institutions were established by the Federal Government in recognition of the importance of technology as vital skills acquisition tool to overcoming poverty and other social problems especially the lack of skill employable labour force. To this end, Nigeria started building a self-reliant and confident system and thus able to meet most of her needs technologically.

Recently, the Nigerian government implemented various initiatives to support the technology sector, including the establishment of technology hubs and innovation centers. The National Information Technology Development Agency (NITDA) lunched in **2001** by the administration of **Olusegun Obasanjo** implemented Nigeria's National Information technology (IT) policy and drove the country's digital transformation. This has increased mobile phone adoption and improved connectivity across the country (Oluwaseyi et. al, 2018). This has played a key role in promoting IT growth and regulation.

Government also introduced National Digital Economy Policy and Strategy (NDEPS), Nigeria Data Protection Regulation (NDPR), and National Artificial Intelligence Policy (NAIP) to drive digital transformation and cybersecurity. It has also launched programs such as the Technology Innovation and Entrepreneurship Support (TIES), Digital Skills Training, and Smart Agriculture Program to support tech startups, digital literacy, and innovation in various sector to regulate and promote IT development, fostering a conducive environment for technological advancement.

Nigeria's technological growth has also been shaped by global trends, and economic development, with significant progress since the liberalization of the telecom sector in the early 2000s. The introduction of Global System for Mobile Communications (GSM) technology in 2001 by General (Rtd) Olusegun

Obasanjo administration marked a turning point in the political and socio-economic history of Nigeria leading to a surge in mobile device adoption and internet penetration, which reached over 104 million users by 2021 (Nigeria Communications Commission, 2021). This expansion has driven digital transformation across various industries by expanding access to banking, telemedicine, and e-government services. Digital inclusion bridges the rural-urban divide, enhances civic participation, and strengthens communication. Additionally, Nigeria's financial technology (fintech) industry emerged in the early 2000s with the introduction of electronic banking and digital payments, gaining significant traction after the Central Bank of Nigeria launched the **Payment Systems Vision 2020** in 2007. The sector has grown rapidly, driven by a large unbanked population and the increasing use of mobile money services. Companies like Flutterwave and Paystack have revolutionized digital payments, attracting international investment and positioning Nigeria as a fintech leader in Africa (Oyedotun, 2021).

Lagos, often referred to as "Africa's Silicon Valley," has played a central role in fostering start-up growth and technological innovation, supported by venture capital funding, incubators, and accelerators (Disrupt Africa, 2021). E-commerce platforms like Konga and Jumia lunched in Nigeria in 2012 have transformed the retail landscape, expanding market access for businesses and providing consumers with a wide range of online shopping options (Ogundele & Adelabu, 2020).

Renewable energy solutions were introduced in Nigeria in the early 2000s, but significant implementation efforts began with the launch of the Renewable Energy Master Plan (REMP) in 2005 by the government, aiming to diversify the energy mix and reduce dependence on fossil fuels. Subsequent policies, such as the National Renewable Energy and Energy Efficiency Policy (NREEEP) in 2015, further promoted the adoption of solar, wind, hydro, and biomass energy solutions. Renewable energy solutions have also gained traction as a response to Nigeria’s energy challenges, with initiatives like Solar Power Naija aiming to provide solar energy to rural communities (World Bank, 2021).

Furthermore, Nigeria is witnessing increasing investment in artificial intelligence (AI) and machine learning (ML), with applications in industries such as healthcare, agriculture, and finance (AI Hub Africa, 2016). These developments highlight Nigeria's evolving technological landscape, driven by local innovation and global advancements, positioning the country as a key player in Africa’s digital transformation.

Positive Impacts of Technology on Society: Nigeria

The positive impact of Technology on Nigeria cannot be overemphasized. The positive impacts include amongst others:

Enhanced Faster Communication

Technology has revolutionized communication, making it faster, more accessible, and efficient. The invention of mobile phones, emails, and social media platforms has enabled individuals and business men to communicate seamlessly across the globe. According to Castells (2009), the rise of the internet and digital networks has led to the emergence of a "network society," where information is exchanged instantly, bridging geographical barriers. Akinyemi and Adelabu (2018) assert that the use of information and communication technology (ICT) has improved corporate process efficiency, especially in industries like e-commerce, banking, and telecoms.

Sustained Population Growth and Job Creation

Technology has played a significant role in sustaining population growth in Nigeria through job creation. The ICT sector has helped significantly to manage the growing number of unemployed youths in the country being one of the largest employers of labour in the country through its direct creation of millions of jobs "ICT alone has the capacity to provide about 2.5 million jobs in 10 years" (Nigerian Communication Commission (NCC), 2021). Even during the Covid-19 pandemic, when countries of the world experienced slowed Socio-economic growth, technology provides government, non-governmental organizations and individuals with the opportunity to create millions of jobs for the teaming population.

Improved Healthcare and Medical Advancements

Technological advancements in healthcare have enhanced diagnosis, treatment, and patient care. Telemedicine, robotic surgery, and artificial intelligence (AI) in diagnostics have significantly improved health outcomes. According to Topol (2019), AI-powered systems can analyze medical data with high accuracy, enabling early detection of diseases. The COVID-19 pandemic further highlighted the importance of technology in healthcare through vaccine development, teleconsultations, and health monitoring apps (WHO, 2021). The establishment of the University of Health Science, Otukpo, Benue State amongst others, have increased medical research and production of pharmaceutical products in Nigeria (Vanguard (2021).

Advancements in Education

Education has greatly benefited from technology through e-learning, virtual classrooms, and digital resources. Online platforms such as Coursera, Khan Academy, and Google Classroom provide access to

quality education regardless of location (Siemens, 2014). The use of artificial intelligence in education also helps in tracking student progress and improving learning outcomes (Selwyn, 2020).

Enhanced Economic Growth

Technology has played a crucial role in economic development by fostering innovation and increased productivity. The increasing knowledge in ICT and the latest technology (MIT) has provided a platform for building a vibrant economic and developmental growth effective for sustainable governance and industrial revolution (Togonu & Bickersteth, 2008). That is to say, that technology supports income growth, which further favours the development of inventions and innovations.

In addition, technology enhances wealth creation, increases productivity and helps to solve our social-economic problems (Chukwuyekwe (2014)). Technology (ICT) helps the economy to grow by fostering communication, easy and quick access to new markets, and expanded number of marketing channels leading to firm mergers (Younu, 2021).

Increased Power Supply

According to Adepetun (2016), Omatek, through its three phase of grid solar solution, is playing a key role in the provision of power to the country by reducing power consumption by factories, banks, telecom firms, etc, which has replaced the “I better pass my neighbor generators”.

Increased Efficiency in Industries

Automation such as Manufacturing, IT and Software Automations and smart technologies such as Smartphones and AI have improved industrial efficiency by reducing manual labor and increasing precision. The Fourth Industrial Revolution (4IR) has introduced smart manufacturing, robotics, and the Internet of Things (IoT), enhancing productivity (Schwab, 2016). According to McKinsey & Company (2020), companies such as Banking and Financial institutions and Oil and Gas that adopted automation are experiencing a significant increase in efficiency, cost reduction, and innovation. The agricultural sector has also benefited from digital farming and biotechnology, leading to increased food production (FAO, 2019).

Environmental Sustainability

Technology has contributed to environmental conservation through green energy, waste management, and climate monitoring. Renewable energy sources such as solar and wind power have reduced reliance on fossil fuels, mitigating climate change (Intergovernmental Panel on Climate Change (IPCC), 2021).

Furthermore, satellite technology and AI-powered environmental monitoring systems assist in tracking deforestation, pollution, and wildlife conservation (NASA, 2021).

Improved Security and Crime Prevention

Advancements in technology such as drone, facial recognition, finger print etc have enhanced security measures through surveillance systems, biometric identification, and cybersecurity tools. According to Clarke (2018), AI-powered facial recognition and predictive policing help law enforcement agencies prevent crimes more effectively. Additionally, blockchain technology improves data security by preventing fraud and unauthorized access (Swan, 2015). The integration of AI in cybersecurity has also strengthened defenses against cyber threats (Symantec, 2020).

Social Inclusion and Accessibility

Technology has improved inclusivity by providing access to essential services such as Anti-discrimination laws, Internet access programs, wheelchairs for people with disabilities and marginalized communities. Moreover, financial inclusion has been facilitated by mobile banking and fintech solutions, allowing individuals in remote areas to access banking services (Demirgüç-Kunt et al., 2018).

Negative Impacts of Technology on Nigeria

Technology has undeniably improved various aspects of life, but it has also brought significant negative consequences.

Reduced physical Social Engagement

While technology has made communication easier, it has also reduced the needed physical interpersonal contact. People's reliance on electronic means of communication has increased alongside the proliferation of social media, making them less likely to conduct significant physical face-to-face exchanges. As a result of this, many people are feeling lonely and isolated, which can have serious psychological implications. Turkle (2015) argues that digital communication diminishes deep, meaningful connections, making individuals more isolated. Social media platforms such as Facebook, Instagram, TikTok and WhatsApp rather than fostering real relationships, often contribute to superficial interactions and reduced empathy (Twenge, 2017).

Job Displacement

Jobs have been lost due to automation because robots and software can do the labor formerly done by humans. To this end, many individuals have lost their employment thus struggling to make ends meet. Automation and artificial intelligence (AI) are replacing human jobs, leading to mass unemployment in

various industries. According to the World Economic Forum (2020), automation is expected to displace millions of jobs, particularly in manufacturing and administrative sectors. This shift disproportionately affects low-skilled workers, increasing wage gaps and economic instability (Autor, 2015).

Privacy Issues

Privacy issues have surfaced as a result of technological advancements, as private information is increasingly mined for profit and political gain. This has raised concerns about security breaches, theft of personal information, and governmental snooping. There have also been concerns raised regarding the morality of social media's data practices, which have led to criticism of the platforms.

Furthermore, the widespread use of digital platforms and social media has raised ethical concerns regarding privacy, surveillance, and misinformation. Scholars argue that the commodification of personal data by major technology firms has created a system of "surveillance capitalism," where users' information is exploited for commercial and political purposes (Zuboff, 2019). Additionally, excessive reliance on digital communication has been linked to declining mental well-being, reduced interpersonal interactions, and increased exposure to online manipulation (Turkle, 2015).

Cyberbullying

Social media and messaging apps have made it easier than ever for people to harass and bully others online. This can have a profound impact on mental health and well-being, particularly for children and teenagers who are more vulnerable to online bullying. According to Symantec (2020), cyberattacks on businesses and governments have risen, compromising sensitive information.

Technology Addiction

Many people spend excessive amounts of time on their phones, computers, and other devices, leading to a range of negative health effects, such as eye strain, sleep deprivation, and increased stress levels.

Challenges Inhibiting Technological Development in Nigeria

Various Technology innovation policies have been formulated and pursued by subsequent governments of Nigeria in order to achieve sustainable technological advancement cum socio-economic and political development of the country but with minimal successes due to several challenges. The challenges include amongst others:

- **Lack of Sustainable Implementation of Technology Innovation Policy by Successive Governments of Nigeria**

What Nigeria lacks over the years is not the formulation of robust policies but rather her failure to pay much attention to the implementation, even the indigenous ones, without recognizing the fact that "no nation has ever or can ever survive without technology (Adepekun (2017)).

- **Inadequate Trained Manpower**
  According to Asuquo et. al (2010), "Nigeria lacks highly trained technological experts, even the few available ones are not encouraged by the government".
- **Inadequate Funding**
  Lack of adequate financial support of the implementation of technology innovation projects where they exist. In addition, technological based institutions in Nigeria, are also poorly funded which have hindered technological growth of the country.
- **Increasing Population with High Rate of Illiteracy**
  People who are not educated about new technological innovations cannot adopt and use them to enhance socio-economic development (Popoola (2018)).
- **Internal Insecurity**
  Nigerian Communication Commission (NCC) (2021) asserted that "internal insecurity in various parts of the country has resulted in the destruction of ICT infrastructure including Fibre infrastructure through cable theft, roads construction and other operations".
- **Incompetence in Governance and Corruption**
  High theft of public funds met for technology projects as well as corruption of political office holders including civil servants, have militated against technologies advancement of the country.
- **Inadequate Power Supply**
  Irregular power supply and high cost of fuel caused by subsidy removal and artificial scarcity
- Trade barriers erected by foreign countries hinders technology growth and bedevilled sustainable technological innovations in Nigeria.
- Lack of focus on the implementation of technology education policy.

Findings

Technology has significantly transformed Nigeria by enhancing communication, healthcare, education, economic growth, industrial efficiency, and environmental sustainability. Innovations such as artificial intelligence, telemedicine, e-learning, and automation have contributed to increased productivity, job creation, and improved quality of life. However, alongside these benefits, technology has also introduced challenges, including job displacement, privacy concerns, technology addiction, cyberbullying, and reduced physical social interactions. The rapid development of emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and blockchain continues to

reshape industries, presenting both opportunities and risks for Nigeria particularly and the world generally in the future.

Conclusion

In the past few decades, technological innovations have altered every aspect of human existence. Technology has played a crucial part in developing the modern world, from the development of the wheel in **3500 BC** in **Mesopotamia** to the most recent advances in artificial intelligence such as AI in skin cancer diagnosis and Google's Gemini. Our lives have gotten simpler, more productive, and more interconnected as a result of technological advancements. Technology has brought about many good improvements that have altered our environment and the way we connect, from cell phones to virtual reality and to artificial intelligence.

Undoubtedly, technology has improved medical care, while driving economic and industrial advancements. Its negative effects, such as job displacement, privacy invasion, cyber threats, technological dependency and addiction highlight the need for responsible and ethical technology use.

The state of technology in the future is exciting and dynamic. Artificial intelligence, the Internet of Things, augmented and virtual reality, blockchain, 5G networks, quantum computing, biotechnology, robotics, cloud computing and cybersecurity are just some of the most significant technological breakthroughs that will alter our world in the near future. Nevertheless, technology has the potential to reduce employment opportunities and increase the economic disparity in the future. Therefore, it is vital that Nigeria, as a country and the world at large remain aware of these hazards and take steps to reducing them while still enjoying the benefits that technology provides.

Recommendations

While there are many positive outcomes to the widespread use of technologies, there are also negative outcomes that must be addressed. To maximize the benefits of technology while minimizing its adverse effects, governments, business moguls, and individuals should implement policies promoting digital literacy, cybersecurity, and ethical data usage. Investment in reskilling programs should address job displacement caused by automation, while governments regulations should safeguard privacy and protect users from cyber threats.

Nigeria should encourage and patronize her locally developed technology in order to create job opportunities for the teaming population and thus, foster the development and growth of the country.

Government at both the federal and state levels should devote a high percentage of the annual budget to fund technologically based tertiary institutions in the country.

Encouraging responsible technology use, especially among young people, can mitigate issues such as technology addiction and cyberbullying. Infact, continued research and innovation should focus on sustainable and inclusive technological advancements to ensuring long-term societal benefits.

As we move forward, it will be essential to consider the potential impacts of new technological advancements and work harder to mitigate any emerging negative effects. Ultimately, it is up to all of us to ensure that technology is used in a way that benefits us as a whole.

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AI AWARENESS AMONG AUCHI POLYTECHNIC STUDENTS: A SURVEY-BASED STUDY

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Abstract

Artificial Intelligence (AI) has been increasingly shaping various sectors, including education, with profound implications for teaching, learning, and institutional administration. This study investigated the level of awareness and understanding of AI among students at Auchi Polytechnic. The research explored how AI was perceived, its potential applications in an academic setting, and the challenges associated with its adoption. Using a quantitative cross- sectional survey design, data were collected from 260 students across 20 academic departments to assess their familiarity with AI concepts, exposure to AI applications, ethical concerns, and perceived societal impacts. Results revealed high baseline awareness (95.4%) but limited technical understanding of AI subfields such as machine learning (68%) and natural language processing (16.2%). Students primarily encountered AI through consumer technologies like voice assistants (55%) and chatbots (33.2%), with limited exposure to specialized applications. While optimism about AI's potential in education (51.4%) and healthcare (39%) was prevalent, significant concerns about job displacement (40.2%), algorithmic bias (47.1%), and transparency (9.7%) emerged. The study highlights fragmented AI literacy and underscores the need for curriculum reforms, ethical education, infrastructure development, and policy initiatives to bridge knowledge gaps. Recommendations include integrating interdisciplinary AI modules, fostering public-private partnerships, and conducting longitudinal research to track AI literacy trends. These findings contribute to strategies for preparing students in developing nations for an AI-driven workforce.

1.0 INTRODUCTION

1.1 Background of the Study

Artificial Intelligence (AI) has emerged as one of the most transformative technologies of the 21st century, reshaping industries, economies, and educational systems worldwide. AI refers to the simulation of human intelligence in machines, enabling them to perform tasks such as learning, reasoning, problem-solving, and decision-making (Russell & Norvig, 2021). In recent years, AI has gained prominence in various fields, including healthcare, finance, business, and education. Its applications in education range from personalized learning and intelligent tutoring systems to automated grading and student performance prediction, thereby enhancing teaching and learning processes (Luckin et al., 2016).

Globally, higher education institutions are increasingly adopting AI-driven solutions to improve learning outcomes and operational efficiency. Countries such as the United States, China, and the United Kingdom have incorporated AI-powered educational platforms that provide real-time feedback, automate administrative tasks, and support adaptive learning (Zawacki-Richter et al., 2019). AI technologies such as chatbots, machine learning algorithms, and natural language processing systems are revolutionizing how students access knowledge and interact with educational content. However, in many developing nations, including Nigeria, AI adoption in education remains limited, partly due to infrastructural challenges, lack of AI expertise, and low awareness among students and educators (Adeleke, Owolabi, & Salami, 2022).

AI literacy—the ability to understand, use, and interact with AI technologies—is becoming a crucial skill for the future workforce. As industries increasingly adopt AI for automation and decision-making, graduates with AI knowledge and skills will have a competitive advantage in the job market (Oluyemisi, 2024). However, studies have shown that in many Nigerian higher institutions, students' awareness and understanding of AI remain low, potentially limiting their ability to harness AI-driven opportunities (Nwodu, 2025). Auchi Polytechnic, as a leading institution for technological and vocational education in Nigeria, plays a critical role in preparing students for an AI-driven economy. Therefore, assessing the level of AI awareness among its students is essential to inform strategies for AI education and integration.

Given the rapid advancements in AI and its increasing relevance in the digital economy, it is imperative to investigate how well students at Auchi Polytechnic understand and perceive AI. A comprehensive assessment of AI awareness among students will provide insights into their level of preparedness for an AI-driven future, the factors influencing their exposure to AI, and the potential barriers to AI adoption. Addressing these challenges through targeted educational interventions will not only enhance AI literacy but also equip students with the skills necessary for success in an increasingly automated world.

1.2 Statement of the Problem

Despite the increasing importance of AI in various sectors, there is limited awareness and understanding of AI concepts among students in Nigerian tertiary institutions. Many students lack exposure to AI technologies, and misconceptions about AI remain prevalent (Adeleke et al., 2022). While developed countries have integrated AI into their education systems, Nigerian institutions are lagging in AI adoption due to infrastructural limitations, insufficient AI-focused curricula, and a lack of trained educators.

Auchi Polytechnic is one of Nigeria's leading technological institutions, yet there is no comprehensive data on the level of AI awareness among its students. Understanding the extent of AI awareness is critical for identifying knowledge gaps and formulating policies to improve AI education. Without a clear assessment of students' knowledge, there is a risk that graduates from Auchi Polytechnic may be unprepared for an AI-driven job market, limiting their employability and potential contributions to Nigeria's technological advancement.

1.3 Research Questions

This study seeks to address the following research questions:

1. What is the level of awareness of AI among Auchi Polytechnic students?
2. What are the primary sources of AI knowledge for these students?
3. What are the major misconceptions and barriers to AI adoption among students?
4. How does students' academic background influence their level of AI awareness?
5. What strategies can be implemented to enhance AI literacy at Auchi Polytechnic?

1.4 Objectives of the Study

The objectives of this study are to:

1. Assess the level of AI awareness among students of Auchi Polytechnic.
2. Identify the primary sources of AI knowledge for students.
3. Examine students' perceptions and misconceptions about AI.
4. Analyze how students' academic disciplines affect their AI awareness.
5. Recommend strategies to improve AI education and literacy at Auchi Polytechnic.

1.5 Significance of the Study

This study is significant because AI is increasingly becoming a fundamental aspect of modern technology and industry. Understanding AI awareness among students at Auchi Polytechnic will help stakeholders, including educators, policymakers, and industry leaders, develop effective AI- related curricula and training programs.

The findings of this study will benefit students by highlighting the importance of AI in their careers and

providing them with insights into available AI learning resources. Educators and institutional administrators will gain valuable information to integrate AI topics into their teaching methodologies. Additionally, policymakers can use the study's findings to develop national AI education policies that promote digital literacy and technological advancement.

1.6 Scope of the Study

This study focuses on AI awareness among students of Auchi Polytechnic, Nigeria. The research will examine students from various academic disciplines to determine their knowledge levels, perceptions, and exposure to AI technologies. The study will not focus on AI technical implementation but rather on students' awareness, sources of knowledge, and misconceptions about AI. The findings will be used to propose strategies for improving AI education in Nigerian polytechnics.

2.0 LITERATURE REVIEW

2.1 Artificial Intelligence in Education

Artificial Intelligence (AI) has revolutionized various sectors, including healthcare, finance, and manufacturing, and is now increasingly being integrated into education. AI in education refers to the use of machine learning algorithms, natural language processing (NLP), and intelligent tutoring systems to enhance teaching, learning, and administrative processes (Zawacki-Richter, Marín, Bond, & Gouverneur, 2019). AI-powered tools such as chatbots, automated grading systems, and personalized learning platforms provide students with interactive and adaptive learning experiences.

Studies have shown that AI can significantly improve student engagement and learning outcomes. For instance, AI-based learning platforms, such as Carnegie Learning's MATHia, provide personalized instruction by adapting to students' learning styles and performance levels (Luckin et al., 2016). Similarly, AI-driven assessment tools can automate grading processes, allowing educators to focus more on teaching and mentorship. The potential of AI in education is immense, but its adoption varies across different regions, with developed countries leading in AI integration while developing nations, such as Nigeria, lag due to infrastructural and technical challenges (Adeleke, Owolabi, & Salami, 2022).

2.2 AI Awareness and Readiness in Higher Education

The awareness and readiness of students to adopt AI technology play a crucial role in its successful integration into education. AI awareness refers to students' understanding of AI concepts, applications, and potential benefits, while AI readiness indicates their willingness and ability to engage with AI-driven tools (Nwodu, 2025). Research has found that students in developed countries have higher levels of AI awareness due to early exposure and integration of AI into their curriculum. In contrast, students in developing countries often have limited exposure, resulting in misconceptions and resistance to AI adoption (Oluyemisi, 2024).

A study by Adeleke et al. (2022) assessed AI awareness among Nigerian polytechnic students and found that while many students had heard of AI, only a small percentage understood its real- world applications. The study highlighted the need for targeted educational initiatives to bridge the AI knowledge gap among students. Similarly, research conducted by Nwodu (2025) on communication undergraduates in Nigeria revealed that students perceived AI as a complex and intimidating technology, emphasizing the need for simplified AI literacy programs.

2.3 Challenges of AI Adoption in Nigerian Higher Institutions

Despite the growing importance of AI, several challenges hinder its adoption in Nigerian higher education institutions. These challenges include:

1. Lack of AI Curriculum Integration – Many Nigerian institutions have not incorporated AI-related courses into their academic programs, leaving students with limited opportunities to learn about AI formally (Adeleke et al., 2022).
2. Infrastructure and Technical Limitations – AI requires advanced computing power and internet connectivity, both of which are limited in many Nigerian institutions (Oluyemisi, 2024).
3. Limited AI Expertise Among Educators – Many lecturers and instructors lack the necessary training in AI, making it difficult to teach AI-related subjects effectively (Nwodu, 2025).
4. Negative Perception and Misconceptions – Some students believe AI will replace human jobs entirely, leading to fear and reluctance to engage with AI technologies (Adeleke et al., 2022).

2.4 Related Works on AI Awareness in Education

Several studies have explored AI awareness and its impact on students in higher education. Zawacki-Richter et al. (2019) conducted a systematic review of AI applications in education and found that AI is increasingly being used for intelligent tutoring, predictive analytics, and automated assessments. However, their study also noted that the success of AI in education depends largely on students' familiarity and comfort with AI technologies.

Adeleke et al. (2022) examined the AI readiness of Nigerian polytechnic students and found that while students showed interest in AI, they lacked sufficient knowledge to use AI tools effectively. The study recommended AI literacy programs to enhance student engagement with AI technologies.

In another study, Luckin et al. (2016) argued that AI can play a transformative role in personalized learning, allowing students to receive customized educational experiences based on their individual needs. Their research emphasized the importance of equipping students with AI skills to prepare them

for the future job market.

2.5 Bridging the AI Knowledge Gap in Nigerian Institutions

To enhance AI awareness among students, Nigerian higher institutions must take proactive steps to integrate AI into their academic programs. Some proposed solutions include:

- Incorporating AI Courses into the Curriculum – Higher institutions should introduce AI- related courses as part of their core curriculum to expose students to AI concepts and applications (Adeleke et al., 2022).
- Providing AI Training for Lecturers – Educators need to be trained on AI technologies to effectively teach AI-related subjects (Nwodu, 2025).
- Using AI-powered Learning Tools – Institutions should adopt AI-driven educational tools such as intelligent tutoring systems and automated grading platforms to enhance student learning experiences (Luckin et al., 2016).
- Raising Awareness through Workshops and Seminars – Organizing AI-focused events can help students understand the benefits of AI and dispel misconceptions (Oluyemisi, 2024).

By addressing these challenges, Nigerian higher education institutions can improve AI literacy among students, preparing them for an AI-driven workforce and enhancing their global competitiveness.

3.0 METHODOLOGY

3.1 Research Design

This study employed a quantitative, cross-sectional survey design to assess the awareness and perceptions of Artificial Intelligence (AI) among students at Auchi Polytechnic, Edo State, Nigeria. The cross-sectional approach was selected to gather data at a single point in time, enabling the identification of patterns and associations within the target population. A descriptive research framework was adopted to systematically analyze the level of AI awareness, attitudes, ethical concerns, and perceived impacts among participants. This design aligns with the study's objective to provide a snapshot of AI literacy and its correlates within the institution.

Population and Sampling

The target population comprised students across all departments and levels (ND1 to HND2) at Auchi Polytechnic. A non-probability convenience sampling technique was utilized, leveraging social media platforms (e.g., WhatsApp groups) to distribute the survey. The final sample included 260 respondents, representing approximately 1–2% of the student population, based on institutional enrollment estimates. While this method ensured rapid data collection, it introduced potential selection bias, as participants were limited to those with internet access and active engagement on social media.

3.2 Data Collection Instrument

A structured, self-administered questionnaire was developed in Google Forms, consisting of 17 closed-

ended questions divided into three sections:

1. Socio-demographics: Department, academic level, gender, and age.
2. Awareness and Knowledge: Familiarity with AI concepts, encountered AI applications (e.g., chatbots, recommendation systems), and understanding of machine learning.
3. Perceptions and Ethics: Attitudes toward AI adoption, trust in AI decision-making, ethical concerns (e.g., privacy, job displacement), and anticipated societal impacts.

Questions employed multiple-choice, Likert-scale, and binary (yes/no) formats. The instrument was reviewed for face validity by the project supervisor and piloted with 20 students to refine clarity and relevance. Cronbach's alpha was not computed due to the descriptive focus, but pilot feedback confirmed internal consistency.

3.3 Data Collection Procedure

The questionnaire was distributed digitally in the second quarter of 2024 via various WhatsApp groups over a four weeks period. Participation was voluntary, and anonymity was ensured by omitting personal identifiers. A brief introduction clarified the study's purpose, confidentiality protocols, and consent requirements. Of 300 distributed forms, 260 completed responses were retained, yielding an 86.7% response rate.

3.4 Data Analysis

Data were analyzed using descriptive statistics with Microsoft Excel and Google Sheets. Frequency distributions and percentages were calculated for categorical variables (e.g., awareness rates, ethical concerns). Central tendency measures (mean, median) summarized age and academic-level trends. Visualization tools, including bar charts and pie graphs, highlighted key findings, such as the prevalence of AI applications encountered (e.g., 55% used smartphone voice assistants) and sectoral impact perceptions (e.g., 51.4% prioritized education). Qualitative insights from open-ended responses were thematically categorized but constituted a minor component.

3.5 Ethical Considerations

The study adhered to ethical guidelines for academic research. Participants provided informed consent electronically prior to survey completion. Data were anonymized, stored securely, and analyzed in aggregate to prevent individual identification. Findings were reported transparently, with limitations openly acknowledged.

3.6 Limitations

1. Sampling Bias: Reliance on convenience sampling and social media recruitment may exclude offline or less tech-engaged students.
2. Temporal Constraints: The cross-sectional design limits insights into longitudinal trends in AI awareness.
3. Evolving Context: Rapid advancements in AI technology may render some findings time-sensitive.
4. Instrument Scope: The absence of inferential statistics (e.g., regression analysis) restricted

exploration of causal relationships.

Recommendations for Future Studies

Future research should incorporate stratified random sampling to enhance representativeness and employ mixed-methods approaches (e.g., interviews) to contextualize quantitative findings.

4.0 RESULTS AND DISCUSSION

4.1 Demographic Profile

The study sought to evaluate the awareness and perception of Artificial Intelligence (AI) among Auchi Polytechnic students. Data was collected from 260 respondents, spanning a range of departments and academic levels, using a structured questionnaire distributed via social media platforms. Below is an in-depth analysis and interpretation of the findings. (Table 4.1).

Table 4.1 Socio-demographic Characteristics of Respondents

	Socio-demographic Characteristic (260)	Frequency	Percentage
S/N	**Department**		
1	Computer Science	84	32.3%
2	Statistics	55	21.2%
3	Mass Communication	34	13.1%
4	Public Administration	10	3.8%
5	Library & Information Science	3	1.2%
6	Science Laboratory Technology	22	8.5%
7	Hospitality Management	3	1.2%
8	Microbiology	2	0.8%
9	Food Technology	2	0.8%
10	Marketing	2	0.8%
11	Electrical Engineering	14	5.4%
12	Business Administration	14	5.4%
13	Biochemistry	2	0.8%
14	Chemistry	1	0.4%
15	Textile	1	0.4%
16	Fashion Design & Clothing Technology	3	1.2%
17	Chemical Engineering	1	0.4%
18	Petroleum Engineering	1	0.4%
19	Office Technology Management	4	1.5%
20	Accountancy	2	0.8%
	Total	260	100.0 %
	Level		
1	ND1	77	29.6%
2	ND2	20	7.7%
3	HND1	73	28.1%
4	HND2	90	34.6%
	Total	260	100.0 %
	Gender		
1	Male	144	55.4%
2	Female	116	44.6%
	Total	260	100.0 %
	Age		
1	15 - < 20	57	21.9%
2	20 - < 25	144	55.4%
3	25 - < 30	49	18.8%

4	30 - < 35	10	3.8%
	Total	260	100.0 %

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3	25 - < 30	49	18.8%
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	Total	260	100.0%

Socio-Demographic Characteristics of Respondents

i. Departments: Respondents represented diverse fields, including Computer Science (32.3%), Statistics (21.5%), and Mass Communication (13.1%). This broad participation underscores AI's relevance across disciplines, not limited to technical fields.
ii. Levels: Higher engagement was noted among HND2 students (34.6%) and HND1 (28.1%), possibly reflecting their advanced academic level and exposure to technological concepts.
iii. Gender Distribution: Male respondents (55.4%) slightly outnumbered females (44.7%), indicating balanced participation across genders.
iv. Age Range: The majority were aged 20–25 years (55.4%), reflecting a youthful population, which aligns with the age bracket likely to be more technologically curious.

Interpretation:

The sample reflects a broad cross-section of the student population, though disciplines like Computer Science and Statistics may inherently have higher exposure to AI concepts, potentially skewing results.

4.2 Research Data and Interpretations

1. Have you heard of artificial intelligence (AI)?

Result: 95.4% Yes, 4.6% No.

Interpretation:

The near-universal awareness reflects AI's pervasive integration into daily life through smartphones, social media, and digital services. This aligns with global trends where youth are exposed to AI via consumer technologies like voice assistants (e.g., Siri, Alexa) and recommendation algorithms (Chen et al., 2020). The 4.6% unawareness may stem from limited digital engagement. **This** suggests that while awareness of AI as a buzzword is high, granular knowledge of its subfields remains superficial. These findings align with global studies highlighting a "surface-level literacy" gap among non-Computer Science students (Long & Magerko, 2020).

2. Do you know what artificial intelligence (AI) is?

Result: 86.9% Yes, 13.1% No.

Interpretation:

While most students claim familiarity, the gap between awareness and depth of understanding is evident in subsequent responses (e.g., limited recognition of technical terms like NLP). This mirrors studies showing that laypersons often conflate AI with automation or robotics rather than understanding its algorithmic foundations (West, 2022). The gap between awareness and nuanced understanding underscores the need for structured AI education beyond technical disciplines.

3. Which applications involve AI?

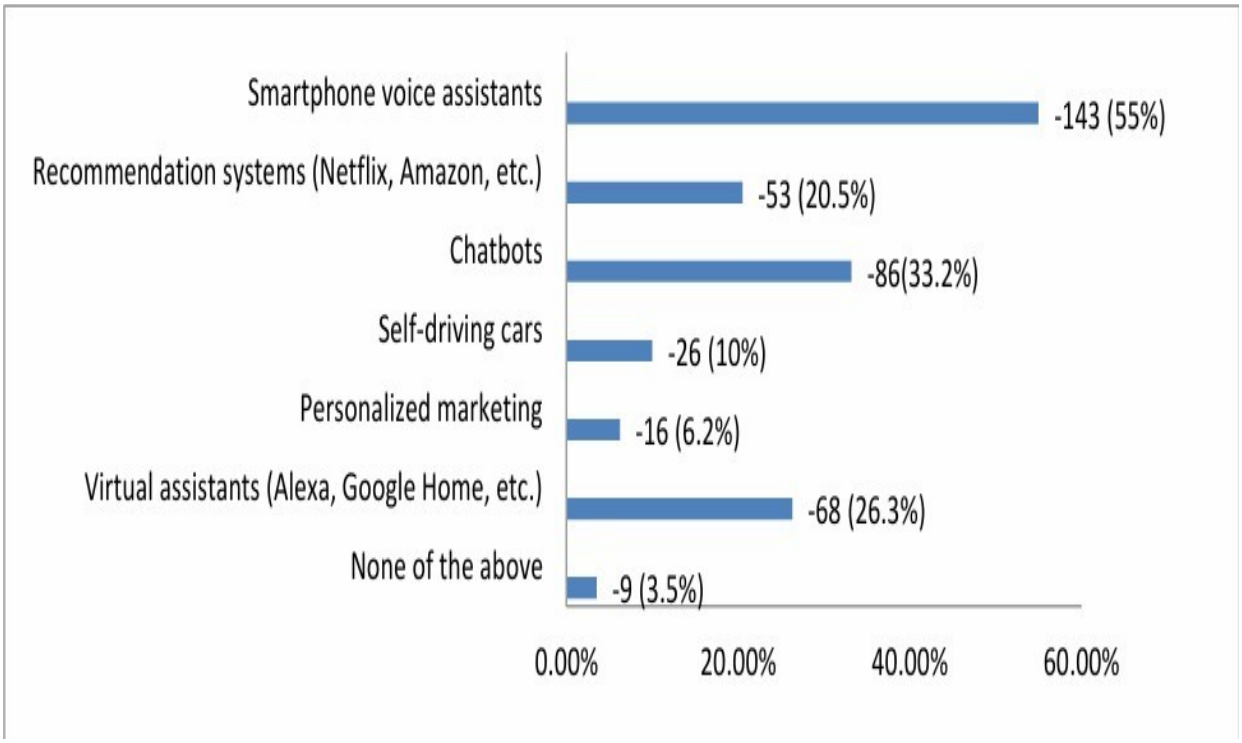


Figure 4.1: Knowledge of AI applications

Result: Smartphone assistants (55%), chatbots (33.2%), recommendation systems (20.5%).

Interpretation:

Daily interactions with user-friendly AI tools dominate exposure. The focus on consumer applications suggests practical familiarity but limited awareness of industrial or specialized AI uses.

4. Are you excited about AI advancements? Result: 86.1% Yes, 6.6% No, 7.3% Not sure. **Interpretation:**

Enthusiasm likely stems from AI's perceived benefits in education (e.g., personalized learning) and convenience (e.g., smart devices). Skepticism may relate to ethical concerns like job displacement, as seen in later questions.

5. Industries where AI will have the biggest impact?

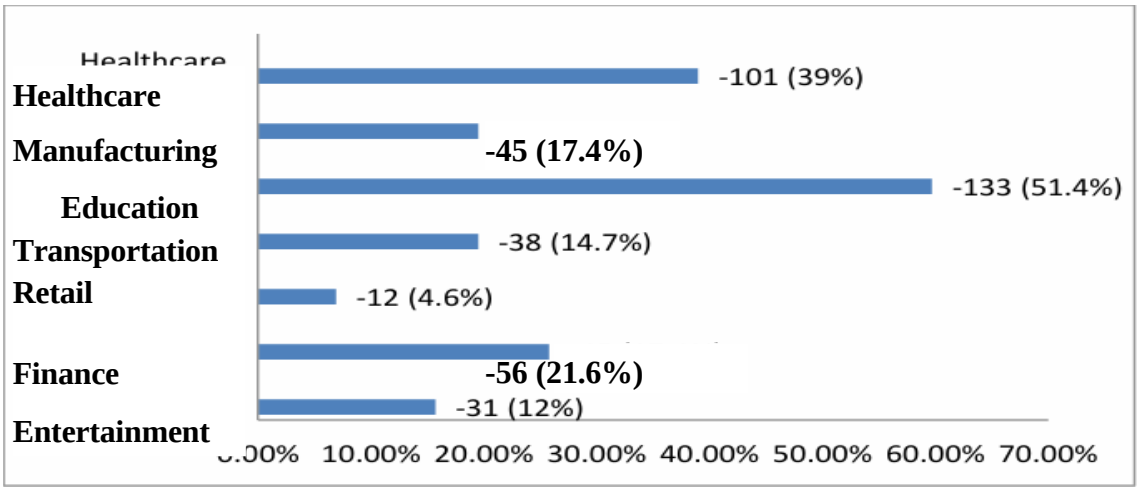


Figure 4.2: Knowledge of AI applications

Result: Education (51.4%), Healthcare (39%), Finance (21.6%).

Interpretation:

Students prioritize sectors directly impacting their lives or widely covered in media. Education's prominence aligns with AI's growing role in adaptive learning platforms (Roll & Wylie, 2016), while healthcare reflects optimism about AI-driven diagnostics (Topol, 2019).

6. Trust in AI decisions?

Result: 45.6% —It depends,‖ 43.6% Yes, 10.8% No.

Interpretation:

Conditional trust underscores demand for transparency and accountability. Students recognize AI's utility but remain cautious about opaque decision-making processes, a trend observed in global youth surveys (Floridi et al., 2018).

7. Ethical concerns?

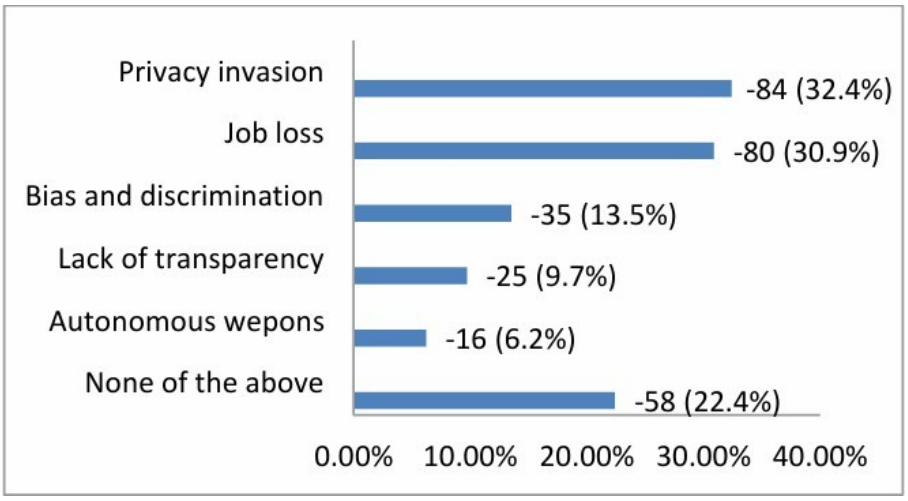


Figure 4.3: AI ethical concerns

Result: Privacy invasion (32.4%), Job loss (30.9%), Bias (13.5%).

Interpretation:

Privacy and economic anxieties dominate, reflecting youth's immediate concerns in a digital economy. Lower emphasis on bias and transparency suggests limited awareness of systemic AI risks, such as algorithmic discrimination in hiring (Buolamwini & Gebru, 2018).

8. AI replacing human jobs?

Result: 51.7% Yes, 25.5% No, 22.8% Not sure.

Interpretation:

The majority acknowledge automation risks, aligning with global discourse on AI's labor market disruptions. Uncertainty (22.8%) reflects mixed narratives about AI's role as a job displacer vs. enhancer (Bostrom, 2014).

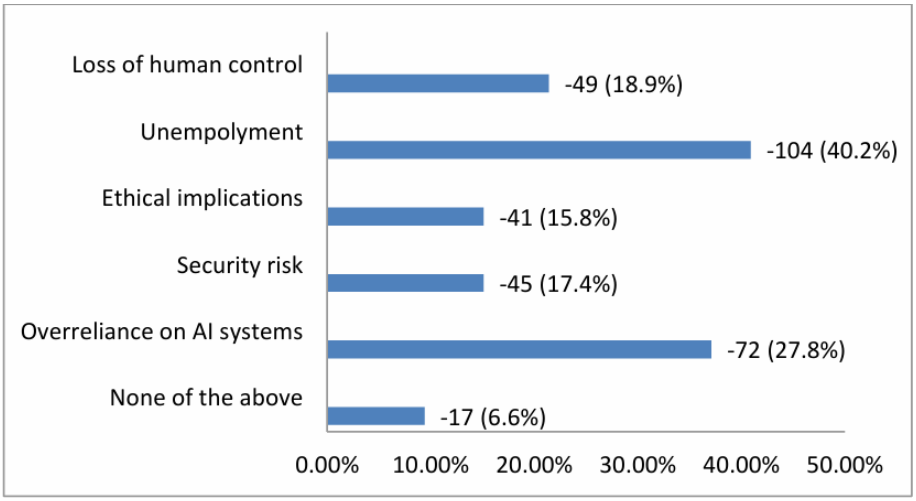
9. Positive societal impact?

Result: 69.1% Yes, 14.3% No, 16.6% Not sure.

Interpretation:

Optimism coexists with skepticism, mirroring public ambivalence toward AI. Positive views likely stem from AI's potential in education and healthcare, while dissenters may fear inequality or loss of human agency.

10. Primary concerns about AI?



11. Primary concerns about AI?

Figure 4.4: Primary concerns about AI

Result: Unemployment (40.2%), Overreliance (27.8%), Security risks (17.4%).

Interpretation:

Economic and practical risks dominate. Unemployment fears reflect labor market anxieties in developing economies, while overreliance concerns echo warnings about reduced critical thinking in AI-dependent societies (Culican, 2024).

12. Familiarity with machine learning?

Result: 68% Yes, 32% No.

Interpretation:

Recognition of machine learning—a core AI subset—indicates foundational knowledge. However, the 32% unfamiliarity highlights gaps in technical literacy, even among digitally native youth.

13. Terms associated with AI?

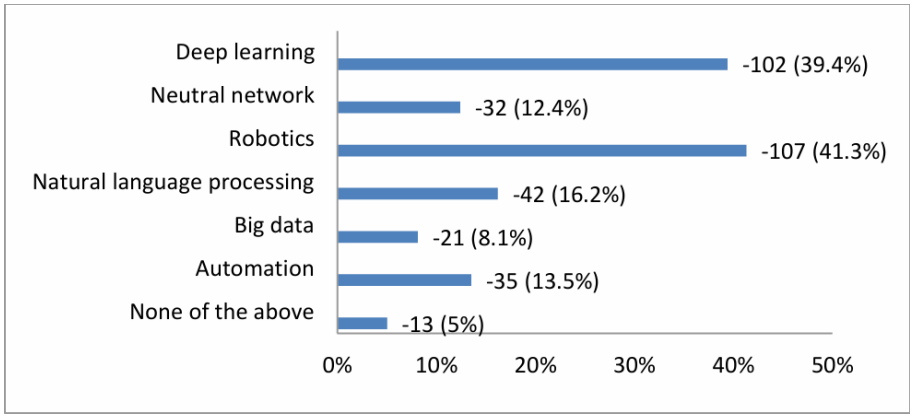


Figure 4.5: AI associated terms

Result: Robotics (41.3%), Deep learning (39.4%), NLP (16.2%).

Interpretation:

Robotics' dominance reflects media-driven narratives (e.g., humanoid robots), overshadowing less visible AI components like NLP or big data. This aligns with studies showing laypersons equate AI with physical machines (West, 2022).

14. Used AI-powered products/services?

Result: 79.2% Yes, 20.8% No.

Interpretation:

High usage confirms AI's ubiquity in daily life (e.g., social media algorithms, streaming recommendations). The 20.8% who haven't used AI tools may underestimate their interactions (e.g., spam filters, autocorrect).

15. Factors for trusting AI?

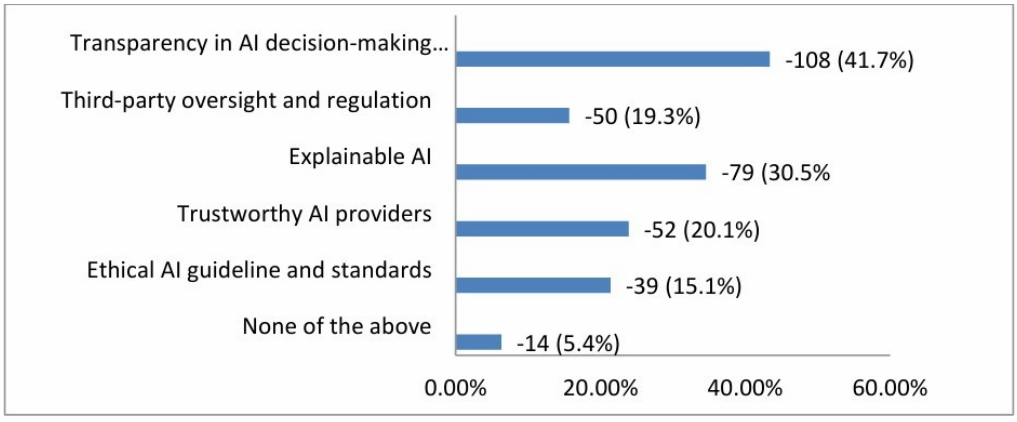


Figure 4.6: Factors that affects reliance on AI for decision-making

Result: Transparency (41.7%), Explainable AI (30.5%), Trustworthy AI providers (20.1%).

Interpretation:

Transparency is paramount, reflecting youth's demand for accountability in ―black box‖ systems. Explainable AI's prominence aligns with ethical frameworks advocating for interpretable algorithms (Floridi et al., 2018).

16. AI surpassing human intelligence?

Result: 52.5% Yes, 34% No, 13.5% Not sure.

Interpretation:

Belief in AI's superiority reflects sensationalized media narratives (e.g., dystopian sci-fi) rather than technical realities. Current AI remains narrow, but youth overestimate its capabilities, a phenomenon termed ―AI mystification‖ (Russell & Norvig, 2021).

17. Belief in AI bias?

Result: 47.1% Yes, 29.3% No, 23.6% Not sure.

Interpretation:

Nearly half recognize AI's potential for bias, likely informed by media coverage of issues like racial profiling in facial recognition. Skepticism (29.3%) may stem from viewing AI as ―neutral‖ code, overlooking training data biases.

18. Areas of life AI will impact most?

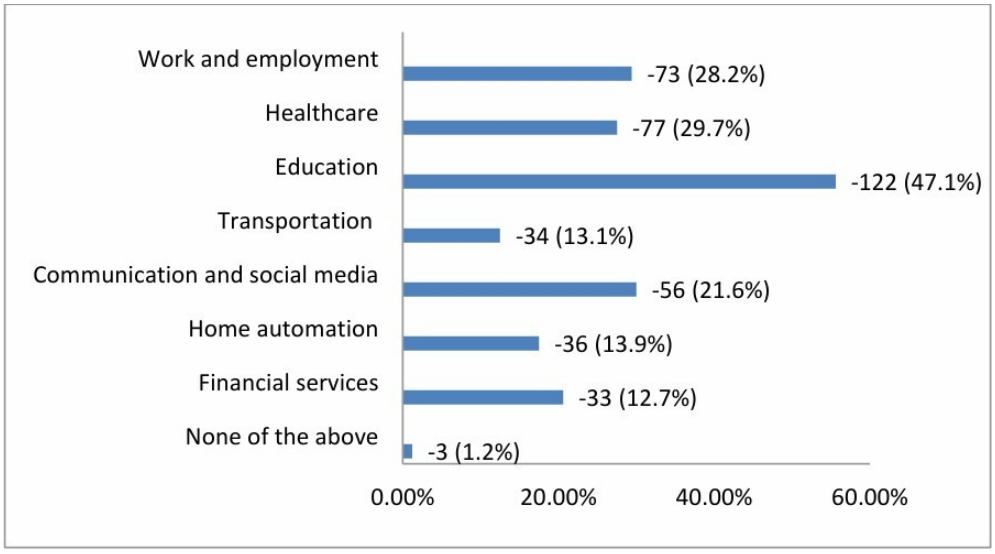


Figure 4.7: Area of life where AI is expected to impact the most Result: Education (47.1%), Healthcare (29.7%), Work (28.2%).

Interpretation:

Education's prominence aligns with students' direct experiences (e.g., AI tutors). Healthcare and work impacts reflect broader societal priorities, though limited recognition of AI in agriculture or governance suggests knowledge gaps.

4.3 Synthesis and Implications

The data reveal a generation that is AI-aware but not AI-literate. Students engage with AI daily but lack frameworks to critically evaluate its ethical, economic, and societal implications.

Key takeaways:

1. High Enthusiasm, Conditional Trust: Students embrace AI's potential but demand transparency and accountability.
2. Ethical Blind Spots: Privacy and job loss dominate concerns, overshadowing systemic risks like bias and opacity.
3. Practical Over Theoretical Knowledge: Familiarity with consumer tools (e.g., chatbots) exceeds understanding of AI's technical or industrial applications.

4.4 Recommendations:

i. Integrate AI literacy across curricula, emphasizing ethics, transparency, and interdisciplinary applications.
ii. Develop workshops to demystify AI, using relatable examples (e.g., TikTok algorithms, AI in healthcare).
iii. Foster critical thinking to help students navigate AI's societal trade-offs (e.g., efficiency vs. job displacement).

By addressing these gaps, Auchi Polytechnic can empower students to harness AI responsibly, ensuring they thrive in an AI-driven future.

5.0 Conclusion

This study reveals a critical dichotomy in AI awareness among Auchi Polytechnic students: while 95.4% demonstrate baseline familiarity with AI, deeper technical literacy—particularly regarding machine learning (68%), ethical implications (15.8%), and specialized applications (e.g., personalized marketing at 6.2%)—remains fragmented. Students exhibit cautious optimism, recognizing AI's transformative potential in education (51.4%) and healthcare (39%) but voicing significant concerns about job displacement (40.2%), algorithmic bias (47.1%), and transparency (9.7%). These findings underscore a pressing need to bridge the gap between surface-level awareness and functional, ethical AI literacy to prepare students for a rapidly evolving technological landscape.

6.0 Recommendations

1. Curriculum Integration: Introduce mandatory interdisciplinary AI modules across all departments, covering foundational concepts, applications, and ethics. Prioritize hands-on training with AI tools (e.g., chatbots, data analytics platforms) to enhance experiential learning.
2. Ethical AI Education: Embed ethics-focused coursework addressing bias, privacy, and accountability in AI systems. Collaborate with industry experts to develop case studies on real-world AI dilemmas (e.g., algorithmic fairness in hiring).
3. Infrastructure Development: Invest in AI labs and digital resources to ensure equitable access to AI technologies. Partner with tech firms to provide subsidized licenses for educational AI platforms (e.g., TensorFlow, IBM Watson).
4. Policy Advocacy: Advocate for national policies mandating AI literacy in technical and vocational education. Establish institutional committees to monitor AI trends and update curricula accordingly.
5. Public-Private Partnerships: Foster collaborations with AI-driven industries for internships, workshops, and guest lectures. Create student-led AI innovation hubs to encourage grassroots projects addressing local challenges.
6. Longitudinal Research: Conduct follow-up studies using stratified sampling to track AI literacy trends. Explore causal relationships between demographics (e.g., department, gender) and AI adoption using inferential statistics.

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Edge Computing: Enabling Low-Latency and Scalable Solutions for Emerging Applications

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Abstract

Edge computing has emerged as a promising paradigm to address the challenges posed by the proliferation of Internet of Things (IoT) devices and the growing demand for real-time data processing and analysis. This paper presents an overview of edge computing, focusing on its principles, architectures, and applications. The paper begins by discussing the limitations of centralized cloud computing, including latency issues, bandwidth constraints, and privacy concerns, which are particularly pronounced in IoT deployments. It then introduces edge computing as a distributed computing model that brings computational resources closer to the data sources, thereby reducing latency and bandwidth usage while enhancing privacy and security. Drawing upon examples from various domains such as smart cities, autonomous vehicles, and industrial automation, the paper showcases the diverse applications of edge computing, including real-time analytics, predictive maintenance, and immersive experiences. Furthermore, the paper explores different edge computing architectures, ranging from simple edge nodes to complex hierarchical structures, and discusses key considerations in designing and deploying edge computing solutions, such as resource allocation, data management, and security. By highlighting the benefits and challenges of edge computing, this paper aims to provide insights into its potential to revolutionize the way data is processed, analyzed, and acted upon at the network edge, paving the way for innovative and scalable solutions in emerging applications.

Keywords: Edge Computing, Low-latency, IoT

1.0 Introduction

Edge computing represents a transformative paradigm in modern technology, revolutionizing how data is processed, stored, and utilized. By bringing computation closer to the data source, edge computing minimizes latency and enhances scalability, crucial for the demands of emerging applications in today's interconnected world. This introduction explores the pivotal role of edge computing in enabling low-latency and scalable solutions, shaping the future of technology across industries and applications.

2.0 Overview of edge computing

Edge computing is a paradigm that decentralizes computation and data storage closer to the location where it is needed, rather than relying solely on centralized data centers. This approach aims to reduce latency and bandwidth usage by processing data closer to the source or end-user device. As defined by Satyanarayanan (2017), edge computing "brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth."

In practical terms, edge computing leverages small data centers or servers (referred to as "edge servers" or "nodes") located at the periphery of the network, typically in close proximity to end-users or IoT devices. These edge nodes perform computation tasks locally, rather than sending data back and forth to a centralized data center. This architecture is particularly advantageous for applications requiring real-time data processing, such as autonomous vehicles, industrial IoT, and augmented reality.

The benefits of edge computing include reduced latency, improved reliability, and scalability, making it suitable for a wide range of emerging applications (Fernando et al., 2019). By processing data closer to where it is generated, edge computing also addresses concerns about privacy and data sovereignty, as sensitive data can potentially be processed locally without being transmitted over long distances. Edge computing represents a significant shift in how data is handled in modern networks, offering low-latency and scalable solutions that are essential for supporting the growing demands of emerging applications.

3.0 Principles of Edge Computing

Edge computing principles revolve around decentralizing computational processes and data storage to the edge of the network, closer to where data is generated or consumed. This approach enhances efficiency, reduces latency, and improves scalability compared to traditional cloud-centric models. These principles collectively enable edge computing to support a wide range of applications, including IoT, autonomous vehicles, and augmented reality, by addressing challenges related to latency, bandwidth, scalability, and data privacy.

1. Proximity: Edge computing emphasizes placing computational resources closer to end-users or data sources, minimizing the distance data must travel. This proximity reduces latency and enhances real-time responsiveness (Shi et al., 2016).

2. Distributed Architecture: Unlike centralized cloud computing, edge computing employs a distributed architecture with interconnected nodes at the network periphery. These nodes collaborate to process and store data, enhancing fault tolerance and reliability (Bonomi et al., 2012).

3. Low Latency: By processing data locally at the edge, edge computing reduces the time it takes for data to travel between the source and processing center, thereby improving application performance for latency-sensitive tasks (Mao et al., 2017).

4. Bandwidth Optimization: Edge computing alleviates strain on network bandwidth by performing data processing and analysis locally. This optimization is critical for applications like IoT and video streaming that generate large volumes of data (Mach et al., 2017).

5. Scalability: Edge computing infrastructure scales horizontally by adding more edge nodes as needed, accommodating fluctuating demands and ensuring efficient resource allocation across distributed environments (Mao et al., 2017).

4.0 Architectures of Edge Computing

Edge computing architectures vary based on specific application requirements, but they generally involve a network of distributed nodes located closer to data sources or end-users. These architectures aim to enhance performance, reduce latency, and improve scalability compared to traditional centralized cloud computing models.

1. Hierarchical Edge Architecture: This architecture consists of multiple layers of edge nodes, each handling specific tasks based on proximity to data sources. For instance, in a smart city scenario, sensors at streetlights may send data to local edge nodes for immediate processing (Mao et al., 2017).

2. Fog Computing Architecture: Fog computing extends the concept of edge computing by introducing an intermediate layer of fog nodes between the edge and the cloud. Fog nodes aggregate and preprocess data before sending relevant information to the cloud for further analysis. An example is Cisco's IOx platform, which enables applications to run at the network edge on Cisco's network devices (Bonomi et al., 2012).

3. Mobile Edge Computing (MEC): MEC integrates computational capabilities into the Radio Access Network (RAN) of cellular networks, enabling operators to deploy applications and services closer to mobile users. For example, MEC enables low-latency applications like augmented reality gaming and video analytics at the edge of 5G networks (Mach et al., 2017).

4. Cloudlet Architecture: Cloudlets are small-scale data centers deployed at the edge of the network, typically in proximity to end-users. They provide computational resources and services to nearby mobile devices. For instance, the MIT Cloudlet platform supports mobile applications that offload computation-intensive tasks to nearby cloudlets (Satyanarayanan et al., 2009).

5. Decentralized Edge Architecture: In decentralized edge architectures, edge nodes operate autonomously without a central coordinator. This approach enhances fault tolerance and scalability by distributing workload across multiple edge nodes. An example is the Ethereum blockchain network, where edge nodes (miners) execute smart contracts and maintain the blockchain ledger (Buterin, 2014).

These architectures illustrate the diversity of edge computing implementations across different domains, from IoT and smart cities to telecommunications and blockchain networks, each tailored to optimize performance and efficiency in specific use cases.

5.0 Applications of Edge Computing

Edge computing finds applications across various domains where low latency, real-time data processing, and efficient bandwidth usage are critical. These applications demonstrate how edge computing addresses the unique requirements of diverse industries, ranging from real-time responsiveness in autonomous systems to enhancing user experiences in augmented reality and optimizing healthcare delivery. Edge computing's ability to process data closer to the source enhances efficiency, reduces costs, and improves overall system performance in these applications.

1. Internet of Things (IoT) Edge computing is integral to IoT applications, where numerous sensors and devices generate vast amounts of data. By processing data locally at the edge, IoT systems can respond in real-time to events without needing to transmit all data to centralized cloud servers. For example, in smart cities, edge nodes can monitor traffic flow, manage energy distribution, and optimize waste management in real-time (Shi et al., 2016).

2. Autonomous Vehicles Edge computing plays a crucial role in enabling autonomous vehicles (AVs) to make split-second decisions. AVs rely on sensors such as cameras and LiDAR to perceive their surroundings and require immediate processing of this data to ensure safe navigation. Edge nodes installed along roadways or within vehicles can process sensor data locally, reducing latency and improving response times (Mao et al., 2017).

3. Augmented Reality (AR) AR applications overlay digital information onto the physical world in real-time. These applications demand low-latency processing to provide seamless user experiences. Edge computing facilitates AR by processing image recognition, spatial mapping, and content rendering closer to the user's device. This approach enhances AR application responsiveness and reduces the dependency on stable internet connections (Shi et al., 2016).

4. Healthcare Edge computing enhances healthcare applications by enabling remote patient monitoring, real-time diagnostics, and personalized treatment recommendations. For instance, wearable health devices equipped with sensors can monitor vital signs and send data to nearby edge nodes for analysis. Edge computing ensures timely processing of health data, enabling healthcare providers to respond quickly to critical situations (Fernando et al., 2019).

6.0 Limitations of Centralized Cloud Computing

Centralized cloud computing, while powerful and widely adopted, faces several limitations that have become increasingly apparent as demands for real-time processing and data privacy have grown.

1. Latency Issues: Centralized cloud computing involves sending data from the user's device or location to a remote data center for processing and storage. This round-trip introduces latency, which is the delay between data transmission and receipt of a response. For applications requiring real-time interaction, such as video conferencing, online gaming, or autonomous vehicles, even small delays can significantly impact user experience and functionality (Shi et al., 2016).

2. Bandwidth Constraints: Transmitting large volumes of data to and from centralized data centers requires substantial bandwidth. In scenarios where numerous devices or sensors generate continuous streams of data (e.g., IoT devices, surveillance cameras), centralized cloud solutions can strain network resources and incur high costs for data transfer. This bandwidth limitation becomes critical in environments with unreliable or limited internet connectivity (Mach et al., 2017).

3. Privacy and Data Sovereignty Concerns: Centralized cloud computing involves storing and processing data on servers controlled by third-party providers. This arrangement raises concerns about data privacy, as users may not have full control over where their data is stored or how it is secured. Compliance with regional data protection regulations, such as GDPR in Europe or CCPA in California, also poses challenges when data crosses international borders (Fernando et al., 2019).

4. Dependence on Network Connectivity: Centralized cloud computing relies heavily on stable and high-speed internet connectivity. Interruptions or slowdowns in network services can disrupt access to cloud resources and impair application performance. This dependency is a significant limitation in remote or rural areas with limited internet infrastructure (Mao et al., 2017).

5. Scalability Challenges: While cloud providers offer scalable resources on-demand, scaling in centralized cloud environments can be complex and costly for certain applications. Sudden spikes in demand may require provisioning additional resources or adjusting configurations, which can impact performance and cost efficiency if not managed effectively (Bonomi et al., 2012).

Addressing these limitations has spurred the development of edge computing, which decentralizes data processing and storage to the network edge. By bringing computation closer to data sources and end-users, edge computing aims to mitigate latency, reduce bandwidth usage, enhance data privacy, and improve overall application performance in diverse use cases.

7.0 Application of edge computing in smart cities, autonomous vehicles, and industrial automation

Edge computing plays a crucial role in enhancing efficiency, responsiveness, and scalability in various applications, including smart cities, autonomous vehicles, and industrial automation:

1. Smart Cities: In smart cities, edge computing enables real-time monitoring and management of urban infrastructure. Edge nodes deployed throughout the city can collect and analyze data from sensors embedded in traffic lights, waste management systems, energy grids, and public safety devices. By processing data locally, edge computing reduces latency in decision-making processes. For example, edge nodes can optimize traffic flow by analyzing real-time data from traffic cameras and sensors, thereby reducing congestion and improving air quality (Shi et al., 2016).

2. Autonomous Vehicles: Edge computing is essential for the operation of autonomous vehicles (AVs) where split-second decision-making is critical for safety and performance. AVs rely on sensors such as cameras, LiDAR, and radar to perceive their surroundings and navigate autonomously. Edge nodes installed along roadways or within vehicles can process sensor data locally to detect obstacles, pedestrians, and other vehicles in real-time. This local processing reduces latency and enables AVs to react swiftly to changing road conditions, improving overall safety and reliability (Mao et al., 2017).

3. Industrial Automation: In industrial automation, edge computing optimizes manufacturing processes by enabling real-time monitoring and control of machinery and production lines. Edge nodes located within manufacturing facilities can collect data from sensors and industrial IoT devices, analyze it locally, and make autonomous decisions without relying on centralized cloud servers. This approach minimizes latency, enhances responsiveness, and improves operational efficiency. For instance, edge computing can facilitate predictive maintenance by analyzing equipment performance data in real-time, thereby reducing downtime and maintenance costs (Bonomi et al., 2012).

In all these applications, edge computing addresses the limitations of centralized cloud computing by processing data closer to where it is generated or needed. This decentralized approach not only reduces latency and bandwidth usage but also enhances data privacy and security, as sensitive information can be processed locally without being transmitted over long distances. By leveraging edge computing, smart cities can achieve better resource management and enhanced public services, autonomous vehicles can operate safely and efficiently in dynamic environments, and industrial automation can achieve higher productivity and reliability in manufacturing processes.

8.0 Different Edge Computing Architectures

Edge computing architectures have evolved to accommodate diverse application needs, emphasizing decentralized processing closer to data sources.

1. Hierarchical edge architecture organizes edge nodes into multiple tiers based on their proximity to data sources and processing requirements. This approach ensures that data is processed efficiently at different levels of the network. For example, in a smart city deployment, local edge nodes at the neighborhood level collect data from sensors monitoring traffic flow and environmental conditions. These nodes then aggregate and process the data before forwarding relevant information to regional edge nodes for city-wide analytics and decision-making (Shi et al., 2020).

2 Fog computing extends edge computing by introducing an intermediate layer of fog nodes between edge devices and centralized cloud data centers. Fog nodes are placed at the network edge, such as base stations or routers, and provide computational resources and storage capabilities closer to end-users. An example is the deployment of fog computing in industrial automation, where fog nodes located within manufacturing facilities process real-time sensor data from machinery to optimize production processes. Fog computing improves responsiveness and reduces latency by handling critical data processing tasks locally (Bonomi et al., 2022).

3. Mobile edge computing integrates cloud computing capabilities into the Radio Access Network (RAN) of cellular networks. MEC enables applications to run on virtualized servers deployed at the network edge, such as base station locations. This architecture supports low-latency applications for mobile users, such as augmented reality (AR) and real-time video streaming. For instance, MEC enables AR applications that overlay digital information onto the physical world by processing AR content closer to mobile devices, reducing latency and improving user experience (Mao et al., 2021).

4. Cloudlet architecture deploys small-scale data centers or cloudlets at the network edge, closer to end-users than centralized cloud data centers. Cloudlets provide computational resources and services to nearby mobile devices or IoT devices, enabling low-latency data processing and real-time interactions. An example is the use of cloudlets in healthcare applications, where cloudlets process patient health data collected from wearable devices to provide real-time health monitoring and personalized medical recommendations. Cloudlets ensure data privacy and reduce the load on centralized servers by processing sensitive health information locally (Fernando et al., 2023).

9.0 Designing and Deploying Edge Computing Solutions,

Designing and deploying edge computing solutions requires careful consideration of several key factors to ensure optimal performance, reliability, and security.

1. Resource Allocation:

- Compute Resources: Determine the computational capabilities required at edge nodes based on the specific workload and application requirements. This includes CPU, GPU, memory, and storage capacities.
- Network Bandwidth: Assess the bandwidth needs for data transmission between edge nodes, devices, and centralized systems. Allocate sufficient network resources to handle peak loads and ensure lowlatency communication.
- Virtualization and Containerization: Use virtualization or containerization technologies to efficiently manage and allocate resources among different applications running on edge nodes. This improves resource utilization and scalability.

2. Data Management:

- Data Processing: Implement data filtering, aggregation, and analytics at the edge to reduce the volume of data transmitted to centralized cloud servers. This minimizes latency and bandwidth usage while extracting actionable insights closer to data sources.
- Data Storage: Decide on the amount and type of data to be stored locally at edge nodes versus centralized cloud storage. Consider data retention policies, backup strategies, and compliance requirements (e.g., GDPR) for data privacy and security.
- Data Synchronization: Ensure seamless synchronization of data between edge nodes and centralized systems to maintain consistency and reliability across the distributed infrastructure.

3. Security:

- Edge Node Security: Implement robust security measures at edge nodes, including encryption, authentication, and access control mechanisms to protect data and applications from unauthorized access and cyber attacks.
- Data Privacy: Ensure compliance with data protection regulations by implementing privacy preserving techniques such as data anonymization and encryption. Limit data exposure and transmission over unsecured networks.
- Edge to Cloud Security: Secure communication channels between edge nodes and centralized cloud servers using VPNs, TLS/SSL protocols, or secure tunnels to prevent interception and tampering of data in transit.

10.0 Conclusion

The adoption of edge computing promises significant advancements across various sectors such as IoT, smart cities, autonomous vehicles, and industrial automation. It enables real-time decision-making, reduces latency, enhances data privacy, and improves overall system efficiency. As the technology continues to evolve, the potential for edge computing to reshape industries and unlock new possibilities remains profound, paving the way for a more interconnected and responsive digital ecosystem. Edge computing is not merely a technological trend but a paradigm shift that promises to redefine how we interact with data and applications in the era of digital transformation.

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THREATS ASSOCIATED WITH CONCURRENT FILE ACCESS

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Abstract
This study investigates threats associated with concurrent file access. It access file control, file locking as operating systems supports the concept of record locking. In dimensions of granularity, semantics, enforcement, optimistic concurrent control, begin, modify, validate and commit/rollback, timestamp ordering protocol. Threats and risk analysis on masquerade, evaves dropping, tempering, transmitted data replay, denial of service (DoS), repudiation, malicious data corruption. Process and deadlock in concurrent computing and concurrent composite operations in main memory.

1. Introduction

Concurrent file access as it pertains to storage, is the ability to access a particular LUN from either two different paths on a single host simultaneously (load balanced), or by two separate hosts within a cluster environment (distributed lock management).

The problem to overcome is when two hosts try to "change" the data at the same time. This is where a lock manager is needed to allow cooperation between the hosts for data access. Within a storage array, using dual ported fibre drives, the firmware can load balance a drive over both ports, and "queue" I/O across the "least full" path. This is a form of "concurrent access" also.

Things get real interesting when you use a "universal" file system. By universal, I mean a file system that is SAN based and is understood by all operating systems. This is very similar to file based access protocols like NFS and CIFS, but is "block" based for high performance applications. There are many vendors working on this type of solution, but it will need the involvement of ALL the OS vendors. This will mean cooperation between SUN (Solaris), Microsoft (NT, Win2K), IBM(AIX), HP(HP-UX), Compaq (VMS, True64 Unix), and all the Linux variants. Something this broad will need to be driven by a standards body like SNIA, FCIA, IETF or the IEEE.

2. Review of Related Literature

In this day and age, millions of computers across the world are connected on multiple hardware and software platforms through the internet (Hussain et.al n.d). There has been a significant increase in web based services and businesses in last two decades. Every small or big organization, ranging from small scale industries to large multinational banks, are dependent on their networks to connect to internet and provide multiple internet based services to serve various personal and professional needs for people and corporations. However, this exponential increase in the interconnectivity of computers over networks has also enabled malicious users to misuse resources and mount denial of service attacks. Denial of service attacks have the potential to affect various areas in an organization, primarily attacking the network infrastructure and the services relying on the network. Denial of service attacks have an aggressive and menacing intrusive behavior towards the network infrastructure and its components like hosts, routers, gateways, switches or an entire network (Jamdagni et al. 2014).

Organizations have adopted various approaches to manage significant information security risks affecting their key risk assets however until recently, DoS attacks were not considered as part of this. This has been the case now as there has been an increasing shift to e-business capabilities, relying on intercommunication between computers, and 24x7 availability of services. Any loss of network or unavailability of network can cause a financial, reputational and information loss. The information security risk management process establishes the organization's context, identifies information assets, threat and vulnerabilities, then assesses the impact and probability of threats occurring and puts control strategies in place (Visintine, 2003; Roper, 1999). Since DoS is not considered as a direct attack on key information assets, organizations have dealt such a risk as low for a long period of time. The major contribution of this paper is to provide a risk management perspective to DoS attacks which historically has not been considered as standard risk for information security. This paper first discusses and supports the inclusion of DoS as a threat or risk for business and its assets, attacking the seamless web based operations of the organization. Further, this literature, gives a risk management point of view to identify, analyze, evaluate and treat the threats associated with DoS attacks.

3. File Control

A File control makes it easy to read, write, or append to a file in a file system. The files can be one of the following types: XmlObject, RawData (binary), or String. When creating a File control, select the file type that matches the files present in the specified directory.

In addition, the File control supports file manipulation operations such as copy, rename, and delete. You can also retrieve a list of the files stored in the specified directory.

A File control performs an operation on a file. Each File control is customized to perform certain operations. This topic describes how to create a new File control and provides an example of the File control’s declaration in the java file. For information on how to add control instances to business processes

i. File Locking

File locking is a mechanism that restricts access to a computer file by allowing only one user or process to access it in a specific time.

Systems implement locking to prevent the classic *interceding update* scenario, which is a typical example of race condition, by enforcing the serialization of update processes to any given file. The following example illustrates the interceding update problem:

1. Process A reads a customer record from a file containing account information, including the customer's account balance and phone number.
2. Process B now reads the same record from the same file so it has its own copy.
3. Process A changes the account balance in its copy of the customer record and writes the record back to the file.
4. Process B, which still has the original *stale* value for the account balance in its copy of the customer record, updates the account balance and writes the customer record back to the file.
5. Process B has now written its stale account-balance value to the file, causing the changes made by process A to be lost.

Most operating systems support the concept of record locking, which means that individual records within any given file may be locked, thereby increasing the number of concurrent update processes. Database maintenance uses file locking, whereby it can serialize access to the entire physical file underlying a database. Although this does prevent any other process from accessing the file, it can be more efficient than individually locking a large number of regions in the file by removing the overhead of acquiring and releasing each lock.

Poor use of file locks, like any computer lock, can result in poor performance or in deadlocks. File locking may also refer to additional security applied by a computer user either by using Windows security, NTFS permissions or by installing a third party file locking software.

When files are shared among processes, concurrent accesses can lead to race conditions, similar to those that can occur in shared memory. To allow cooperating processes to coordinate access to shared files, file-system provides lock primitives. Dimensions in file locking:

Granularity

a. file lock: can lock entire file only
b. record lock: can lock arbitrary region of file (locks held on non-overlapping regions of a file do not conflict)

Semantics

a. shared lock: multiple processes can acquire shared locks for the same (region of) a file.
b. Exclusive lock: if a process hold an exclusive lock on a (region of) a file, no other process can hold a shared or exclusive lock on the same (region of a) file.

Enforcement

a. Mandatory lock: OS prohibits access to files by processes that do not hold the appropriate lock.
b. Advisory locks: OS does not restrict access to files based on lock ownership. Processes can chose to ignore locking.

ii. Optimistic concurrency control

Optimistic concurrency control (OCC) is a concurrency control method applied to transactional systems such as relational database management systems and software transactional memory. OCC assumes that multiple transactions can frequently complete without interfering with each other.

While running, transactions use data resources without acquiring locks on those resources. Before committing, each transaction verifies that no other transaction has modified the data it has read. If the check reveals conflicting modifications, the committing transaction rolls back and can be restarted (Kung & John, 2003).

OCC is generally used in environments with low data contention. When conflicts are rare, transactions can complete without the expense of managing locks and without having transactions wait for other transactions' locks to clear, leading to higher throughput than other concurrency control methods. However, if contention for data resources is frequent, the cost of repeatedly restarting transactions hurts performance significantly; it is commonly thought that other concurrency control methods have better performance under these conditions. However, locking-based ("pessimistic") methods also can deliver poor performance because locking can drastically limit effective concurrency even when deadlocks are avoided.

More specifically, OCC transactions involve these phases:

a. **Begin**: Record a timestamp marking the transaction's beginning.
b. **Modify**: Read database values, and tentatively write changes.
c. **Validate**: Check whether other transactions have modified data that this transaction has used (read or written). This includes transactions that completed after this transaction's start time, and optionally, transactions that are still active at validation time.
d. **Commit/Rollback**: If there is no conflict, make all changes take effect. If there is a conflict, resolve it, typically by aborting the transaction, although other resolution schemes are possible. Care must be taken to avoid a TOCTTOU bug, particularly if this phase and the previous one are not performed as a single atomic operation.

iii. Timestamp Ordering Protocol

The Timestamp Ordering Protocol is used to order the transactions based on their Timestamps. The order of transaction is nothing but the ascending order of the transaction creation. The priority of the older transaction is higher that's why it executes first. To determine the timestamp of the transaction, this protocol uses system time or logical counter. The lock-based protocol is used to manage the order between conflicting pairs among transactions at the execution time. But Timestamp based protocols start working as soon as a transaction is created. Let's assume there are two transactions T1 and T2. Suppose the transaction T1 has entered the system at 007 times and transaction T2 has entered the system at 009 times. T1 has the higher priority, so it executes first as it is entered the system first.

The timestamp ordering protocol also maintains the timestamp of last 'read' and 'write' operation on a data.

Basic Timestamp ordering protocol works as follows:

1. Check the following condition whenever a transaction Ti issues a **Read (X)** operation:
   a. If W_TS(X) >TS(Ti) then the operation is rejected.
   b. If W_TS(X) <= TS(Ti) then the operation is executed.
   c. Timestamps of all the data items are updated.
2. Check the following condition whenever a transaction Ti issues a **Write(X)** operation:
   a. If TS(Ti) < R_TS(X) then the operation is rejected.
   b. If TS(Ti) < W_TS(X) then the operation is rejected and Ti is rolled back otherwise the operation is executed.

Where,

TS(TI) denotes the timestamp of the transaction Ti.

R_TS(X) denotes the Read time-stamp of data-item X.

W_TS(X) denotes the Write time-stamp of data-item X.

Advantages and Disadvantages of TO protocol:

a. TO protocol ensures serializability since the precedence graph is as follows:

Image: Precedence Graph for TS ordering

Fig. 1: Timestamp Ordering Protocol

b. TS protocol ensures freedom from deadlock that means no transaction ever waits.
c. But the schedule may not be recoverable and may not even be cascade- free.

4. Threats and risk analysis

4.1 Eavesdropping

Eavesdropping is the act of secretly or stealthily listening to the private conversation or communications of others without their consent.[1] The practice is widely regarded as unethical, and in many jurisdictions is illegal. Eavesdropping vectors include telephone lines, cellular networks, email, and other methods of private instant messaging. VoIP communications software is also vulnerable to electronic eavesdropping via infections such as trojans. Network eavesdropping is a network layer attack that focuses on capturing small *packets* from the network transmitted by other computers and reading the data content in search of any type of information. This type of network attack is generally one of the most effective as a lack of encryption services are used. It is also linked to the collection of metadata. Those who perform this type of attack are generally black hat hackers; however, government agencies, such as the National Security Agency, have also been connected.

4.2 Tempering

Tempering is a process of heat treating, which is used to increase the toughness of iron-based alloys. Tempering is usually performed after hardening, to reduce some of the excess hardness, and is done by heating the metal to some temperature below the critical point for a certain period of time, then allowing it to cool in still air. The exact temperature determines the amount of hardness removed, and depends on both the specific composition of the alloy and on the desired properties in the finished product. For instance, very hard tools are often tempered at low temperatures, while springs are tempered to much higher temperatures.

4.3 Transmitted Data Replay

A replay attack is a category of network attack in which an attacker detects a data transmission and fraudulently has it delayed or repeated. The delay or repeat of the data transmission is carried out by the sender or by the malicious entity, who intercepts the data and retransmits it. In other words, a replay attack is an attack on the security protocol using replays of data transmission from a different sender into the intended into receiving system, thereby fooling the participants into believing they have successfully completed the data transmission. Replay attacks help attackers to gain access to a network, gain information which would not have been easily accessible or complete a duplicate transaction. A replay attack is also known as a playback attack.

4.4 Denial-of-service (DoS)

A denial-of-service (DoS) is any type of attack where the attackers (hackers) attempt to prevent legitimate users from accessing the service. In a DoS attack, the attacker usually sends excessive messages asking the network or server to authenticate requests that have invalid return addresses.

In computing, a denial-of-service attack (DoS attack) is a cyber-attack in which the perpetrator seeks to make a machine or network resource unavailable to its intended users by temporarily or indefinitely disrupting services of a host connected to the Internet. Denial of service is typically accomplished by flooding the targeted machine or resource with superfluous requests in an attempt to overload systems and prevent some or all legitimate requests from being fulfilled.[1]

In a distributed denial-of-service attack (DDoS attack), the incoming traffic flooding the victim originates from many different sources. This effectively makes it impossible to stop the attack simply by blocking a single source.

A DoS or DDoS attack is analogous to a group of people crowding the entry door of a shop, making it hard for legitimate customers to enter, disrupting trade.

Criminal perpetrators of DoS attacks often target sites or services hosted on high-profile web servers such as banks or credit card payment gateways. Revenge, blackmail and activism can motivate these attacks.

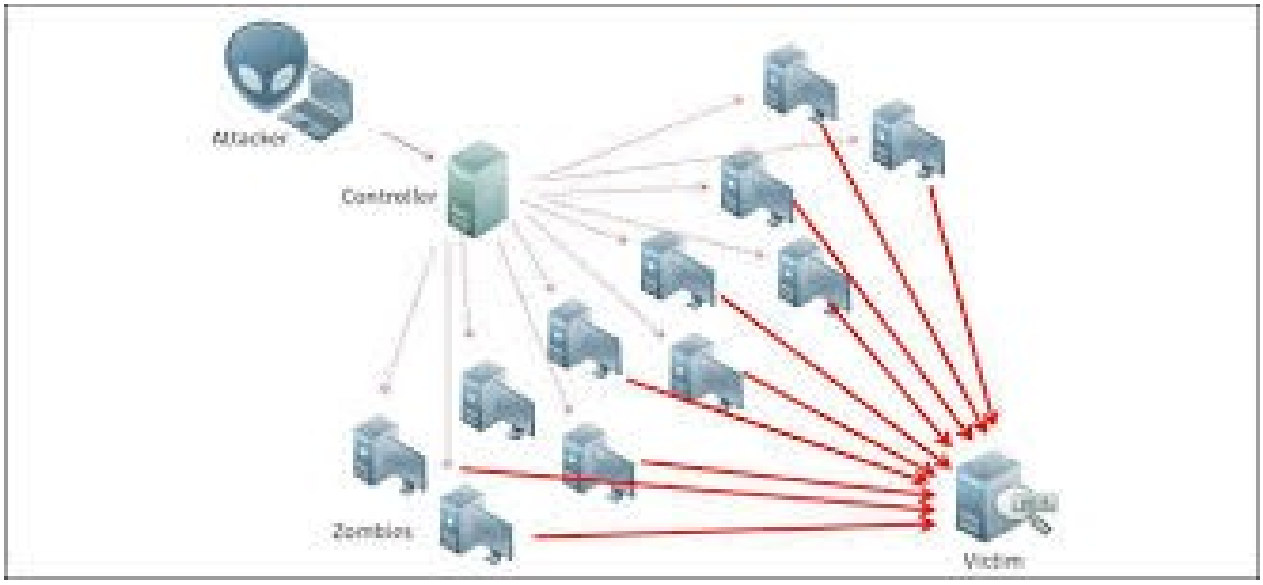


Fig 2: Denial-of-service (DoS)

4.5 Repudiation

Repudiation is the act of refuse authoring of something that happened. A repudiation attack happens when an application or system does not adopt controls to properly track and log users' actions, thus permitting malicious manipulation or forging the identification of new actions. This attack can be used to change the authoring information of actions executed by a malicious user in order to log wrong data to log files. Its usage can be extended to general data manipulation in the name of others, in a similar manner as spoofing mail messages. If this attack takes place, the data stored on log files can be considered invalid or misleading.

4.5 Malicious data corruption

Malicious Data corruption refers to errors in computer data that occur during writing, reading, storage, transmission, or processing, which introduce unintended changes to the original data. Computer, transmission, and storage systems use a number of measures to provide end-to-end data integrity, or lack of errors.

In general, when data corruption occurs a file containing that data will produce unexpected results when accessed by the system or the related application. Results could range from a minor loss of data to a system crash. For example, if a document file is corrupted, when a person tries to open that file with a document editor they may get an error message, thus the file might not be opened or might open with some of the data corrupted (or in some cases, completely corrupted, leaving the document unintelligible). The adjacent image is a corrupted image file in which most of the information has been lost.

Some types of malware may intentionally corrupt files as part of their payloads, usually by overwriting them with inoperative or garbage code, while non-malicious viruses may also unintentionally corrupt files when it accesses them. If a virus or trojan with this payload method manages to alter files critical to the running of the computer's operating system software or physical hardware, the entire system may be rendered unusable.

5. Process And Deadlock

Process Synchronization means sharing system resources by processes in a such a way that, Concurrent access to shared data is handled thereby minimizing the chance of inconsistent data. Maintaining data consistency demands mechanisms to ensure synchronized execution of cooperating processes.

In concurrent computing, a deadlock is a state in which each member of a group is waiting for some other member to take action, such as sending a message or more commonly releasing a lock. Deadlock is a common problem in multiprocessing systems, parallel computing, and distributed systems, where software and hardware locks are used to handle shared resources and implement process synchronization.

In an operating system, a deadlock occurs when a process or thread enters a waiting state because a requested system resource is held by another waiting process, which in turn is waiting for another resource held by another waiting process. If a process is unable to change its state indefinitely because the resources requested by it are being used by another waiting process, then the system is said to be in a deadlock.

In a communications system, deadlocks occur mainly due to lost or corrupt signals rather than resource contention.

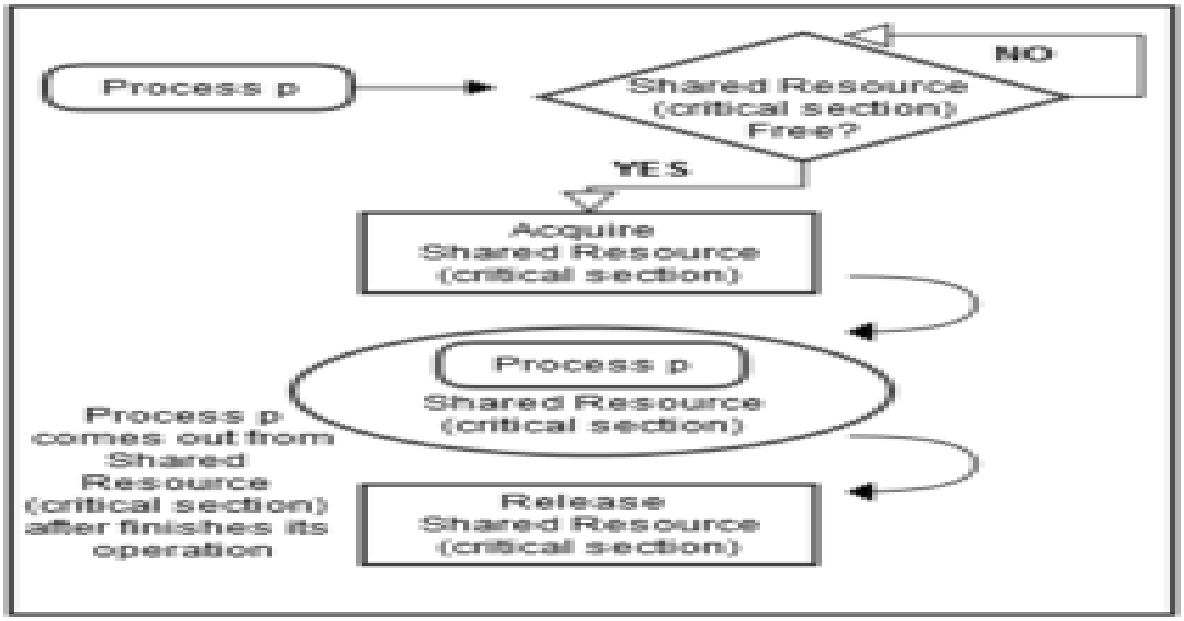


Fig. 3: Process

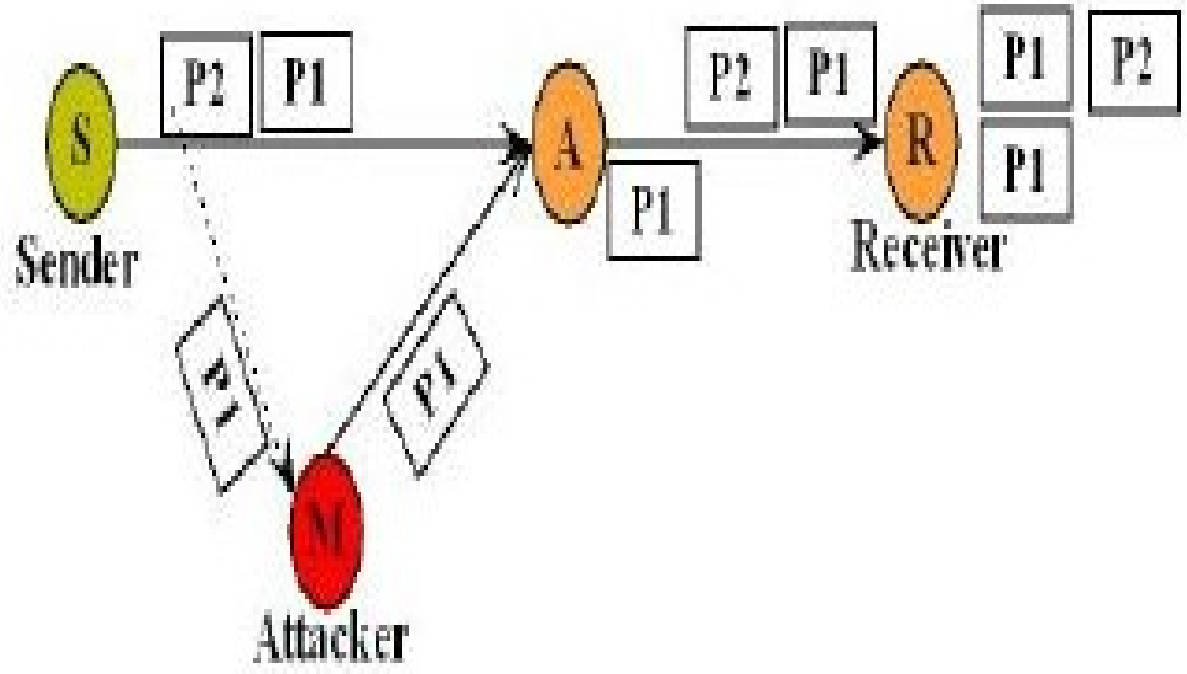
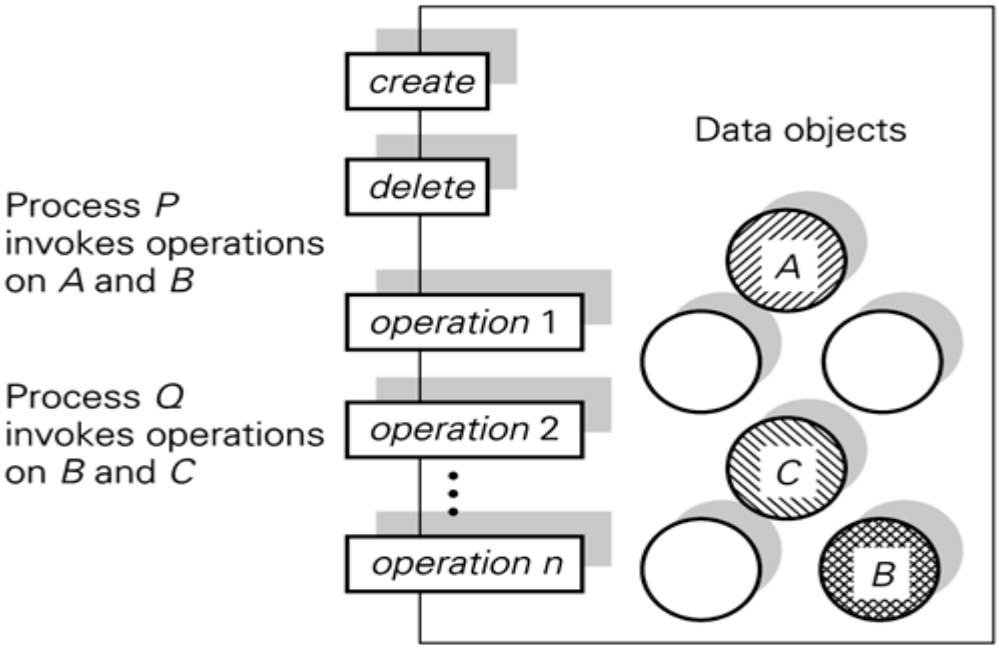


Fig. 4: Deadlock

6. Concurrent composite operations in main memory

Assume that a concurrent program has been developed in a modular fashion. We assume that each shared data abstraction is implemented as an abstract data type, as shown above and a data object is locked for exclusive use while any of its operations is invoked. Section showed how this might be implemented for a single operation.

Fig. 5: Related operations on data objects in main memory.



Conclusion

The basic idea behind the Internet was to have openness in communication with speed and reliability. The fast paced development of technology and its standards have attracted organizations in relying their businesses on the web services. Existence of tools and techniques to bypass the security standards governing the web networks, have evolved as a devastating way to impact an organization or an economy as a whole. We analyzed the Denial of Service attacks on the organization's networks, impacting their business profits as well as their reputation in the market. We have analyzed such attacks interrupting the end user services from the risk management perspective which focused on Identification of such threats, their analysis and evaluation and finally treatment.

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TEAMWORK: A TOOL FOR EFFECTIVE FOOD SERVICE OPERATION

(A REVIEW)

BY

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Abstract

Contemporary food service business establishment lay so much emphasis on the value of team work in optimizing employee job performance, recognizing it as a pivotal attribute for organizational success. This research highlight the relevance of teamwork practices in achieving food service profitability. The research also provides insight on working as part of a team, team characteristics, team group development stages, team building and team building barriers. Leadership and leadership styles are equally highlighter in the research. The researcher adopted a review method, with emphasis on literature on team work and team building viz a viz the benefits derivable from team building in food service organization.

Keywords: Teamwork, Collaboration, Employee, Productivity

Introduction

The goal of every restaurant and food service establishments is to provide high quality meals and excellent service to customers while staying within food and labour costs so that the operation can make significant profit (Matson, 2020). This goal can only be achieved with the cooperation and support of all service staff. Team work has emerged as a prevalent and integral approach within an organizational frame works, prominently observed in various sectors, including the food and beverage service industry in most part of Nigeria. These food service industries structure their tasks in alignment with the over arching mission and vision outlined in their mission statements, organizing distinct working units or department, each with designated leadership structures and specific mandates. These interdependent units

collaborate, share resources cohesively to collectively achieve organizational objective (Wanyeke, Maina, Sanyanda & Kiru, 2019).

Team invariably outperform individuals if they are working effectively. When groups come together to solve problem, they come up with more creative and flexible solutions than could individuals. In restaurants and similar food service outlets, excellent food service is always a team effort. If the meal is not well prepared or if the service is poor, the customer may not enjoy the dinning experience. All members of the team have a role in making the customer experience memorable (Matson, 2020).

Employee performance and discipline constitute the cornerstone of an individual's contribution to an organization, encompassing activities aimed at fulfilling organizational objectives. Employee performance evaluation involves a comprehensive assessment of various components such as work quality, quantity, cooperativeness discipline, diligence, resourcefulness, reliability, conduct, self development efforts and experience (Abosede & Adesanya, 2017). Evaluating an employee's performance provides critical insights into their contributions to organizational goals, and it is instrumental to determining merit based outcomes within work place.

In most food and beverage service establishments, cooks often think only of the team in the kitchen. The kitchen staff members may think of themselves as a team ("us") allied against the front of house staff ("them") the kitchen staff on the other shifts, management and other proponents of the operation may also consider "them". This is not productive in a well organized restaurant. The staff may believe that if only "they" were more understanding, working harder, or knew what it was really like, "we" could do the best job of course this same thinking is prevalent in other group, except in reverse.

The flaw with this kind of thinking is that it pits one group against the other. It contributes to poor customer service petty jealousies and conflicts can lead to various schemes to get the better of the other group. This is an immature way of looking at your work place and unfortunately the customer will suffer. Being part of a team means being respectful to all other members for their particular role and duties. Team building entails inculcating discipline, good relationship, respect for each other and seeing each member of a group as one. When the entire group sees itself as having a common set of goals to achieve, and each member of the team understands his or her contributions to the overall team effort, the best result is achieved.

The objective of this research is centered on the need for every food service restaurants management to inculcate team building and work discipline amongst its employees. This research work also highlight requisite characteristics of a working group, team group development stages, role of team members, barriers to group performance, leadership, leadership roles, leadership styles and delegation of responsibilities and authority in work place environment for organizational success.

Study Methodology

The researcher adopted a review method, where secondary literature on team work and team building were explored, taking into consideration the challenges inherent of food service operations where team work and team building is lacking.

Study Literature

Groups that work effectively have the following characteristics (Matson, 2020):

- Group members share a sense of purpose or common goals that each member is willing to work toward. Members feel that they played a role in determining these goals and the methods used to achieve them. When a task is accomplished or the demands of the situation change, the group can change its focus or direction to meet the new goals.
- The group is concerned not only with the task, but also with its own processes and operating procedures. The group periodically evaluates its performance.
- The group members use one another as a resource. The group willingly accepts the influence and leadership of members whose resources are relevant to the immediate task. Roles are balanced and shared to ensure that the tasks are accomplished and that group cohesion and morale are enhanced.
- Communication is clear and direct. Group members continually try to listen to and clarify what is being said and show interest in what others say and feel. Differences of opinion are encouraged and freely expressed.
- The group focuses on problem solving rather than expending energy on competitive struggles or interpersonal issues. The group is willing to deal with conflict and focus on it until it is resolved or managed in a way that does not reduce the effectiveness of the group and its members. Confrontation is accepted as a challenge to examine one's behaviour or ideas. It is not viewed as an uncaring personal attack.
- Mistakes are seen as sources of learning rather than reasons for punishment. This encourages creativity and risk taking.
- The group has a clear set of expectations and standards for the behaviour of group members.
- Developing a climate of trust underlies all of these elements. In order to trust one another, individuals in a group must understand and get to know one another.

Stages of group development

Groups go through a set of predictable stages of development. In 1965, Bruce Tuckman, who carried out research on group dynamics, identified the four stages as forming (getting to know each other); storming (initial confrontation as group members identify their differences); norming (coming together to work for the benefit of the team); and performing (working well together with a process to deal with any differences of opinion and reassessing to look for opportunities for improvement). (Tuckman, 2019)

- **Forming:** When a group is first formed, individuals wait and see what is going on. They are unsure of their role and concerned about how they will fit in. They want to belong to the group, feel accepted, and find out what the task is. If you think for a moment, you will probably remember feeling like this on your first day of work. The supervisor or leader can help at this stage by providing a comfortable and structured environment. Ensure that each person is introduced and there is an opportunity to get to know one another. Be clear about goals and expectations.

- **Storming:** During the confrontation stage, individuals in a group begin to struggle to establish their place in the group. They may challenge the leadership of the group or the group boundaries. They may also, for the first time, express disagreement or impatience with the task or group process. At first, the leader may wonder why the group, which seemed to be working well, now seems to be in trouble. This stage is healthy because group members feel comfortable and trusting enough to air conflicts which previously had been kept hidden. The supervisor needs to provide time to deal with issues as they arise and avoid the temptation to "put the lid on" the conflict. Healthy dissent leads to better problem solving and better cooperation. If you prevent conflict from being expressed, it may continue to fester under the surface, causing greater problems later on.
- **Norming:** At the working stage, groups have developed methods of dealing with task and process and can work effectively together. People become more tolerant of differences in the group and encourage self-expression. The group can accept and build on one another's strengths, sharing tasks in the most productive way.
- **Performing:** During maturity, the group continues to cooperate to resolve issues and accomplish objectives. The group can stagnate and become less effective if new challenges and opportunities do not arise. Perhaps you have worked in a restaurant where the entire working group has been together for a couple of years. The group works together well, but unless there are new challenges, such as a new menu or an expansion, the situation can become boring. When group members are bored and unchallenged, their performance may decline and conflicts between members may start to dominate the working of the group.

During reassessment, members examine their performance and working processes. They begin to provide honest feedback which is not always positive and begin to share ideas that might create conflict. As a result of this examination, the group can continue to develop its effectiveness.

Work groups are constantly being formed and reformed as new staff members join and others leave. New members of the team have the same needs as new groups. Because the team has a different membership, the whole group may revert to an earlier stage of development. This is especially true if the new team member has a position of authority over other members. A good leader always watches for signs that the group needs more structure or a new challenge.

This sense of teamwork is not something that just happens; it is created through good communication, leadership, caring for individuals as people, and an understanding of group process.

Types of Team

Two types of team can be identified within an organization.

(a) **The formal team:** This is a department or section created within a re-organised structure to pursue specific goals.

(b) **The informal team:** This is a type of team where members have fewer fixed organizational relationships and the team is disbanded after performing its function

selecting and shaping teams to work within a department is a very important task. This is the job of the departmental head. It requires management skills, matching each individual talent to the task or job has to be considered.

A well developed team should be able to;

(i) Analyse problems effectively and create useful ideas.
(ii) Communicate with each other and gets things done.
(iii) Show good leadership which will result in skilled operation with technical precision and ability.
(iv) Evaluate logically and equate control system.

The group will never become a team unless the personalities involved are able to relate and communicate with one another and value the contribution that each employee or team members makes.

The team leader as expected to have a strong influence on his team or that have to be followed, particularly when under pressure, dealing with conflict personality clash, change and stress.

Peoples behaviour is affected by many factors

- Individual characteristics
- Cultural attributes and social skills

The team leader must lead rather than drive and encourage the team to practice reasonable and supportive behaviour so that any problem are dealth with in an objective way and the team personal skills harnessed to achieve their full potential.

Roles of group members

Members of a work group fall into two categories. Initiators are the people who speak up first and generate ideas. They contribute their knowledge of relevant information and experience and give opinions. Responders listen and respond to suggestions they have heard. They evaluate information, criticize proposals, and ask questions. They play an important role in developing the ideas put forward by initiators.

As the group process continues, members switch back and forth between the roles. Both roles are important for group function. Groups need a balance between these roles. If there is only idea generation, the result will be a contentious, unruly group that is too divided to make up its mind. If there is too much emphasis on criticism of contributions and evaluation of ideas, the group may not come up with any new and innovative ideas to try. Maintaining a balance is the role of the group leader.

Barriers to group performance

In an effective group, the purpose of the group takes precedence over the needs of individuals. When individuals place their needs ahead of those of the group, they act as a barrier to performance. These people can be classified as:

- Aggressors who want to win or exert power
- Defeatists who feel that the problem is insurmountable, and sometimes, demoralize the group and sabotage the group process

- Stars who have to be in the limelight all the time, even when not making a contribution
- Storytellers who keep lapsing into asides and irrelevant conversations
- Clowns who just want to get attention and laughs
- Dominators who want to run things more than they want to solve the problem
- Axe-grinders who relate everything to their pet peeve

Perhaps you can think of one or two people with whom you've worked who fit into these categories.

Challenges Every Team Leader has to deal with:

1. The egos weakness and the strength of individuals
2. The self appointed experts within the group
3. Relationships/circumstance constantly changing

The lead team is able to manage the team successfully by pulling back from the taks in hand. He or she must examine the processes that create efficient team work finding out what it is that makes it greater than the sum of its parts. To assist this process the following attributes are necessary.

- Have a consistent approach to solving problems
- Take into account peoples characters as well as their technical skills
- Encourage supportive behaviour in the team
- Create an open and healthy environment
- Create time to appraise the team progress

Supportive team practices

(a) Listening Skills

- Pay attention, responding positively
- Look interested, avoid interrupting
- Build on proposals, asking for clarity on questions
- Summarise to check your understanding

(b) Co-operating

- Encourage others to give their views
- Compliment good ideas
- Avoid co-ercion and acrimony
- Give careful consideration to different proposals
- Offer new ideas openly

(c) Evaluating team practices

- Any assumptions are questioned in a reasonable manner
- Continually refer back to the problem solving process and aims
- Review the progress of objectives and aims in relation to the team and in taken

Good communication

Good communication always leads to better cooperation. Communication that is honest and assertive tells the listener what you need. It does not expect the listener to read

between the lines. When appropriate, it also expresses feelings about the situation. When problems arise, honest communication allows them to be resolved in a mature way.

When you deal with problems in an aggressive manner, the situation may appear to be resolved in your favour initially, but the other person will likely have hard feelings and resentments. If you deal with problems by giving in to others even though you feel your position has some validity, or when you complain to others but not to the persons involved, you may also begin to feel resentments. Over time, hard feelings and resentments may continue to build over a series of small incidents.

Leadership

Leadership is important in a team. A good supervisor is a leader who can bring the group together and build an environment in which the team can work together effectively. A leader acts as a:

- Representative of management
- Role model
- Problem solver
- Motivator
- Manager of daily operations

A group leader does not have to perform all of these functions all of the time. Some of the most effective leaders lead from behind. They lead the group unobtrusively, sharing the responsibilities and rewards of leadership.

That does not mean that they do nothing. They work hard at “catching people doing it right” and acknowledging their efforts. They value the contributions of others and share decision making. They also recognize when it is important to step in and take charge.

A successful leader has the ability to influence employees by making suggestions and guiding discussion. Every supervisor has legitimate power, which is the authority associated with being a boss. In addition to this authority, effective leaders have a second type of power: the power to influence or persuade people. This power depends on the employee’s acceptance of the supervisor as a person who makes sound judgments and merits respect.

Employees may obey the requests of an authority, but they will go above and beyond the call of duty for someone with influence. Of course, a supervisor needs both authority and influence. If the supervisor has no authority to make decisions, he or she will be unable to create a climate in which work can be performed. In turn, he or she will not enjoy the respect and acceptance that creates influence.

Successful leaders combine a focus on task (getting the job done) with a commitment to helping employees achieve their personal goals. If a supervisor concentrates only on accomplishing tasks, he or she will be perceived to be uncaring and unsupportive. Employees may feel that they are not appreciated for their unique skills and interests.

If, on the other hand, the supervisor concentrates only on making employees feel comfortable and fostering a pleasant work environment, the tasks for which the group is responsible may not be accomplished. The owner of the company will not get the necessary job performance. Profits and customer service will suffer. Although you might expect

employees to be satisfied, they will not have a sense of accomplishment in their work. Morale will suffer.

Leadership styles

The style of leadership that supervisors use can be categorized into four types:

- Authoritarian
- Passive
- Bureaucratic
- Participative

Authoritarian leaders plan, organize, coordinate, control, and direct in a very commanding manner. They make the decisions and expect their subordinates to obey. Most military units function under this type of leadership. This does not mean that the leader is not concerned about the welfare of the staff. This type of leader may be a caring individual, but may feel that he or she is in the best position to judge what is best for the staff being supervised. He or she may be like the wise and caring father in a traditional family.

Passive leaders do not want to face conflict. They avoid situations where decisions have to be made or they have to interact with others. They have little concern for either people or production. This style of leadership is seldom appropriate in the type of situations encountered in the food service industry.

A bureaucratic leader expects employees to put in an honest day's work for an honest day's pay. He or she expects everyone to play by the rules. The results may be predictable, but this type of leadership does not foster creativity or initiative.

Participative leaders believe that participation in decision making is the key to achieving the company's goals. In today's world, where most people have a strong streak of individualism, this style may complement the personality and needs of employees well.

However, this does not mean it is appropriate in all situations. For example, an authoritarian style will likely be most effective in an emergency. If there is a fire in the restaurant and the customers and guests must be evacuated, someone needs to take charge quickly. There is no time to consult with staff and arrive at a consensus about what approach should be taken.

The style you choose should reflect the needs of a situation, taking into consideration your personality and the needs of your employees. When you have chosen a style (or one is imposed from above), do not attempt to disguise it. For example, authoritarian leaders sometimes wish to appear more participative. They make a pretense of consulting with others, when in fact a decision has already been made. This only angers and confuses their subordinates.

Tips on being an Effective Leader:

- Be clear about your expectations of employees. Expect excellent performance and customer service. Let employees know that you have confidence in them.
- Share the responsibilities of the job and the credit for a job well done. Praise employees on work well done.

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- Give honest feedback to help employees improve performance. See mistakes as an opportunity to grow and develop.
- Earn respect by modelling appropriate behaviour and exercising self-discipline.
- Be positive and encouraging about challenges the group faces. Introduce incentives to help your group achieve the desired level of productivity. Respond to your employees' motivation and efforts by showing enthusiasm.
- Enhance your knowledge and skills so that you can answer employee questions and provide detailed information about specific processes and techniques employed by your business.
- When challenges arise, pitch in and help where help is needed. Encourage others to do so as well.
- Stand up for your staff when they need support. Listen to your employee's side of the story before you make a decision.
- Do not be a gossip or a back stabber. Never say or repeat anything you are not prepared to acknowledge saying.
- Be consistent, firm, and fair.

Delegation

Some supervisors believe that if you want a job done, do it yourself. These individuals often work themselves so hard that they burn out. They may work long, hard hours and be admired by others, but inevitably something slips. Perhaps the supervisor becomes ill due to overwork. Because the junior staff have never been given the opportunity to learn the work performed by that individual, the performance of the whole team suffers. Junior staff may feel unappreciated and unchallenged because they have not been given the opportunity to learn new skills.

Delegation of tasks provides you with time to meet your responsibilities. It recognizes the abilities of others and provides them with opportunities to develop their skills and talents. It divides the work to be done among the team members, increasing effectiveness and efficiency.

When you delegate a task to a junior staff member, it is not enough to simply ask the person to do the job. You must ensure that you:

- Explain why the task is necessary and how it relates to the goals of the company
- Explain what is to be done
- Set performance standards
- Give a timeline for completion of the task
- Give the person the necessary resources, authority, and responsibility to carry out the task
- Provide adequate training
- Give support and guidance during the initial period
- Provide feedback on completion of the task

For example, you are planning changes to the menu. You need to test and cost the recipes for the new items. You decide that one of the apprentices you supervise could handle

some of the breakfast items you are considering adding to the menu. You might proceed as follows:

“Kuldip, I would like your help in testing and costing the recipe for a new fruit waffle (what) that we are considering adding to our breakfast menu (why).

“You will need to prepare the recipe exactly as shown here. You will calculate the food cost and estimate a menu price based on a 35% food cost. You will prepare four portions that we will serve to some of the dining room staff to get their reactions. I want you to listen to their comments carefully and make notes regarding the flavour, presentation, and cost. I would also appreciate your suggestions on dealing with these comments (what, performance standards).

“Do you have any questions about what you will do?

“In order to test this item, I would like you to stay an extra half hour tomorrow. I will arrange the schedule with the restaurant manager. All the necessary supplies are available. The dining room staff knows that they will be working with you, but you will have to explain exactly what information you need (necessary resources, authority and responsibility).

“I would like your report by 2:30 tomorrow (timeline).

“Do you understand how to fill out the standard recipe costing form we use? This process was covered in your third-year apprentice technical training class. If you have any problems, review this material (handing apprentice an appropriate reading) or come to see me for help (provide training and offer support).”

On the following day, you would go over the report and provide feedback to Kuldip on what she did well and what she could improve.

Conclusion

Team members are expected to share a sense of purpose as common goal, that each member is expected to work towards achieving. Team managers who determined to achieve team objective should prioritize participative management to enhance employee skills experience and involvement in decision making process. This can be achieved through fostering collaboration. By focusing on these aspects food service firms can improve task accomplishment timeliness of output and employee innovativeness ultimately leading to higher productivity and competitiveness in food service industry.

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A chef plating food ©go2HR.used with permission

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The Contributions of Global Systems for Mobile Telecommunications(GSM) to the Growth of the Nigerian Economy in Etsako West Local Government of Edo State, Nigeria

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Abstract
This study examines the contributions of Global Systems for Mobile Telecommunications(GSM) to the growth of the Nigeria economy since inception. *The paper highlights the problems the country faced prior to the introduction of GSM, t*elephone was not a common commodity but was exclusively owned by government officials, mostly restricted to offices and the homes of Nigerians elites and the rich, Embassies, Military formations, big businesses like hotels, supermarkets, hospitals, universities, and a few other places of interest. Social interaction and communication via telephone was very limited, costs of doing business and travels costs were very prohibitive. Since the introduction of GSM, sectors like information technology, banking and finance, online trade, sporting, education, entertainment, security and healthcare have significantly improved over the years. But there are still some *challenges that face the country in reaping the full benefits of GSM such as* monumental infrastructural challenges operators face, high logistics costs, inconsistent power supply, high technical staff depth, multiple taxations, high-interest rates, lack of credit structure, low Tech Small and Medium Enterprise(SME)platforms and entrepreneurs, conflicting government policies and lack of adequate youth tech start-ups.
Data were collected in Etsako West Local Government area of Edo state using structured questionnaires. The analysis was based on ranking, Chi-square and t-test via SPSS version 22.0. The finding revealed that 78% of respondents agreed that GSM has positively contributed to the growth of the country economy. It also showed that the introduction of GSM has created both direct and indirect employment opportunities for millions of Nigeria youths. More so, the study found that GSM business had reduced cost of doing business in terms of traveling and transaction costs.
The study concluded from the empirical investigations that GSM has contributed positively to the economic growth of Nigeria and has served as source of income and employment to many Nigerian youths. More so, the findings suggested the need for Nigerian Communication Commission (NCC) and the Federal Government of Nigeria to provide the necessary infrastructures (particularly power supply) to ease the efficient delivery of GSM services and to reduce their charges. The government should also create atmosphere for the expansion of tele-density and directly make telephone communications accessible. To achieve this goal, more licenses should be given to GSM operators in order to allow for healthy competition among the GSM operators.

Keywords*:* Global System for Mobile Telecommunication, Economic growth, Deregulation, Tele-density, SME.

Introduction
The advent of Global Systems for Mobile Telecommunications (GSM) in Nigeria marked a transformative phase in the nation's economic, social, and technological evolution. Since the liberalization of the telecommunications sector in 2001 and the subsequent licensing of GSM operators, Nigeria has witnessed a paradigm shift in the way people communicate, conduct business, and access information. The penetration of GSM technology has not only bridged communication gaps across urban and rural areas but has also catalyzed

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economic development by fostering entrepreneurship, enhancing productivity, and facilitating the delivery of critical services.

Before the introduction of GSM, Nigeria's telecommunications infrastructure was underdeveloped, unreliable, and largely inaccessible to the majority of the population. The monopolistic structure under the Nigerian Telecommunications Limited (NITEL) offered limited coverage and substandard service quality. The liberalization policy initiated by the Nigerian Communications Commission (NCC) opened the sector to private participation, ushering in mobile network operators such as MTN, Airtel, Globacom, and 9mobile. These operators brought substantial investments, improved infrastructure, and enhanced service delivery to millions of Nigerians (Adeola, O., & Ikpefan, O. A., 2021).

GSM technology has since become a critical enabler of economic activities across various sectors, including commerce, agriculture, education, health, and financial services. It has facilitated the growth of small and medium-scale enterprises (SMEs), improved market access for rural farmers, enabled mobile banking and fintech innovations, and contributed significantly to government revenues through taxes, licensing fees, and job creation. Moreover, the telecommunications sector, largely driven by GSM services, has consistently contributed to Nigeria's Gross Domestic Product (GDP), demonstrating its strategic importance to national development. However, several demerits have also aroused from this advancement such as cyber-crime, cyber-bullying, blackmailing, identity theft and reduced productivity attributed to social media distractions. Even with the apparent progress, it can be concluded that the telecommunication sector is still quite under-exploited in Nigeria. The lack of basic infrastructures like constant electricity and accessible road networks across several parts of the country, and the harsh economic policies have severely limited the potential for heightened economic productivity (Oluwafemi, K. B., & Alabi, F. 2020)

This paper seeks to critically examine the contributions of GSM to the growth of the Nigerian economy. It explores key economic indicators such as employment generation, investment inflow, financial inclusion, and sectoral GDP contributions. In addition, the paper highlights the socio-economic impact of GSM adoption on livelihoods and national productivity. By drawing upon empirical data, regulatory reports, and scholarly literature, this study provides a comprehensive analysis of how GSM services have evolved into a cornerstone of economic progress in Nigeria.

Statement of the Problems

Before the introduction of Global Systems for Mobile Telecommunications (GSM) in Nigeria in 2001, the country's telecommunications landscape was characterized by inefficiency, poor service delivery, and limited access to communication facilities. The sector was monopolized by the government-owned Nigerian Telecommunications Limited (NITEL), which failed to meet the communication needs of the rapidly growing population. Telephone services were largely confined to major urban centers, leaving the vast majority of the population, particularly in rural areas, without access to reliable communication infrastructure.

At the time, Nigeria had one of the lowest teledensity rates in the world, with only about 400,000 connected telephone lines serving a population of over 120 million people (NCC, 2001). The process of obtaining a telephone line was cumbersome, expensive, and often took several months or even years. In addition, the quality of service was extremely poor, plagued by frequent call drops, limited coverage, and inadequate customer support.

This communication deficit had far-reaching implications for national development. Businesses struggled to communicate efficiently with clients and partners, government institutions were hampered in their operations, and citizens lacked a means to access timely information or emergency services. The absence of a competitive telecommunications market discouraged innovation and private investment, further stalling progress in the sector.

Consequently, the lack of accessible, affordable, and reliable communication services significantly hindered economic growth, limited job creation, and contributed to the marginalization of rural communities. The urgent need to address these deficiencies paved the way for the liberalization of the telecommunications sector and the introduction of GSM technology, which promised to revolutionize communication and stimulate economic development across Nigeria.(Olayemi, M. A., & Aderibigbe, T. A., 2021)

Objective of the Study

The objective of this paper is to do a holistic comparative study to examine the socio-economic impact of GSM penetration in Nigeria. More so, this study highlights how the revolution in the telecommunications industry has changed the lives of Nigerians. Also, the research work would investigate if truly the telecommunications industry has been a significant contributor to the economy, how it has enhanced the lifestyle of Nigerians, businesses, social engagements, and networks, and the contributions to the GDP of the country.

Hypothesis Statement

H_1: GSM has contributed positively to the growth of the Nigeria economy.
H_0: GSM has not contributed positively to the growth of the Nigeria economy.

Overview of GSM Economic Growth in Nigeria

The integration of GSM technology into Nigeria's telecommunications landscape has attracted considerable scholarly attention, particularly due to its profound economic implications. Several studies have highlighted the pivotal role of mobile telephony in transforming the Nigerian economy and improving the standard of living across both urban and rural areas.

According to (Ibrahim, A., & Adewoye, J., 2023), mobile phones have significantly reduced transaction costs and information asymmetry in developing economies, thereby enhancing market efficiency and boosting productivity. In the Nigerian context, GSM technology has not only improved communication but has also become a platform for innovation, particularly in sectors such as finance and agriculture. Similarly, Olayemi & Aderibigbe (2021) observed that the adoption of GSM has expanded the digital economy, enabling millions of Nigerians to access online markets, mobile banking services, and digital financial platforms.

The economic contributions of GSM can also be seen in employment generation. The expansion of mobile networks has led to both direct and indirect employment opportunities through network operations, sales, customer service, and related value-added services (Ndukwe, 2008). This growth has been complemented by infrastructural investments from major telecom providers such as MTN, Airtel, Globacom, and 9mobile. According to the Nigerian Communications Commission (NCC, 2022), the telecommunications sector contributed 12.61% to Nigeria's GDP in the second quarter of 2022, with GSM services forming the backbone of this growth.

Moreover, GSM has been instrumental in enhancing financial inclusion. Mobile money platforms and GSM-enabled fintech services have allowed unbanked populations, especially in rural areas, to participate in the formal economy. These services have provided avenues for savings, credit, and insurance, which were previously inaccessible to millions of Nigerians.

Despite these gains, some scholars have noted the challenges associated with GSM growth in Nigeria. These include poor network coverage in rural areas, high cost of services, and issues of data privacy and cyber security. Furthermore, infrastructure deficits such as inconsistent power supply and limited broadband penetration continue to hinder the full realization of GSM's potential.

In sum, the body of literature affirms the significant and multifaceted contributions of GSM to Nigeria's socio-economic development. However, it also underscores the need for strategic investment and regulatory reforms to address existing limitations and maximize the impact of GSM technology on national growth (Aderemi, *et al.*,2022).

GSM Penetration Journey in Nigeria from 2004 to 2019

The Telecommunications sector in Nigeria has significantly improved from a government monopoly organization with around 11,400,000 subscribers in 2004 to over 180,250,000 subscribers in 2019. More so, teledensity followed the same growth pattern, from 12% in 2004 to over 100% in 2019, internet penetration grew from 8% to 44.68% in 2019 and with the sector contributing over $70 billion to GDP at just 9% (from 2004-2019). (Adeyemi, *et al.*, 2021).

Agboola, *et al.*, (2020) posited that the Telecommunications sector has pulled in around 25 billion US dollars from direct foreign investment into the country while as far as job opportunity, an absolute several millions of employments were created. The industry has developed to such an extent that it helps the development of

service sectors like insurance, IT, banking, consultancies, transportation, Small and Medium Scale Enterprises (SMEs). There has also been a critical improvement in the activity of the economy.

More so, increased yearnings of the population to communicate and bridge the urban-rural divide, given that opportunities are created in the service industry, rapid digitalization of records, and service delivery has been key to the shift in the socio-economic paradigm that has become evident. (Sanni, *et al*., 2021) ascribed Nigeria's Telecommunications revolution and rapid growth to the activities of the 2001 deregulation efforts and eventual privatization exercise.

GSM Penetration and Economic Opportunities

Active internet subscription (GSM) has grew sharply since the introduction of GSM. In more clear terms, internet penetration was enhanced by its circulation. Around 19 years after GSM penetrated Nigeria, e-commerce is by all accounts the new market by which jobless graduates make money and even use their creative and inventive cap. Nigerians are progressively being viewed as expatriates in other countries. This is a clear differentiation to when the country was reliant exclusively on oil for more than 40 years and which the effect on the socio-economic life of the people was restricted (Guardian, 2019).

However, now GSM has made social media and the internet very accessible to people. Therefore, Small scale businesses and business proprietors can promote their businesses, on social media platforms like Facebook, Instagram, Twitter, Google Search Engine, YouTube, and many more (Nnadi, *et al.*, 2021). Most SMEs in Nigeria utilize GSM to speak with their customers and by this form a more grounded relationship. They have understood that easy access to GSM and the conveyance of their products or services are significant drivers in creating and sustaining market competitiveness nationally and globally. (Bakare, *et al.*,2020)

The digital inclusion that the penetration of GSM has made has created new vocations, new business ideas for Nigerians. Nigerian retailers are progressively utilizing the internet to drive sales. Different service providers and traders have made social media their marketplace. People sell and purchase clothes, food, electronics, toiletries, wedding items, and many more on social media. People hire service providers like graphics designers, babysitters, virtual assistants, writers, dispatch riders, and many other service providers on social media. Currently, there are applications for practically anything, for job search, online courses, shopping, cooking, makeover, and Do-It-Yourself ideas. These applications and the avalanche of contents on the internet have inspired many youths to become entrepreneurs just by owning an Android or iOS mobile phone. (Okereke, *et al*., 2022).

GSM Penetration and Digital/Mobile Payment Systems

Different banks in Nigeria have their Mobile Apps by which customers can conveniently carry out transactions. Also, customers with the upgraded version of mobile phones also known as Android and iOS can simply use their bank-generated transfer code to implement transactions successfully. The status quo has reduced the rate of armed robbery drastically as people hardly move with large sums of cash, neither do they keep huge sums at home. (Ekong, *et al.*,2021). Although, Ekong, *et al.*,(2021), argued that the rise of GSM has achieved a stupendous improvement in the significant area of the economy, like banking, telecoms, and commerce in general. The penetration of GSM has brought numerous profits which incorporates expanded financial sector turnover through loans, advances, e-commerce, e-banking (Mohammed, *et al*.,2020).

Additionally, electronic banking like Automated Teller Machine (ATM), services, online monetary exchanges, international credit uptake of debit and credit cards and debit card facilities, airline ticketing, and reservations are a portion of the various ways that the introduction of GSM has helped the improvement, refinement, security and fast transactions in the Nigerian financial sector (NCC, 2017). Nigeria is as of now positioned as the biggest and quickest developing telecommunications market in Africa and among the top 10 fastest growing telecommunications markets in the world. (Ibrahim, *et al.*,2023).

GSM Penetration on Social Relationships and Networking

Kareem, *et al.*, (2022), opined that social and family relationship has likewise been essentially improved. GSM is utilized by Nigerians generally to communicate with one another. Students utilized it to communicate with their course mates, companions, lecturers, and family members. Furthermore, family matters, finance, and

academic matters constitute the major functions of mobile communication for most people. Prior to the existence of GSM, these functions had been performed manually, yet the accessibility of mobile phones has restricted the majority of the students' travels, followed by facilitation of exchange information whenever the need emerges.

In addition, youths can explore opportunities on social media due to their easy access to smartphones. Different skits, videos, and contents are flying all over social media and these youths generate money from the recognition they get from those contents. For instance, in the entertainment industry, music artists release songs and videos which they sell to different websites, and these websites in turn make their money by the deluge of people who visits their websites for download or to stream. The same thing applies to the movie industry. This development has brought huge improvement to the challenge of piracy and has heightened the revenue generated in the entertainment industry (Mohammed, M. A., & Usman, I., 2020).

Methodology

Empirical Analysis

Table 1: Mean, Percentage and Ranking of Respondents Based on the Relevant Questions

	SD (%)	D (%)	A (%)	SA (%)	$\overline{X}$	Ranking
The introduction of mobile telecommunication (GSM) has reduced transaction cost of various activities in Nigeria	24 (12)	36 (18)	69(34.5)	71(35.5)	2.93	**9th**
GSM has contributed positively to the growth of the Nigeria economy	16 (8)	25 (12.5)	86 (43)	73 (36.5)	3.08	**7yh**
The introduction of mobile telecommunication (GSM) has led to generation of employment opportunities (both direct and indirect) for Nigerians	13 (6.5)	24 (12)	81 (40.5)	82 (41)	3.16	**2nd**
Global System of Mobile telecommunication has led to increased income and the living standard of Nigerians	6 (3)	27 (13.5)	99 (49.5)	68 (34)	3.15	**3rd**
The introduction of GSM has reduced travelling and communication costs in the country	10 (5)	30 (15)	82 (41)	78 (39)	3.14	**4th**
The introduction of GSM has made how we communicate and interact faster, easier and also led to heighten social cohesiveness among one another	20 (10)	28 (14)	88 (44)	64 (32)	3.13	**5th**
The introduction of GSM has helped in the way we conduct and advertise our business	6 (3)	18 (9)	101 (50.5)	75 (37.5)	3.23	**1st**
The introduction of GSM has tremendously supported the growth of Tech startups and SME entrepreneurs in the country	18 (9)	29 (14.5)	88 (44)	65 (32.5)	3	**8th**
The country has fully benefited from the potential of GSM technology to drive her economic growth	21 (10.5)	13 (6.5)	93 (46.5)	73 (36.5)	3.09	**6th**

Source: Field survey, 2024

Interpretation of Mean and Percentage Responses

The result of the analysis indicates that based on the ranking of the mean responses of respondents, it is believed that the introduction of GSM in the country have helped in the way business and advertisement are conducted generally. This is followed by respondents agreeing that the advent of GSM have helped secure employment opportunities to Nigerians, however the respondents believes that the introduction of GSM has tremendously supported the growth of technology startups and development of SME in the country, although the least response on the average respondents approximately agree that the introduction of mobile telecommunication (GSM) has reduced transaction cost of various activities in Nigeria.

Generally, from the responses gathered shows that the respondents agreed to the different question asked which is an indication that the introduction of GSM in the country have helped in improving the economic condition of the country which in turn gives rise to improve economic growth.

Table 2: One sample t test statistic

	Item Measure	t	df	Sig. (2-tailed)	Remark
1	The introduction of mobile telecommunication (GSM)has reduced transaction cost of various activities in Nigeria	6.104	199	.000	Significant
2	GSM has contributed positively to the growth of the Nigeria economy	9.127	199	.000	Significant
3	The introduction of mobile telecommunication (GSM) has led to generation of employment opportunities (both direct and indirect) for Nigerians	10.649	199	.000	Significant
4	Global System of Mobile telecommunication has led to increased income and the living standard of Nigerians	12.010	199	.000	Significant
5	The introduction of GSM has reduced travelling and communication costs in the country	10.637	199	.000	Significant
6	The introduction of GSM has made how we communicate and interact faster, easier and also led to heighten social cohesiveness among one another	3.845	199	.000	Significant
7	The introduction of GSM has helped in the way we conduct and advertise our business	13.991	199	.000	Significant
8	The introduction of GSM has tremendously supported the growth of Tech startups and SME entrepreneurs in the country	7.742	199	.000	Significant
9	The country has fully benefited from the potential of GSM technology to drive her economic growth	9.071	199	.000	Significant

Source: Field Survey 2024

The result of the analysis as shown from the table above indicates that the one sample test carried out for all related questions at a degree of freedom of n-1, the calculated values are greater than the tabulated value hence we see that the questions are significant. Moreover, the p-value as shown is less than the asymptotic significance. Therefore, it could be concluded that there is a significant association and positive relationship between the use of GSM mobile technology and the economic growth.

Hypothesis testing: GSM has contributed positively to the growth of the Nigeria economy

		Frequency	Percent
Valid	Strongly Disagree	16	8.0
	Disagree	25	12.5
	Agree	86	43.0

	Strongly Agree	73	36.5
	Total	200	100.0

Calculating the chi square value

Response	O	E	$(O-E)$	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Strongly Agree	16	50	-34	1156	23.12
Agree	25	50	-25	625	12.5
Disagree	86	50	36	1296	25.92
Strongly Disagree	73	50	23	529	10.58
Total	200				72.12

$$\chi^2_{calculated}=\sum_{i=1}^{n}\frac{(O_i-E_i)^2}{E_i}$$

To obtain the expected value from the goodness of fit chi square

$$E_i=\frac{1}{n}\sum_{i=1}^{n}O_i$$

$$E=\frac{16+25+86+73}{4}$$

$$E=\frac{200}{4}$$

$$E=50$$

Decision Rule:

$$If\ \chi^2_{calculated}<\chi^2_{tabulated}\ Accept\ H_0$$

$$If\ \chi^2_{calculated}>\chi^2_{tabulated}\ Accept\ H_1$$

From the above test since $\chi^2_{calculated}>\chi^2_{tabulated}$ that is $72.12>7.815$

H_1 will be accepted while H_0 will be rejected.

Interpretation

Findings: the chi-square calculated value is 72.12, while the chi-square table value is 7.815. Since the chi-square calculated value is higher than the tabulated value, hence, the (H_1) alternative hypothesis which says that

there is a positive contribution of GSM to the economic growth of the country is accepted while the (H_0) null hypothesis should be rejected. Therefore, there is a positive contribution of GSM mobile technology to the economic growth of the country.

Summary of hypothetical result

Hypothesis	Chi-Square	Df	Asymp. Sig.	Critical value	Decision	Conclusion
GSM has contributed positively to the growth of the Nigeria economy	72.120	3	0.000	7.185	Significant	Accept the Alternative hypothesis

Discussions

The result of the analysis shows that based on the response, the introduction of mobile telecommunication has reduced transaction cost of some activities in Nigeria and also led to generation of employment opportunities in Nigeria. This is an indication that through the introduction of mobile telecommunication, citizens have been able to create job opportunities for themselves and also in turn employ others, this will bring improvement in the country's economic growth through the development of the immediate community. Respondents also believes that mobile telecommunication has led to the increase in the standard of living of citizens in the country. Meanwhile the introduction of GSM and improved network have led to the reduction of travel expenses from one location to the other as one can call to place an order for a product through mobile communication and receive without having to travel to the market for transaction making communication easier and faster. Through online marketing, citizens are able to show case their product to potential customers by means of online advertising through the help of GSM.

Finally, the chi-square result shows that there is a positive contribution of mobile telecommunication technology on the economic growth of Nigeria.

Conclusion

This study discovered that the penetration and circulation of GSM and the evolution of the telecoms industry have influenced key economic and social paradigm shifts in the Nation. Although, it would be an erroneous submission to say that every contribution of GSM penetration is positive or that GSM is the only and major catalyst to the economy. However, the argument is clarified; thus, the penetration of GSM has reduced exorbitant rates of subscriptions and communication that was deployed during the existence of NITEL. The penetration of GSM technology and freehand given to Network providers that are operating gave rise to wide accessibility both in Urban and Rural Areas and reduced the digital divide drastically. As a result, access to and utilization of GSM technology has soared among a population of users across locations, occupations, and classes (Okereke, U., & Okechukwu, A., 2022).

Based on the foregoing, there have been foreign direct investments attractions, a remarkable contribution to the GDP, creation of over millions direct and indirect jobs, innovations, and inventions of witty and novel business ventures, ease of doing businesses, consumer surplus, and elevation of social interactions. Although, there have been negative inclinations like cyber-bullying, cybercrimes, social media distractions, hidden charges by telecoms operators, and reduction in cultural values, based on collected evidence, but the positive impact of GSM penetration far outweighs the negative consequences. Therefore, along these lines, it could be concluded dependent on the empirical finding, that the GSM penetration in Nigeria has had a synergistic impact on the socio-economic development of Nigeria.

Recommendations

It is recommended that there is the need for Nigerian Communication Commission (NCC) and the Federal Government of Nigeria to provide the necessary infrastructures (particularly power supply) to the GSM

operators in order for them to deliver efficient services and to be able to reduce their charges. The government should also create atmosphere for the expansion of tele-density and directly make telephone communications accessible. To achieve this goal, more licenses should be given to GSM operators in order to allow for healthy competition among the GSM operators.

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ARTIFICIAL INTELLIGENCE (AI) AS AN EMERGING TREND IN THE CONDUCT OF OBECTIVE MASS MEDIA RESEARCH

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ABSTRACT

This paper examines Artificial Intelligence (AI) as an emerging trend in the conduct of objective mass media research. AI is emerging as a significant trend in mass media, impacting data collection, presentation and analysis. It complements human expertise rather than replacing it, offering tools for faster work and improved content quality. In a bid to achieve the aim of this paper, the relevance of AI to mass media research where highlighted. However, relevant literatures were reviewed as technological determinism theory and source credibility theory were employed as the theoretical framework on which the study was underpinned. It was however discovered that despite the fact that AI affects the transparency of media content by introducing challenges and opportunities, it can also enhance transparency by enabling automated content labeling, improving accountability and fostering trust through clear explanations. The paper recommends inter-alia that researchers and other stake holders in research institute should make sure that the ethics of research are not floated in the course of research and work cum findings should always be subjected to plagiarism test before they are made public.

Keywords: Artificial intelligent, emerging trend, Mass media Research

INTRODUCTION

That artificial intelligence has a significant impact on the media with regard to the conduct of research and news reportage is not in doubt. With the advent of artificial intelligent, the media have been undergoing a technological drastic change leading to nothing less than a revolution in all walks of life. From all indications, AI is transforming scientific research as well as everyday life, from communications to transportation to health care and more.

Since the 1950s, scientists and engineers have designed computers to "think" by making decisions and finding patterns like humans do. In recent years, artificial intelligence has become increasingly powerful, propelling discovery across scientific fields and enabling researchers to delve into problems previously too complex to solve. Outside of science, artificial intelligence is built into devices all around us, and billions of people across the globe rely on it every day. Stories of artificial intelligence-from friendly humanoid robots to SkyNet-have been incorporated into some of the most iconic movies and books (Catch Science Exchange, 2024).

As observed by Akinola (2024) artificial Intelligence research tools are becoming increasingly important in academic environments as they offer various benefits. One significant advantage is the ability to access relevant repositories and analyse complex datasets easily. This allows researchers to gather necessary information efficiently. These tools aid publishers in identifying potential reviewers and combating plagiarism. The integration of AI technologies to academic environments leads to streamlined processes, improved research outcomes, and fosters innovation. Data analysis is a key area where AI is transforming academic research. Researchers can utilise AI algorithms to quickly and efficiently analyse large amounts of data. The integration of AI research tools in academia is revolutionising the landscape, offering researchers and publishers valuable tools to enhance their work and ensure integrity. He emphasises:

The use of AI in academic research is therefore becoming more prominent, as professionals recognise the advantages it brings in terms of efficiency and productivity. AI tools can be utilised in various aspects of research, including writing, editing, and citing research papers, contributing to the improvement of the overall research process. It is most vital for researchers to be aware of the benefits and opportunities AI offers to enhance research quality. However, it is equally important to acknowledge the challenges that may arise when incorporating AI tools into academic research.

As AI continues to disrupt and revolutionise different fields, researchers seems to overlook the potential that AI holds in academia. However, embracing AI technology and understanding its potential limitations, researchers can harness its advantages to drive innovation and elevate the quality of their researches. AI is revolutionising the field of academic writing by providing researchers with various tools to enhance their productivity and efficiency. AI tools now enable researchers to generate research grants, write books, and

even compose articles for scientific journals. These tools also help researchers in editing their articles, ensuring grammatical accuracy in their writing.

Statement of the Problem

Artificial Intelligence (AI) is becoming increasingly integrated in all walks of life and conduct of mass media research is not an exemption. However, this integration can be liken to a double edge sword with both opportunities and challenges. In this regard, the growing and increasing role of AI in research and information acquisition, has also raised ethical concerns such as potential biases in AI systems, the risk of AI generated misinformation and displacement of human research.

In view of the above, the questions are, to what extent has AI been employed in the conduct of objective mass media researches? And what exactly are the pros and cons of AI in the conduct of researches? These questions and other issues are the focus of this paper.

Literature Review

Artificial Intelligence and Data Analysis

Data analysis is a vital component of research, and AI based data analysis tool enhance efficiency and objectivity in the process. With the overwhelming amount of scientific literature published each year, AI tools can assist in reading and summarizing complex articles saving researchers' valuable time (Akinola, 2024). AI can also aid researchers in attributing sources from extensive literature

Messeri and Crockett (nd) cited in Cummings (2024) classified proposed visions of AI spanning the scientific process that are currently creating buzz among researchers into four archetypes:

- **In study design**, they argue, "AI as Oracle" tools are imagined as being able to objectively and efficiently search, evaluate, and summarize massive scientific literatures, helping researchers to formulate questions in their project's design stage.
- **In data collection**, "AI as Surrogate" applications, it is hoped, allow scientists to generate accurate stand-in data points, including as a replacement for human study participants, when data is otherwise too difficult or expensive to obtain.
- **In data analysis**, "AI as Quant" tools seek to surpass the human intellect's ability to analyze vast and complex datasets.
- **And "AI as Arbiter**" applications aim to objectively evaluate scientific studies for merit and replicability, thereby replacing humans in the peer-review process.

Cumming (2024) however, warns against treating AI applications from these four archetypes as trusted partners, rather than simply tools, in the production of scientific knowledge. Doing so, they say, could make scientists susceptible to illusions of understanding, which can crimp their perspectives and convince them that they know more than they do. He added:

The efficiencies and insights that AI tools promise can weaken the production of scientific knowledge by creating "monocultures of knowing," in which researchers prioritize the questions and methods best suited to AI over other modes of inquiry.

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And "AI as Arbiter" applications aim to objectively evaluate scientific studies for merit and replicability, thereby replacing humans in the peer-review process, leaves researchers vulnerable to what they call "illusions of exploratory breadth," where scientists wrongly believe that they are exploring all testable hypotheses, when they are only examining the narrower range of questions that can be tested through AI.

For example, "Surrogate" AI tools that seem to accurately mimic human survey responses could make experiments that require measurements of physical behavior or face-to-face interactions increasingly unpopular because they are slower and more expensive to conduct, Crockett said. The authors also describe the possibility that AI tools become viewed as more objective and reliable than human scientists, creating a "monoculture of knowers" in which AI systems are treated as a singular, authoritative, and objective knower in place of a diverse scientific community of scientists with varied backgrounds, training, and expertise. A monoculture, they say, invites "illusions of objectivity" where scientists falsely believe that AI tools have no perspective or represent all perspectives when, in truth, they represent the standpoints of the computer scientists who developed and trained them (Cummings,2024).

Impact of Artificial Intelligence on Mass Media

With regards to artificial intelligence and the mass media, Ashava (2021) note that media companies can leverage AI throughout their content supply chain to automate operation drive decision making and personalize the consumer experience. Through techniques such as image recognition and speech to text transcription, metadata tagging is the most widen data automatically created by the AI algorithm can be used to drive content monetization strategies. As we rapidly shift towards a world characterized by digitalization, the power of AI expands and stretches till not even the media industry has been able to escape
it's ditches. The industry has also been undergoing a high degree of transformation with the digital media paving its way towards becoming the main focus of interest across all its sub-sectors that includes TV, Print and Radio

- **AI in Controlling Bias**

Overcoming the rising predisposition is one unbearable disgrace which the media has been looking in the present current world. The information being catered to the audience may often be layered with degrees of bias leading to misleading content instead of factual, balanced now.

- **AI in Social Media**

As the use of Social Media expands and booms at an increasing rate over the years, so does the hold Artificial Intelligence enjoy over it:

Facebook. The entire backbone of Facebook is based on understanding and gaining knowledge of the behavior of its users, yet with its massive user base it makes use of several techniques to do the same. Like – Deep learning, Deep text, face Recognition etc.

Twitter.
Twitter makes use of AI algorithm to flag and removes the accounts that are promoting extremist groups or hateful tweets and also recommending tweets on the user's timeline and ensuring that the pertinent tweets are obliged them first. It makes use of Natural language Processing (NLP) to analyze thousands of tweets per second and provide insight on the inclination of the users

Instagram.
Search suggestions – with millions of photos being shared on the platform every day, Instagram leverages AI to create its search function with its massive database to help users find images related to their own favorite activities and experiences

.Linkedin.
Job/Connection Recommendations makes use of AI for offering job recommendations, suggesting people for the user's to connect with and for delivering specific post on the user's feed.

Theoretical Framework

This paper utilises the technological determinism theory and source credibility theory which are relevant to the issues of discourse in this paper.

Technological Determinism Theory

In 1964, Marshal McLuhan was the one who first formulated the technological determinism theory. The goal of the reductionist theory, known as the technological determinism, is to establish a causal connection between the development of technology and the makeup. It investigates question of whom or what might wield controlling power over human affairs. The theory investigates how technological concerns influence human thought and behavior. The theory's fundamental premise is that various media forms are merely extensions of the natural environment in which human live. According to Asemah (2011), the theory proposes that the media change both the environment in which they are presented and

the message they deliver. The media cultivate new behaviors which are likely to persist, while their technologies have the potential to produce novel settings. He went to say that the theory proposes that technologies, particularly the media, play significant role in determining how individuals think, feel and how societies organize themselves and function. The medium determines the content of the communication. [Creative Common]. Our understanding of the world is susceptible to being skewed by the medium's influence. The preponderance of mass communication can no longer be denied (p.215).

As Baran and Davis (2006, page 304) observed, McLuhan declared the media to be the extensions of man and argued that media quite literally extend sight, hearing and touch through time and space. Baran and Davis made this observation; the proliferation of electronic media would present regular people with novel opportunity and instantaneously make possible for us to be everywhere. Despite open up a new vista for ordinary people and instantly enable us to be everywhere.

Still, McLuhan's observations concerning the global village and the role of electronic media in it continue to be prophetic. When satellite communications were just being developed, he seemed to foretell the rise of the Cable News Network with its ability to seemingly make us eyewitnesses to history as it moved on the battlefield or at the barricade. At a time when maintenance computers filled entire floors of office buildings, he envisioned a time when personal computers would be everywhere, and the internet would give everyone instant access to immense stores of information.

Given the above, one media critic Meyrowitz (1985), noted that to be everywhere is to be nowhere and to have no sense of place. Having access to information is not the same as being able to select and use information effectively. The global village isn't situated in space or time. Despite the criticisms of McLuhan's work, much of it merits attention. Rogers (2000) argued that McLuhan's perspective deserves more attention from mass communication scholars, especially those interested in studying new media. Some young scholars find it an exciting standing point for their thinking (wolf, 1996). It is possible because McLuhan's none is so eccentric and open-ended.

Griffin (1994) says McLuhan traced the emergence of western civilization in stages tied to the media available for human communication, they include; the tribal age, the literate age, the print age and the electronic age. Each period brought a new era with it:

i. **The Tribal Age**: This was when man's perception of his environment was multi-sensory, and his mode of communication was oral. Society was essentially a recollection of the past.
ii. **The Literate Age**: In this stage, McLuhan wrote that the phonetic alphabets fell into the acoustic world like a bombshell, installing sight ahead of the other senses. People who could read exchange an eye for an eye. Literacy brought people out of collection tribal involvement into civilised private detachment. Literacy moved away from the tribal age and left the tribe without being cut off from the floor of information. The age of literacy made visual dependence possible.
iii. **The Print Age**: If the age of literacy made visual dependence possible, the print age made it widespread. Because the print age demonstrated mass production of identical products, McLuhan called it the forerunner of the industrial revolution.

iv. **The Electronic Age**: This age is the ICT era. It is the stage at which communication now transcends national and planet barriers. It could also be referred to as the age of cyberspace or superhighway, with the satellites stationed in geosynchronous orbits. This stage overlaps the print age.

Each stage in McLuhan's theory marked an improvement in the communication process. The electronic age has altered broadcast media. This effect can be seen in newsgathering and dissemination ICT brought with it.

Source Credibility Theory

The Source credibility theory was propounded by Hovland and Weiss in 1951. This theory according to Wikipedia (2022), source credibility is a term commonly used to assume a communicator's positive behaviour that hinder the receiver's acceptance of message. Asemah (2011), states that the credibility of the originator determines how the receiver will react to the message. That is the attitude of the message receivers when they receive a message depends to a great extent on how they see the source and how they perceive the source to be.

The source credibility theory exists between attitude change and the source of a message. When the right source is used to transmit a message, it boosts the chances of having an effective message. But when the wrong channel is used, the response will be poor. Anaeto and Anaeto (2010), note that the source credibility is categorised into three models. These are the factor model, the functional model according to Anaeto and and Anaetor(2010) helps to determine the extent to which the receiver judge the source as credible, the functional model views credibility as the degree to which a source satisfies a receiver's individual needs. There are different media organisations in our society. The journalist should use the right media to disseminate information to the audience.

By and large, the relevance of the technological determinism theory to this study is that it states that media technologies shape how a society operates as we move from one technological age to another. Moreover, new media are not only an addition to existing media, they are also new technologies and therefore do have a deterministic factor as well. Marshall McLuhan made a famous statement that "the medium is the message". This means that the medium used to communicate influences the mind of the receiver. The introduction of news print, television and the internet have all shown how technological advances have an impact on the society in which we live in. while the source credibility theory hinges on the fact that the acceptance of any message in communication is dependent on the communicator's positive characteristics, that is, the credibility of the messenger serve as a major determinant of what the recipient will do to the message.

Methodology

The desktop research methodology was employed in this study. According to Drive research.com (2023), desktop research, also known as secondary research or library research, is a method of gathering information and insights by analyzing and synthesizing existing data and sources rather than conducting primary data collection through fieldwork or survey. Here, literatures were reviewed from both primary and secondary sources. In the study, the

desktop was found to be most appropriate for this particular study. The desktop as a research technique was used to obtain data either by reviewing of literature from diverse sources.

The findings and recommendations of this study are hoped to be of immense benefits to both government and other policy makers.

On completion, this work will also serve as a reference material to future researchers who will or may have interest in carrying out research in a relative area of study.

Conclusion

Just as everyday in our modern society is always characterised with all sort of changes, the conduct of mass media researches are not exceptions. However, as AI continues to advance, it will have an increasingly pervasive influence on our lives. To better prepare for this future, a deeper understanding of the differences between AI and human intelligence is necessary. With this, it is crucial to acknowledge the limitations of AI and not expect too much too soon in terms of reducing negative social impacts.

Recommendations

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

1. Researchers and other stake holders in research institute should make sure that the ethics of research are not floated in the course of research.
2. Researchers should be factual and objective in their employment of AI in conducting research.
3. Research work cum findings should always be subjected to plagiarism test before thay are made public.

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ENHANCING CYBERSECURITY SYSTEMS THROUGH MACHINE LEARNING TECHNIQUES

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Abstract
Cybersecurity threats are growing in scale and complexity, rendering traditional defense mechanisms insufficient. Machine learning (ML), a subset of artificial intelligence, offers adaptive, data-driven approaches that improve real-time detection and response to cyber threats. This paper examines the role of ML in enhancing cybersecurity systems, focusing on its applications in intrusion detection, malware analysis, phishing detection, and behavioral authentication. The study also identifies the benefits, challenges, and future directions for integrating ML into cybersecurity practices.

Keywords: machine learning, cybersecurity, intrusion detection, phishing, malware, anomaly detection

INTRODUCTION

The digital transformation across industries has led to an increased reliance on networked systems and the internet, exposing organizations to a wider range of cyber threats (Sahu et al., 2022). As businesses, governments, and individuals increasingly store sensitive information online and rely on digital services, the attack surface for malicious actors has expanded significantly. Cybercriminals now exploit sophisticated techniques such as ransomware, phishing, advanced persistent threats (APTs), and zero-day exploits to breach systems and disrupt operations. In 2023 alone, global damages from cybercrime were estimated to exceed $10 trillion USD, a figure projected to grow in the coming years (Cybersecurity Ventures, 2023).

Conventional cybersecurity solutions, such as firewalls and antivirus programs, primarily operate on predefined rules and signature-based detection, which are limited in identifying novel or evolving threats. These static defenses often fail to detect previously unseen attacks or adapt to changing tactics used by cybercriminals. In contrast, machine learning (ML) presents a viable alternative, enabling systems to learn from historical data, recognize patterns, and detect irregularities with minimal human intervention (Brownlee, 2023).

Machine learning techniques are capable of analyzing massive volumes of structured and unstructured data at high speeds, making them ideal for dynamic security environments. For example, anomaly detection models can identify deviations in network traffic that suggest a cyber intrusion, even if the exact attack pattern has never been seen before (Chandola et al., 2020). Likewise, supervised learning algorithms can be trained to distinguish between legitimate and malicious activity based on labeled datasets, while reinforcement learning models can optimize responses to ongoing threats in real time.

The growing volume, variety, and velocity of cyber threats necessitate a more intelligent, automated, and scalable approach to security. ML not only enhances detection and prevention but also plays a crucial role in forensic analysis, threat intelligence, and vulnerability assessment. It allows organizations to move from reactive to proactive cybersecurity strategies.

This paper explores the integration of ML in cybersecurity systems and its capacity to improve security through intelligent automation and predictive analytics. It examines key applications of ML in areas such as intrusion detection, malware analysis, phishing prevention, and behavioral authentication, while also addressing the benefits, challenges, and future implications of ML-driven security frameworks.

MACHINE LEARNING AND CYBERSECURITY

Machine learning (ML), a core subset of artificial intelligence (AI), enables computer systems to automatically learn and improve from experience without being explicitly programmed. By applying statistical and computational models to large datasets, ML allows systems to identify patterns, make decisions, and predict future outcomes (Goodfellow et al., 2016). In the context of cybersecurity, ML offers powerful capabilities for detecting threats, responding to attacks, and proactively preventing intrusions by analyzing behavioral patterns, traffic anomalies, and data irregularities in real time (Chandola et al., 2020).

Unlike traditional cybersecurity solutions that rely on predefined rules or known attack signatures, ML models can adapt to new and previously unknown threats. These models continuously evolve by learning from both historical and real-time data, enabling faster detection of advanced and stealthy attacks, such as zero-day exploits and polymorphic malware.

TYPES OF MACHINE LEARNING TECHNIQUES IN CYBERSECURITY

To understand how ML contributes to cybersecurity, it is important to distinguish among the primary types of learning techniques:

- **Supervised Learning:** This method involves training a model on a labeled dataset where input-output pairs are clearly defined. In cybersecurity, supervised learning is widely used in spam email detection, phishing classification, and malware identification. Algorithms such as Decision Trees, Support Vector Machines (SVM), and Logistic Regression are commonly applied.
- **Unsupervised Learning:** In cases where labeled data is unavailable, unsupervised learning helps detect anomalies or hidden structures within datasets. This technique is effective in identifying abnormal behavior in network traffic, unauthorized access, or

insider threats. Clustering algorithms like K-Means or dimensionality reduction techniques like Principal Component Analysis (PCA) are frequently utilized.

- **Reinforcement Learning:** This learning approach enables an agent to interact with an environment and learn optimal actions through trial and error, receiving feedback in the form of rewards or penalties. In cybersecurity, reinforcement learning can be used to develop autonomous systems that adaptively defend networks or optimize firewall configurations over time (Nguyen & Reddi, 2019).

The integration of these techniques empowers security professionals to automate threat analysis, prioritize incidents based on severity, and minimize the risk of human error in complex security environments.

APPLICATIONS OF MACHINE LEARNING IN CYBERSECURITY

Machine learning (ML) has revolutionized cybersecurity by providing tools that adapt to new threats, automate detection processes, and enhance response efficiency. As cyber threats become more sophisticated, ML applications are becoming essential across multiple security domains, from real-time threat detection to user authentication and anomaly recognition.

Intrusion Detection Systems (IDS)

Intrusion Detection Systems monitor traffic to identify potential intrusions or policy violations. Traditional IDS rely heavily on rule-based systems, which are often rigid and miss novel attack patterns. ML-based IDS use algorithms such as Random Forest, Naïve Bayes, and Artificial Neural Networks (ANNs) to analyze traffic data and detect anomalies indicative of breaches (Shone et al., 2018). These models are particularly effective at identifying stealthy or zero-day attacks by learning baseline behaviors and flagging deviations.

Malware Detection

Conventional antivirus programs rely on signature databases, which are ineffective against new or obfuscated malware. ML techniques such as Decision Trees, Support Vector Machines (SVM), and Deep Neural Networks (DNN) allow malware detection systems to classify files based on features such as opcode sequences, file size, or API calls (Raff et al., 2018). These dynamic and static analysis models enable real-time classification of unknown files, reducing false positives and improving response times.

Phishing Detection

Phishing remains one of the most common forms of social engineering attacks. ML, coupled with Natural Language Processing (NLP), has become effective in detecting phishing emails by analyzing the language used, embedded links, sender reputation, and visual similarities to legitimate websites (Abdelhamid et al., 2014). These models are integrated into email gateways to block suspicious content before it reaches users.

Behavioral Authentication

Beyond passwords, behavioral biometrics offer enhanced security by identifying users based on how they interact with systems. ML algorithms can monitor user-specific behaviors—such as typing patterns, mouse movements, and usage habits—to detect impersonation or unauthorized access attempts (Teh et al., 2016). These models enhance authentication

processes without increasing user friction, making them ideal for continuous, passive security.

BENEFITS OF MACHINE LEARNING IN CYBERSECURITY

Machine learning (ML) offers numerous advantages in the realm of cybersecurity, providing enhanced detection capabilities, better scalability, and more efficient management of evolving threats. Below are some key benefits of incorporating ML into cybersecurity practices.

Real-Time Threat Detection

One of the most significant advantages of ML in cybersecurity is its ability to detect threats in real time. Traditional cybersecurity measures, such as signature-based detection, often fail to identify new or sophisticated attack methods. ML models, especially anomaly detection algorithms, can analyze network traffic or system behaviors in real time, identifying malicious activity as it occurs (Xia et al., 2020). This proactive approach reduces response time and minimizes the impact of potential breaches.

Enhanced Accuracy with Fewer False Positives

ML algorithms, when trained on large datasets, can distinguish between benign and malicious activities more accurately than rule-based systems. By continuously learning from new data, these models can adapt to evolving threats and reduce the number of false positives (Turan et al., 2021). This accuracy is particularly crucial in complex environments where traditional security measures may struggle to differentiate between legitimate actions and cyber-attacks, improving both efficiency and security.

Scalability and Adaptability to New Threats

Cybersecurity threats are dynamic and constantly changing, making it essential for security systems to evolve. ML-based systems are inherently scalable and adaptable, capable of processing vast amounts of data and learning from new threats without human intervention. As organizations grow and their digital infrastructure becomes more complex, ML models can scale to meet increasing demands and automatically adapt to emerging cyber threats, such as zero-day attacks (Bhattacharyya et al., 2019).

Automation of Manual Security Processes

ML allows the automation of repetitive and time-consuming security tasks, such as log analysis, threat hunting, and incident response. By automating these processes, organizations can free up valuable resources, improve efficiency, and ensure more consistent security monitoring. This automation also enhances the speed and accuracy of threat detection, as ML systems can identify potential vulnerabilities and attacks faster than manual processes (Das et al., 2020).

CHALLENGES AND LIMITATIONS OF MACHINE LEARNING IN CYBERSECURITY

While machine learning (ML) has significantly advanced cybersecurity, its integration is not without challenges. As the complexity and volume of data increase, so do the difficulties in deploying ML models effectively within cybersecurity environments. Below are some of the key challenges and limitations associated with the implementation of ML in cybersecurity.

Data Privacy Issues

The use of sensitive and personal data in training machine learning models poses significant privacy concerns. In order for ML systems to accurately detect threats, they often require access to large datasets containing personal, confidential, or proprietary information. This data, when improperly handled, can lead to violations of privacy laws, such as the General Data Protection Regulation (GDPR) in Europe. Additionally, organizations may face ethical dilemmas related to consent and data anonymization (Tambe et al., 2020). Ensuring the protection of personal data while utilizing it for ML training is a critical challenge.

Adversarial Attacks

Adversarial machine learning presents a growing threat to cybersecurity. Attackers can craft inputs designed to deceive or manipulate ML models, making them misclassify malicious activity as benign (Goodfellow et al., 2018). For example, attackers may introduce slight variations to malware files or network traffic that can bypass detection systems, highlighting the vulnerability of ML models to adversarial perturbations. This raises concerns about the robustness of ML models in real-world, hostile environments.

Resource Requirements

Machine learning models, especially deep learning networks, demand substantial computational power and large amounts of data for effective training. The training process can be time-consuming and costly, requiring specialized hardware such as Graphics Processing Units (GPUs) or Tensor Processing Units (TPUs) (Chien et al., 2020). Additionally, the data required for training models must be diverse and high-quality, which may be difficult to obtain in some cybersecurity contexts. This resource-intensive nature of ML can be a barrier to smaller organizations or those with limited budgets.

Interpretability and Transparency

One of the major challenges with ML models, particularly deep learning models, is their lack of interpretability. These "black-box" models are highly complex and difficult to audit or explain, which poses a significant issue in cybersecurity, where transparency and accountability are critical. Without a clear understanding of how a model arrives at its decisions, it becomes challenging to trust the results and debug potential issues (Gilpin et al., 2018). This lack of explainability also makes it difficult for cybersecurity professionals to justify decisions made by ML systems, especially in legal or regulatory contexts.

FUTURE PROSPECTS OF MACHINE LEARNING IN CYBERSECURITY

The future of machine learning (ML) in cybersecurity holds significant promise, particularly with advancements in deep learning, federated learning, and the integration of hybrid human-AI systems. As cyber threats evolve and become more sophisticated, the role of ML will continue to grow in safeguarding digital environments. Below are some key developments that are expected to shape the future of ML in cybersecurity.

Deep Learning

Deep learning, a subset of ML, has shown remarkable success in improving the detection of complex cyber-attacks, such as zero-day vulnerabilities and advanced persistent threats. By utilizing multi-layered neural networks, deep learning algorithms are able to learn more abstract features and capture intricate patterns within large datasets (Yuan et al., 2020). The

growing computational power and access to larger, more diverse datasets will enable deep learning models to provide more accurate and faster detection of sophisticated threats in real-time.

Federated Learning

Federated learning is an emerging approach that allows ML models to be trained across decentralized devices or servers without sharing sensitive data. This technique is particularly valuable in cybersecurity, as it can help mitigate data privacy concerns while still benefiting from collaborative learning across different sources (Li et al., 2020). By enabling secure model training while keeping data localized, federated learning provides a promising solution for privacy-preserving machine learning in environments where sensitive information must remain confidential.

Hybrid Human-AI Systems

While ML has made great strides in automating cybersecurity tasks, human expertise remains crucial for interpreting complex threat scenarios and making strategic decisions. Hybrid human-AI systems aim to combine the strengths of both human intuition and machine efficiency. In these systems, ML models can assist cybersecurity professionals by providing real-time alerts and suggestions, while human operators make final decisions based on context, experience, and intuition (Sarker et al., 2021). This collaboration is expected to improve decision-making accuracy, reduce response time, and enhance overall security.

Continued Research and Development

Despite the promise of ML in cybersecurity, continued research is essential to address the ethical, technical, and operational challenges that still exist. These challenges include data privacy concerns, adversarial attacks, and the interpretability of complex models (Tambe et al., 2020). As the field of cybersecurity becomes more integrated with AI and ML, there will be an increasing need for interdisciplinary research to develop frameworks that balance innovation with ethical and legal considerations.

CONCLUSION

Machine learning (ML) has emerged as a critical tool in the evolution of cybersecurity, offering advanced capabilities to detect, analyze, and respond to threats in real-time. By leveraging the power of data-driven algorithms, ML enables cybersecurity systems to adapt to emerging threats and defend against sophisticated attacks more effectively than traditional methods. As cyber threats become more complex and dynamic, ML's ability to process large volumes of data and identify patterns that are difficult for human analysts to detect plays a vital role in strengthening security measures across industries.

However, realizing the full potential of ML in cybersecurity requires addressing several challenges. These include concerns about data privacy, adversarial attacks, the interpretability of complex models, and the resource demands associated with training and deploying ML systems. As ML continues to evolve, these challenges must be tackled through interdisciplinary collaboration, bringing together experts from fields such as computer science, ethics, law, and policy-making. Responsible innovation is crucial in ensuring that ML technologies are developed and deployed in ways that protect individual privacy, uphold security standards, and adhere to ethical frameworks. Moreover, continued research is

essential to improve the robustness of ML algorithms, making them more resilient to adversarial manipulation and increasing their transparency and accountability.

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THE COMPARATIVE ANALYSIS OF DIFFERENT MEANS OF PROTEST IN MENDING A BETTER GOVERNANCE FROM THE GOVERNMENT OF NIGERIA.

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Abstract.

The increasing social-welfare protest in Nigeria has become a great concern to the public. This is basically due to the perennial economy downturn and the sluggish attitude of the Government to deliver on their promises: "Change" they promised Nigerians. The focus of this paper therefore, is to examine the possible causes of series of protest across the country by various political institutions and group of individuals as well as the best modes of carrying out a protest that would have a vehement human touch on the Government, to listen to the yearnings and aspirations of the people. A total of 200 returned questionnaires administered to the public were used to ascertain the best approach of carrying out a peaceful and meaningful protest. Statistical Package in Social Science (SPSS) was adopted to analysis the sample responses of public opinion and Descriptive Statistics such as coefficient of variation (C.V) was employed to examine the most consistent means of carrying out a protest. Among the different approaches examined, the study revealed that, street demonstration with placards and strike action proved to be the most consistent means of protesting against unfavorable and harsh Government policies. Based on this studies, it was recommended that the Government should do the needful for the people they Govern. Pushing the masses to embarked on a protest and subsequently strike action should not be the case. They must get the trust of the people with an open sound economic plan and adequate budget implementation in order to revived our economy.

***KEY WORSDS*:** Street Protest, Bad Economy, Political Institutions, Poor Governance, Strike Action.

1.0 INTRODUCTION.

A protests is an expression of objection, by words or by actions, to particular events, policies or situations. Protests can take many different forms, from individual statements to mass demonstrations. Protesters may organize a protest as a way of publicly making their opinions heard in an attempt to influence public opinion or government policy, or they may undertake direct action in an attempt to directly enact desired changes themselves.

Protest has been instrumental in forcing the introduction of most of the freedoms that now exist in liberal democracies. Direct action, mostly nonviolent, played a major role in the ending of slavery, extension of the franchise, curtailing ruthless aspects of the exploitation of labour and extending rights to women and minorities (Carter, 1973).

When talking about democracy, it‘s usually understood to be basically just about the vote we have every two or four years, in which we select our politicians to run our State and our Country, and the lucky few actually get the politician of their choice representing them. But actually, democracy is about more than just voting in elections. It is about participating fully (or at least to the best of one‘s ability and interest) in civic life. Thus, the important pillar of a fully democratic society is the right to protest (Simon, 2010).

The policy makers need to understand that the protest is not a great threat to the power of the state rather it is crucial in a democracy as information and ideal help to inform political debate and are essential to public accountability and transparency in Government and thus, protests should not be discouraged or restricted. The threat to peaceful protest organizers and union leaders by security agents forces in recent time is not a healthy trend to democracy in a country like Nigeria.

2.0 LITERATURE REVIEW.

Among scholars of African politics, the region-wide trend toward the adoption of increasingly liberal political institutions since the end of the Cold War is often traced back to the periodic mass urban protests that began in the late 1980s in response to economic crisis and public discontent with the prevailing political status quo (Wiseman 1996; Bratton and van de Walle 1997). In a particularly influential study, and one of the few to provide a quantitative, comparative empirical analysis of the links between protest and political liberalization in Africa, Bratton and van de Walle (1997) showed that protest activity was positively and significantly correlated with political liberalization. Seghal, Siddharth (2011), People have the right to express opposition and give suggestions. This was the philosophy of our father of Nation - Mahatma Gandhi and his tool was non-violence and Satyagraha. With the help of these two tools, he fought Indian freedom struggle and with his great ideas, he inspired the entire world. Martin Luther King, an American activist, and prominent leader in the African-American Civil Rights Movement, Nelson Mandela, a South African anti-apartheid activist and Nobel peace prize winner to name a few.

In the world that we live in today, fanatics and angry youths resort to guns and bombs to make their points as already being exhibited by BOKO HARAM, MEND, BRIAFA, IPOB, AVENGERS etc. When protests are non-violent we should appreciate and embrace them for the betterment of our future. No matter what part of the world we live in, we should live by the ideas of democracy, peace and justice. Movement organizations have a wide range of tactics they can be use to express their grievances and to attempt to influence state

representatives or Federal Government in this difficult Economy. These range from behind the-scenes, quiet lobbying of officials, to petition etc.

However, is it expedient that a protest must be peaceful, orderly and non-violent irrespective of any form or dimension it might take. Mahatma, G (1935), Non-violence is the greatest force at the disposal of mankind. It is mightier than the mightiest weapon of destruction devised by the ingenuity of man. We have seen Syrians, Egyptians, Libyans and millions of Arabs rebelling on streets, challenging their dictatorship in whatever ways they can. Unfortunately, these struggles have resulted in the loss of thousands of innocent lives. Amongst the riots occurred around the world, the Indian freedom struggle led by Gandhi caught the world‘s attention because of its peaceful and non-violent protest. So, It is a necessary reminder to us that the principles of peace, self-restraint, and non-aggression were effective in the past. They still work today and will work in the future, too. The need of the time is to redefine and redesign the right to protest and related acts, so that the voice and views of a common man can be a national issues (Gyanant, 2011).

3.0 THE PERCEPTION OF INCREASING RATE OF STREET PROTEST IN NIGERIA.

Undoubtedly, there has been a perennial increase of street protest across the country. February 6, 2017 is still fresh in our memory in which peaceful protest took place in Lagos, Abuja, Ibadan, Osun,Ijebu Ode e.t.c being lead by notable personality ranging from Entertainment Industry, Human right activist, Labour Congress, Trade Union Congress e.t.c. Series of protest have equally be reported in different part of the country. On February 13th,2017 Labour union Congress organized a mass protest in Abuja to protest against the harsh economy in the country. Peaceful and violent demonstration has been reported severally in Easter and Southern part of the Country, “the Biafra phenomenon”. The Niger Delta Avengers and other aggrieved groups are not left out.

The Nigerian Health workers have equally staged peaceful protest at different times in 2015. More recent is the health workers protest in Abuja on the 22, February,2017 to speak against total neglection of the health sector by Federal Ministry of Health.

Hardship had become the lot of the citizenry since 2015. Even without laborious findings, the sights and sounds of the socio-economic realities in the country explained why Nigerians took to the streets on the 6, February, 2017. That rare display of courage was reminiscent of a quote by Frantz Fanon in one of his numerous revolutionary books. The late Algerian pre-independence nationalist famed for his authorship of the Wretched of the Earth had stated thus: “When we revolt it’s not for a particular culture. We revolt simply because, for many reasons, we can no longer breathe.” Truly, the protests, irrespective of a few contrary opinions, were simply because the hardship in the country had become strangulating for Nigerians. Accordingly, from our findings and other sources the following and among others were observed as immediate and remote causes of the series of protest by angry Nigerians:

(i) High cost of living/grinding hardship : For anyone living in the country at the moment, life has been reduced to a harrowing experience as a result of the escalating prices of goods and services. This situation has brought about widespread hunger especially among middle-income earners, low-income earners, and commoners. Virtually every commodity has

witnessed over 100 percent increase in price since 2015, resulting in low purchasing power. Even staple food items that are locally produced, are affected by the escalating prices. Since virtually everyone is a victim, it was not surprising that many apart from those in positions of authority, their supporters and hangers-on supported the protests. The role this factor played in provoking the exercise was better articulated by the then Acting President, Prof Yemi Osinbajo in a speech acknowledging the grouse of protesters. "We are in a serious economic situation and the President was particularly concerned about the lot of the common man. And I quote him, "Recession today for many, for some its means not being able to pay school fees, for others not being able to afford the high cost of rice and millet and for most of our young people recession means joblessness, 'he stated.

(ii) Harsh economic policies: Before now, experts and non-specialists had frowned at some economic policies of the present administration, with the consensus that it was accentuating the economic crisis. For instance, the World Bank and the International Monetary Fund, IMF, had in October 2016 urged the Federal Government to come up with an economic blueprint. Latching on its understanding of the dynamics of the Nigerian economy, a leading global financial magazine, The Economist dismissed the fiscal policies of the administration. The surprising disposition of the UK-based magazine, which supported Buhari in the 2015 presidential election, came a few days after Financial Times termed the same fiscal policies as the height of foolishness. Two former governors of Central Bank of Nigeria, CBN, Prof Charles Soludo and Emir of Kano, Alhaji Mohammadu Sanusi had reasoned in that direction. Soludo had said that the President's economic policies, since 2015, were still based on campaign promises. However, some policies that have not been widely accepted include fixed exchange rate, forex restrictions, implementation of Treasury Single Account, TSA, politics of naira devaluation and banning of some items the country had no comparative strength of producing among others.

(iii) Delay in making key decisions :In the estimation of most Nigerians, this administration is famed for not being apt in the area of making critical decisions. Analysts have argued that some policy actions of the government often come belated when the issues they were expected to have addressed had become complex. Those easily referenced are the delay in the appointment of ministers and heads of parastatals, delay in the appointment of ambassadors, delay in the appointment of National Commissioners of Independent National Electoral Commission, INEC and delay in 2016 budget presentation among others. More disturbing is their failure to take decisions that can improve the hardship in these present economy. All calls to higher or engage a sound economic team have been ignored. This trend is believed to have resulted in the seeming lack of pace in the business of governing Nigeria.

(iv) Collapse of power sector: Currently Power generation and distribution is still a challenge as most cities, towns, and villages are in darkness, the billions of money spent on the sector notwithstanding. Instructively the highest generation so far recorded was the generation of 5074.7MW February 2, 2016, while the highest maximum daily energy wheeled nationwide was 109,372MWH on the same day. Unfortunately, that achievement meant nothing till date as the generation level has continued to hover between 3,730.5 MW as of February 9, 2017, and 2,662MW (the amount recorded on January 2, 2017) Saturday Vanguard of 11th,

February, 2017. The worsened power challenge has increased the fuel consumption rate of most people, who spend much now to power their generators at homes and offices. Another worrisome aspect of the energy crisis in Nigeria is the high tariff being charged for the insignificant electricity supplied.

(v) Rising unemployment rate: In nearly two years, the unemployment rate in the country has witnessed a steady rise in percentage. The National Bureau of Statistics had in December 2016, stated that Nigeria's unemployment rate rose from 13.3 percent in the second quarter to 13.9 percent in the third quarter of 2016. The report stated that the number of unemployed increased by 555,311 persons. However, the trend which is a common social challenge in Nigeria became more alarming with the loss of jobs brought about by the economic recession. Many Nigerians were thrown to the streets by their employers as a cost cutting measure. The seriousness of the scourge was evident from the inscription of unemployment among the challenges listed on the placards of most protesters. Even though the Federal Government had cautioned companies against sacking their workers, most organizations are still laying off workers in large numbers. (vi) Absence of defined response to Economic Challenge: Most Nigerians are alarmed by the absence of an economic blueprint aimed at tackling the country's economic woes. Harping on historical experiences where nations had used concretized fiscal road-maps to emerge stronger from a downturn, there are concerns that the government is yet to have a blueprint in the face of the worst economic crisis in Nigeria's history. At the moment, the vehicle through which the government intends surviving the meltdown is still unclear, as experts keep demanding a work plan. That the government had recorded some gains in some areas did not stop observers from maintaining that its fiscal policies were less holistic and impactful.. For instance, the World Bank and IMF, an investigation by this paper, revealed, mounted pressure on the government to come up with an economic blueprint, if its drive for foreign loans was not to be stalled. This delay in coming up with a plan is believed to be accentuating the economic woes thereby prolonging the lifespan of the recession. At the moment, the economy is reportedly growing at two percent with a high inflation rate of 18.5 percent.

(vii) Crashed value of the naira/Inflation: Nigeria's currency which used to be among the strongest in Africa has lost over 100 percent of its value. With the 2024 budget pegging the exchange rate at N800 to 1$, the naira has continued to crash in the parallel market. The currency currently trades at N1350 to a dollar. Today, virtually most Nigerians are groaning given that the valueless state of the naira has brought extreme hunger and other forms of hardship in the country. The fact that this is happening unabated leaves the populace frustrated about what the days ahead hold.

(viii) Handling of rampaging herdsmen: Most Nigerians are alarmed by the manner the disposition of the administration towards the mass killings being done by Fulani herdsmen across the country. For a government that had excelled in decimating the capacity of Boko Haram insurgents to commit mass murder, its seeming silence on most murderous activities being perpetrated by Fulani herdsmen, leaves most people surprised and irritated. For instance, the administration's handling of the massacres in Agatu and Southern Kaduna was

mostly considered unimpressive. Unfortunately, such attitude is giving rise to the notion that the Government had applied double standards in responding to some national challenges.

(ix) Polarization of Nigeria along ethnic lines: The pulse of a cross section of Nigerians is that the present administration had in policies and appointments, favoured some ethnic groupings against others. Those, who hold this position, maintain that the North is more favoured in this dispensation in manners that rubbished the contents of the Federal Character Principles. This is one factor that Saturday Vanguard of 11th, February, 2017 found to be irritating the larger South, especially the South East extraction. This feeling which had long existed was recently re-echoed by a former Military Administrator of Kaduna State, Col Umar Dangiwa, retd, who claimed that the administration's pro-North disposition was dividing Nigeria. Dangiwa, who said this against the backdrop of the initial delay before the appointment of Justice Walter Onnoghen as the substantive Chief Justice of Nigeria, said: ''The unity of the nation has already been pushed to the precipice by the recruitment and appointment policies of a government which tends to favour the north in violation of the Federal Character provision of the constitution."

x) Moribund State of our Road Network It is a common knowledge that Nigerian roads are generally either in a state of disrepair, poorly maintained or altogether untarred. With Nigeria boasting of the largest road network in Africa, it is not surprising that only about 60,000km or less out of its estimated 195,000km or road network is paved. Majority of the nation's road network was constructed between the 80s and 90s, with a larger portion of them currently deteriorated because of poor maintenance. Even when the existing roads are constructed or supposedly maintained, it soon falls into disrepair due to the use of low-quality materials. Despite huge budgetary allocations been committed annually to infrastructural development projects, much yet remains to be seen on how the condition of the roads justifies their fiscal allocation. Recently, members of the Nigerian Union of Petroleum and Natural Gas Workers, NUPENG, had embark on industrial action over poor roads in Nigeria which constantly causes tanker accidents and the resultant life and economic losses. The National President of the Union reportedly stated that: *We are shocked at the lackadaisical attitude of local, states and Federal governments to the issues of addressing the degenerating state of Nigeria roads before the coming of the current raining season despite all our warnings for them to make necessary construction, repairs and maintenance of all our roads, which are now in a parlous state and becoming practically impassable. (Vanguard,13th Oct., 2021)*

Though the strike was subsequently called off due to some intervention by the Federal Government, one cannot but agree with the motive behind NUPENG's intended strike. There is no doubt that road usage accounts for the great percentage of transportation which means that the deplorable condition of the roads which cars, trucks, buses, and motorcycles are forced to ply together is bound to engender occasional crashes. Angry Nigerians had mounted road blocks in different part of the State across the Federation, this was to drive home their demands. Very recently Jettu junction was blocked for days without any movement by angry youths and Nigeria Union of Road Transport Workers (NURTW). This has been the common scenes in all parts of Nigeria today.

4.0 STAEMENT OF PROBLEM.

Research work of Simon (2010) shows that Democracy is not just about electing or voting Government representative into power by the masses but participating fully (or at least to the best of one's ability and interest) in civic life. Thus, the important pillar of a fully democratic society is the right to protest. The statement of problems, is therefore, to investigate among these various identified means of protest, which one is more impactful on the ruling Government of the Society ? Viz::

i) Peaceful street demonstration with placard and Banners
ii) Partial / Total strike action.
iii) Use of Social median .(Artificial Intelligence).
iv) The use of hunger Strike.
v) Social boycott of politicians functions.
vi) Road Blocks / Sit at Home

5.0 Aims and Objectives

Based on the above highlighted problems by different Institutions, Groups and Authorities, the following aim and objectives were formulated i.e to identify the better means of protest among various alternatives**:** This is achieved based on these specific objectives:
(i) To lucidly investigate the best modes of protest to be adopted by protesters in Nigeria.
(ii) To deeply investigate the impacts of street protest on Nigeria Government.
(iii) To make adequate recommendations for the society in the light of the analysis

6.0 Research Methodology / Materials.

In this research, questionnaires were design and administered to solicit for responses from the public. These were done in the, public work places, and Motto Parks centers and the response rate and pattern were examined to test for the validity of the research. The questionnaire were segmented with section A centered on Bio-data and section B centered on pertinent questions covering the variables of interest for the research and the question were design based on a standard linker scale such that SA = 5, AG =4, UN = 3, DA =2, SD = 1. Out of the 500 questionnaires administered, a little above 400 questionnaires were retrieved and this form the population of the study. The sample size of 200 was adopted using the Taro Yamane formula (1967) as follows:

$$n = \frac{N}{¿¿}$$

where n = Sample size
N = Population = 400
e = margin error = 0.05 (5% significant level)

$$n = \frac{400}{¿¿}$$

$$n = \frac{400}{2}$$

n = 200

Responses to the different variables under study were collected and analyzed to examined the best mode of protest in line with the linker scale measurement. The mean, which is the average and the respective standard deviation were determined using the SPSS to run the descriptive statistics. Coefficient of variation (C.V) was further used to examined the most consistent variables to be adopted as best means of protest in Nigeria today.

Given that : C.V = $\frac{S}{\overline{X}}$ x 100

Were**:**

$\overline{X}$ = Sample mean.

S = Sample Standard Deviation.

7.0 Data Presentation.

Table 1: The summary table shows the responses of various means of protest as obtained from the returned questionnaire administered.

Scale Responses / Modes of protest.	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6
Strongly Agree. (5)	66	60	57	52	55	49
Agree. (4)	54	50	49	49	48	35
Undecided. (3)	25	30	26	24	33	30
Disagree (2)	25	28	32	35	30	45
Strongly Disagree. (1)	30	32	36	40	34	41
Total	200	200	200	200	200	200

Sources : Field Survey, (2024).

Where :

Y_1 - Peaceful street demonstration with placard and Banners.

Y_2 - Partial / Total strike action.

Y_3 - Use of Social median .(Artificial Intelligence).

Y_4 - The use of hunger Strike.

Y_5 - Social boycott of politicians functions.

Y_6 - Road Blocks / Sit at Home

7..1 Summary Analysis of Results.

Table 2. Descriptive analysis of results:

Modes of Protest.	Sum	Mean	Standard Dev.	C.V
Y_1	701	3.51	1.44	41.03
Y_2	678	3.39	1.45	42.80
Y_3	659	3.29	1.48	44.98
Y_4	638	3.18	1.49	46.71
Y_5	660	3.30	1.46	48.18
Y_6	606	3.03	1.49	49.17

8.0 Conclusion.

The analysis above revealed that a peaceful street protest with placard and banners, proved to be the most efficient and consistent means of carrying out a protest and followed by a strike action as shown by the coefficient of variation (C.V). This indeed, is a true reflection in Nigeria situation today, were workers/civil servant will usually protest before embarking on an industrial action if the Government or management of an establishment fail to meet with the demands of the people. Again, the results also shows that on the average in line with linker scale (4) , protesters generally agreed that peaceful street demonstration with placards and banners is the best mode of protesting for a good governance in these current recessed economy.

9.0 Recommendations.

(1) When protests are non-violent we should appreciate them and embrace them for the betterment of our future. No matter what part of the world we live in, we should live by the ideas of democracy, peace and justice.

(2) We need to understand therefore, the Gandhian way of protest at the time of Indian freedom struggle and his strategy of non-violence because a slight act of violence or indiscipline can ruin the entire effect and seriousness of the campaign and can convert it from a meaningful protest of national interest into a disturbing violent act against national security, law and order.

(3) We need to have the protests which are systematic, well-planned, non-violent, patient and peaceful. At the same time, we need some reformers, like Gandhi, who can re-think over the democratic structure and redesign the system, so that democratic protests regain their importance and will again become a strong pillar of democracy and a tool of common man to check the system and control the governance especially in our present recessed Economy.

(4) Strike actions should be well thought of as a means of protest before embarking on it because of the serious economic effect it could have on our already recessed economy.

(5) The Government should do the needful for the people they Govern. Pushing the masses to embarked on a protest and subsequently strike action should not be the case. They must get

the trust of the people with an open sound economic plan and adequate budget implementation in order to revived our recessed economy.

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The Contributions of Global Systems for Mobile Telecommunications (GSM) to the Growth of the Nigerian Economy in Etsako West Local Government of Edo State, Nigeria

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Abstract
This study examines the contributions of Global Systems for Mobile Telecommunications(GSM) to the growth of the Nigeria economy since inception. *The paper highlights the problems the country faced prior to the introduction of GSM, t*elephone was not a common commodity but was exclusively owned by government officials, mostly restricted to offices and the homes of Nigerians elites and the rich, Embassies, Military formations, big businesses like hotels, supermarkets, hospitals, universities, and a few other places of interest. Social interaction and communication via telephone was very limited, costs of doing business and travels costs were very prohibitive. Since the introduction of GSM, sectors like information technology, banking and finance, online trade, sporting, education, entertainment, security and healthcare have significantly improved over the years. But there are still some *challenges that face the country in reaping the full benefits of GSM such as* monumental infrastructural challenges operators face, high logistics costs, inconsistent power supply, high technical staff depth, multiple taxations, high-interest rates, lack of credit structure, low Tech Small and Medium Enterprise(SME)platforms and entrepreneurs, conflicting government policies and lack of adequate youth tech start-ups.
Data were collected in Etsako West Local Government area of Edo state using structured questionnaires. The analysis was based on ranking, Chi-square and t-test via SPSS version 22.0. The finding revealed that 78% of respondents agreed that GSM has positively contributed to the growth of the country economy. It also showed that the introduction of GSM has created both direct and indirect employment opportunities for millions of Nigeria youths. More so, the study found that GSM business had reduced cost of doing business in terms of traveling and transaction costs.
The study concluded from the empirical investigations that GSM has contributed positively to the economic growth of Nigeria and has served as source of income and employment to many Nigerian youths. More so, the findings suggested the need for Nigerian Communication Commission (NCC) and the Federal Government of Nigeria to provide the necessary infrastructures (particularly power supply) to ease the efficient delivery of GSM services and to reduce their charges. The government should also create atmosphere for the expansion of tele-density and directly make telephone communications accessible. To achieve this goal, more licenses should be given to GSM operators in order to allow for healthy competition among the GSM operators.

Keywords*:* Global System for Mobile Telecommunication, Economic growth, Deregulation, Tele-density, SME.

Introduction
The advent of Global Systems for Mobile Telecommunications (GSM) in Nigeria marked a transformative phase in the nation's economic, social, and technological evolution. Since the liberalization of the telecommunications sector in 2001 and the subsequent licensing of GSM operators, Nigeria has witnessed a paradigm shift in the way people communicate, conduct business, and access information. The penetration of GSM technology has not only bridged communication gaps across urban and rural areas but has also catalyzed economic development by fostering entrepreneurship, enhancing productivity, and facilitating the delivery of critical services.
Before the introduction of GSM, Nigeria's telecommunications infrastructure was underdeveloped, unreliable, and largely inaccessible to the majority of the population. The monopolistic structure under the Nigerian

Telecommunications Limited (NITEL) offered limited coverage and substandard service quality. The liberalization policy initiated by the Nigerian Communications Commission (NCC) opened the sector to private participation, ushering in mobile network operators such as MTN, Airtel, Globacom, and 9mobile. These operators brought substantial investments, improved infrastructure, and enhanced service delivery to millions of Nigerians (Adeola, O., & Ikpefan, O. A., 2021).

GSM technology has since become a critical enabler of economic activities across various sectors, including commerce, agriculture, education, health, and financial services. It has facilitated the growth of small and medium-scale enterprises (SMEs), improved market access for rural farmers, enabled mobile banking and fintech innovations, and contributed significantly to government revenues through taxes, licensing fees, and job creation. Moreover, the telecommunications sector, largely driven by GSM services, has consistently contributed to Nigeria's Gross Domestic Product (GDP), demonstrating its strategic importance to national development. However, several demerits have also aroused from this advancement such as cyber-crime, cyber-bullying, blackmailing, identity theft and reduced productivity attributed to social media distractions. Even with the apparent progress, it can be concluded that the telecommunication sector is still quite under-exploited in Nigeria. The lack of basic infrastructures like constant electricity and accessible road networks across several parts of the country, and the harsh economic policies have severely limited the potential for heightened economic productivity (Oluwafemi, K. B., & Alabi, F. 2020)

This paper seeks to critically examine the contributions of GSM to the growth of the Nigerian economy. It explores key economic indicators such as employment generation, investment inflow, financial inclusion, and sectoral GDP contributions. In addition, the paper highlights the socio-economic impact of GSM adoption on livelihoods and national productivity. By drawing upon empirical data, regulatory reports, and scholarly literature, this study provides a comprehensive analysis of how GSM services have evolved into a cornerstone of economic progress in Nigeria.

Statement of the Problems

Before the introduction of Global Systems for Mobile Telecommunications (GSM) in Nigeria in 2001, the country's telecommunications landscape was characterized by inefficiency, poor service delivery, and limited access to communication facilities. The sector was monopolized by the government-owned Nigerian Telecommunications Limited (NITEL), which failed to meet the communication needs of the rapidly growing population. Telephone services were largely confined to major urban centers, leaving the vast majority of the population, particularly in rural areas, without access to reliable communication infrastructure.

At the time, Nigeria had one of the lowest teledensity rates in the world, with only about 400,000 connected telephone lines serving a population of over 120 million people (NCC, 2001). The process of obtaining a telephone line was cumbersome, expensive, and often took several months or even years. In addition, the quality of service was extremely poor, plagued by frequent call drops, limited coverage, and inadequate customer support.

This communication deficit had far-reaching implications for national development. Businesses struggled to communicate efficiently with clients and partners, government institutions were hampered in their operations, and citizens lacked a means to access timely information or emergency services. The absence of a competitive telecommunications market discouraged innovation and private investment, further stalling progress in the sector.

Consequently, the lack of accessible, affordable, and reliable communication services significantly hindered economic growth, limited job creation, and contributed to the marginalization of rural communities. The urgent need to address these deficiencies paved the way for the liberalization of the telecommunications sector and the introduction of GSM technology, which promised to revolutionize communication and stimulate economic development across Nigeria.(Olayemi, M. A., & Aderibigbe, T. A., 2021)

Objective of the Study

The objective of this paper is to do a holistic comparative study to examine the socio-economic impact of GSM penetration in Nigeria. More so, this study highlights how the revolution in the telecommunications industry has changed the lives of Nigerians. Also, the research work would investigate if truly the telecommunications

industry has been a significant contributor to the economy, how it has enhanced the lifestyle of Nigerians, businesses, social engagements, and networks, and the contributions to the GDP of the country.

Hypothesis Statement

H_1: GSM has contributed positively to the growth of the Nigeria economy.
H_0: GSM has not contributed positively to the growth of the Nigeria economy.

Overview of GSM Economic Growth in Nigeria

The integration of GSM technology into Nigeria's telecommunications landscape has attracted considerable scholarly attention, particularly due to its profound economic implications. Several studies have highlighted the pivotal role of mobile telephony in transforming the Nigerian economy and improving the standard of living across both urban and rural areas.

According to (Ibrahim, A., & Adewoye, J., 2023), mobile phones have significantly reduced transaction costs and information asymmetry in developing economies, thereby enhancing market efficiency and boosting productivity. In the Nigerian context, GSM technology has not only improved communication but has also become a platform for innovation, particularly in sectors such as finance and agriculture. Similarly, Olayemi & Aderibigbe (2021) observed that the adoption of GSM has expanded the digital economy, enabling millions of Nigerians to access online markets, mobile banking services, and digital financial platforms.

The economic contributions of GSM can also be seen in employment generation. The expansion of mobile networks has led to both direct and indirect employment opportunities through network operations, sales, customer service, and related value-added services (Ndukwe, 2008). This growth has been complemented by infrastructural investments from major telecom providers such as MTN, Airtel, Globacom, and 9mobile. According to the Nigerian Communications Commission (NCC, 2022), the telecommunications sector contributed 12.61% to Nigeria's GDP in the second quarter of 2022, with GSM services forming the backbone of this growth.

Moreover, GSM has been instrumental in enhancing financial inclusion. Mobile money platforms and GSM-enabled fintech services have allowed unbanked populations, especially in rural areas, to participate in the formal economy. These services have provided avenues for savings, credit, and insurance, which were previously inaccessible to millions of Nigerians.

Despite these gains, some scholars have noted the challenges associated with GSM growth in Nigeria. These include poor network coverage in rural areas, high cost of services, and issues of data privacy and cyber security. Furthermore, infrastructure deficits such as inconsistent power supply and limited broadband penetration continue to hinder the full realization of GSM's potential.

In sum, the body of literature affirms the significant and multifaceted contributions of GSM to Nigeria's socio-economic development. However, it also underscores the need for strategic investment and regulatory reforms to address existing limitations and maximize the impact of GSM technology on national growth (Aderemi, *et al.*,2022).

GSM Penetration Journey in Nigeria from 2004 to 2019

The Telecommunications sector in Nigeria has significantly improved from a government monopoly organization with around 11,400,000 subscribers in 2004 to over 180,250,000 subscribers in 2019. More so, teledensity followed the same growth pattern, from 12% in 2004 to over 100% in 2019, internet penetration grew from 8% to 44.68% in 2019 and with the sector contributing over $70 billion to GDP at just 9% (from 2004-2019). (Adeyemi, *et al.,* 2021).

Agboola, *et al.,* (2020) posited that the Telecommunications sector has pulled in around 25 billion US dollars from direct foreign investment into the country while as far as job opportunity, an absolute several millions of employments were created. The industry has developed to such an extent that it helps the development of service sectors like insurance, IT, banking, consultancies, transportation, Small and Medium Scale Enterprises (SMEs). There has also been a critical improvement in the activity of the economy.

More so, increased yearnings of the population to communicate and bridge the urban-rural divide, given that opportunities are created in the service industry, rapid digitalization of records, and service delivery has been key to the shift in the socio-economic paradigm that has become evident. (Sanni, *et al*., 2021) ascribed

Nigeria's Telecommunications revolution and rapid growth to the activities of the 2001 deregulation efforts and eventual privatization exercise.

GSM Penetration and Economic Opportunities

Active internet subscription (GSM) has grew sharply since the introduction of GSM. In more clear terms, internet penetration was enhanced by its circulation. Around 19 years after GSM penetrated Nigeria, e-commerce is by all accounts the new market by which jobless graduates make money and even use their creative and inventive cap. Nigerians are progressively being viewed as expatriates in other countries. This is a clear differentiation to when the country was reliant exclusively on oil for more than 40 years and which the effect on the socio-economic life of the people was restricted (Guardian, 2019).

However, now GSM has made social media and the internet very accessible to people. Therefore, Small scale businesses and business proprietors can promote their businesses, on social media platforms like Facebook, Instagram, Twitter, Google Search Engine, YouTube, and many more (Nnadi, *et al.,* 2021). Most SMEs in Nigeria utilize GSM to speak with their customers and by this form a more grounded relationship. They have understood that easy access to GSM and the conveyance of their products or services are significant drivers in creating and sustaining market competitiveness nationally and globally. (Bakare, *et al.*,2020)

The digital inclusion that the penetration of GSM has made has created new vocations, new business ideas for Nigerians. Nigerian retailers are progressively utilizing the internet to drive sales. Different service providers and traders have made social media their marketplace. People sell and purchase clothes, food, electronics, toiletries, wedding items, and many more on social media. People hire service providers like graphics designers, babysitters, virtual assistants, writers, dispatch riders, and many other service providers on social media. Currently, there are applications for practically anything, for job search, online courses, shopping, cooking, makeover, and Do-It-Yourself ideas. These applications and the avalanche of contents on the internet have inspired many youths to become entrepreneurs just by owning an Android or iOS mobile phone. (Okereke, *et al.,* 2022).

GSM Penetration and Digital/Mobile Payment Systems

Different banks in Nigeria have their Mobile Apps by which customers can conveniently carry out transactions. Also, customers with the upgraded version of mobile phones also known as Android and iOS can simply use their bank-generated transfer code to implement transactions successfully. The status quo has reduced the rate of armed robbery drastically as people hardly move with large sums of cash, neither do they keep huge sums at home. (Ekong, *et al.*,2021). Although, Ekong, *et al.*,(2021), argued that the rise of GSM has achieved a stupendous improvement in the significant area of the economy, like banking, telecoms, and commerce in general. The penetration of GSM has brought numerous profits which incorporates expanded financial sector turnover through loans, advances, e-commerce, e-banking (Mohammed, *et al*.,2020).

Additionally, electronic banking like Automated Teller Machine (ATM), services, online monetary exchanges, international credit uptake of debit and credit cards and debit card facilities, airline ticketing, and reservations are a portion of the various ways that the introduction of GSM has helped the improvement, refinement, security and fast transactions in the Nigerian financial sector (NCC, 2017). Nigeria is as of now positioned as the biggest and quickest developing telecommunications market in Africa and among the top 10 fastest growing telecommunications markets in the world. (Ibrahim, *et al.*,2023).

GSM Penetration on Social Relationships and Networking

Kareem, *et al.*, (2022), opined that social and family relationship has likewise been essentially improved. GSM is utilized by Nigerians generally to communicate with one another. Students utilized it to communicate with their course mates, companions, lecturers, and family members. Furthermore, family matters, finance, and academic matters constitute the major functions of mobile communication for most people. Prior to the existence of GSM, these functions had been performed manually, yet the accessibility of mobile phones has restricted the majority of the students' travels, followed by facilitation of exchange information whenever the need emerges.

In addition, youths can explore opportunities on social media due to their easy access to smartphones. Different skits, videos, and contents are flying all over social media and these youths generate money from the recognition

they get from those contents. For instance, in the entertainment industry, music artists release songs and videos which they sell to different websites, and these websites in turn make their money by the deluge of people who visits their websites for download or to stream. The same thing applies to the movie industry. This development has brought huge improvement to the challenge of piracy and has heightened the revenue generated in the entertainment industry (Mohammed, M. A., & Usman, I., 2020).

Methodology

Empirical Analysis

Table 1: Mean, Percentage and Ranking of Respondents Based on the Relevant Questions

	SD (%)	D (%)	A (%)	SA (%)	$\overline{X}$	Ranking
The introduction of mobile telecommunication (GSM) has reduced transaction cost of various activities in Nigeria	24 (12)	36 (18)	69(34.5)	71(35.5)	2.93	**9th**
GSM has contributed positively to the growth of the Nigeria economy	16 (8)	25 (12.5)	86 (43)	73 (36.5)	3.08	**7yh**
The introduction of mobile telecommunication (GSM) has led to generation of employment opportunities (both direct and indirect) for Nigerians	13 (6.5)	24 (12)	81 (40.5)	82 (41)	3.16	**2nd**
Global System of Mobile telecommunication has led to increased income and the living standard of Nigerians	6 (3)	27 (13.5)	99 (49.5)	68 (34)	3.15	**3rd**
The introduction of GSM has reduced travelling and communication costs in the country	10 (5)	30 (15)	82 (41)	78 (39)	3.14	**4th**
The introduction of GSM has made how we communicate and interact faster, easier and also led to heighten social cohesiveness among one another	20 (10)	28 (14)	88 (44)	64 (32)	3.13	**5th**
The introduction of GSM has helped in the way we conduct and advertise our business	6 (3)	18 (9)	101 (50.5)	75 (37.5)	3.23	**1st**
The introduction of GSM has tremendously supported the growth of Tech startups and SME entrepreneurs in the country	18 (9)	29 (14.5)	88 (44)	65 (32.5)	3	**8th**
The country has fully benefited from the potential of GSM technology to drive her economic growth	21 (10.5)	13 (6.5)	93 (46.5)	73 (36.5)	3.09	**6th**

Source: Field survey, 2024

Interpretation of Mean and Percentage Responses

The result of the analysis indicates that based on the ranking of the mean responses of respondents, it is believed that the introduction of GSM in the country have helped in the way business and advertisement are conducted generally. This is followed by respondents agreeing that the advent of GSM have helped secure employment opportunities to Nigerians, however the respondents believes that the introduction of GSM has tremendously supported the growth of technology startups and development of SME in the country, although the least

response on the average respondents approximately agree that the introduction of mobile telecommunication (GSM) has reduced transaction cost of various activities in Nigeria.
Generally, from the responses gathered shows that the respondents agreed to the different question asked which is an indication that the introduction of GSM in the country have helped in improving the economic condition of the country which in turn gives rise to improve economic growth.

Table 2: One sample t test statistic

	Item Measure	t	df	Sig. (2-tailed)	Remark
1	The introduction of mobile telecommunication (GSM)has reduced transaction cost of various activities in Nigeria	6.104	199	.000	Significant
2	GSM has contributed positively to the growth of the Nigeria economy	9.127	199	.000	Significant
3	The introduction of mobile telecommunication (GSM) has led to generation of employment opportunities (both direct and indirect) for Nigerians	10.649	199	.000	Significant
4	Global System of Mobile telecommunication has led to increased income and the living standard of Nigerians	12.010	199	.000	Significant
5	The introduction of GSM has reduced travelling and communication costs in the country	10.637	199	.000	Significant
6	The introduction of GSM has made how we communicate and interact faster, easier and also led to heighten social cohesiveness among one another	3.845	199	.000	Significant
7	The introduction of GSM has helped in the way we conduct and advertise our business	13.991	199	.000	Significant
8	The introduction of GSM has tremendously supported the growth of Tech startups and SME entrepreneurs in the country	7.742	199	.000	Significant
9	The country has fully benefited from the potential of GSM technology to drive her economic growth	9.071	199	.000	Significant

Source: Field Survey 2024

The result of the analysis as shown from the table above indicates that the one sample test carried out for all related questions at a degree of freedom of n-1, the calculated values are greater than the tabulated value hence we see that the questions are significant. Moreover, the p-value as shown is less than the asymptotic significance. Therefore, it could be concluded that there is a significant association and positive relationship between the use of GSM mobile technology and the economic growth.

Hypothesis testing

GSM has contributed positively to the growth of the Nigeria economy

		Frequency	Percent
Valid	Strongly Disagree	16	8.0
	Disagree	25	12.5

Agree	86	43.0
Strongly Agree	73	36.5
Total	200	100.0

Calculating the chi square value

Response	O	E	$(O-E)$	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Strongly Agree	16	50	-34	1156	23.12
Agree	25	50	-25	625	12.5
Disagree	86	50	36	1296	25.92
Strongly Disagree	73	50	23	529	10.58
Total	200				72.12

$$\chi^2_{calculated} = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

To obtain the expected value from the goodness of fit chi square

$$E_i = \frac{1}{n} \sum_{i=1}^{n} O_i$$

$$E = \frac{16+25+86+73}{4}$$

$$E = \frac{200}{4}$$

$$E = 50$$

Decision Rule:

$$If\ \chi^2_{calculated} < \chi^2_{tabulated}\ Accept\ H_0$$

$$If\ \chi^2_{calculated} > \chi^2_{tabulated}\ Accept\ H_1$$

From the above test since $\chi^2_{calculated} > \chi^2_{tabulated}$ that is $72.12 > 7.815$

H_1 will be accepted while H_0 will be rejected.

Interpretation

Findings: the chi-square calculated value is 72.12, while the chi-square table value is 7.815. Since the chi-square calculated value is higher than the tabulated value, hence, the (H_1) alternative hypothesis which says that there is a positive contribution of GSM to the economic growth of the country is accepted while the (H_0) null hypothesis should be rejected. Therefore, there is a positive contribution of GSM mobile technology to the economic growth of the country.

Summary of hypothetical result

Hypothesis	Chi-Square	Df	Asymp. Sig.	Critical value	Decision	Conclusion
GSM has contributed positively to the growth of the Nigeria economy	72.120	3	0.000	7.185	Significant	Accept the Alternative hypothesis

Discussions

The result of the analysis shows that based on the response, the introduction of mobile telecommunication has reduced transaction cost of some activities in Nigeria and also led to generation of employment opportunities in Nigeria. This is an indication that through the introduction of mobile telecommunication, citizens have been able to create job opportunities for themselves and also in turn employ others, this will bring improvement in the country's economic growth through the development of the immediate community. Respondents also believes that mobile telecommunication has led to the increase in the standard of living of citizens in the country. Meanwhile the introduction of GSM and improved network have led to the reduction of travel expenses from one location to the other as one can call to place an order for a product through mobile communication and receive without having to travel to the market for transaction making communication easier and faster. Through online marketing, citizens are able to show case their product to potential customers by means of online advertising through the help of GSM.

Finally, the chi-square result shows that there is a positive contribution of mobile telecommunication technology on the economic growth of Nigeria.

Conclusion

This study discovered that the penetration and circulation of GSM and the evolution of the telecoms industry have influenced key economic and social paradigm shifts in the Nation. Although, it would be an erroneous submission to say that every contribution of GSM penetration is positive or that GSM is the only and major catalyst to the economy. However, the argument is clarified; thus, the penetration of GSM has reduced exorbitant rates of subscriptions and communication that was deployed during the existence of NITEL. The penetration of GSM technology and freehand given to Network providers that are operating gave rise to wide accessibility both in Urban and Rural Areas and reduced the digital divide drastically. As a result, access to and utilization of GSM technology has soared among a population of users across locations, occupations, and classes (Okereke, U., & Okechukwu, A., 2022).

Based on the foregoing, there have been foreign direct investments attractions, a remarkable contribution to the GDP, creation of over millions direct and indirect jobs, innovations, and inventions of witty and novel business ventures, ease of doing businesses, consumer surplus, and elevation of social interactions. Although, there have been negative inclinations like cyber-bullying, cybercrimes, social media distractions, hidden charges by telecoms operators, and reduction in cultural values, based on collected evidence, but the positive impact of GSM penetration far outweighs the negative consequences. Therefore, along these lines, it could be concluded dependent on the empirical finding, that the GSM penetration in Nigeria has had a synergistic impact on the socio-economic development of Nigeria.

Recommendations

It is recommended that there is the need for Nigerian Communication Commission (NCC) and the Federal Government of Nigeria to provide the necessary infrastructures (particularly power supply) to the GSM operators in order for them to deliver efficient services and to be able to reduce their charges. The government should also create atmosphere for the expansion of tele-density and directly make telephone communications accessible. To achieve this goal, more licenses should be given to GSM operators in order to allow for healthy competition among the GSM operators.

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ARTIFICIAL INTELLIGENCE (AI) AS AN EMERGING TREND IN THE CONDUCT OF OBECTIVE MASS MEDIA RESEARCH

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BEING A SEMINAR PRESENTED AT THE 13TH ANNUAL NATIONAL AND PHYSICAL CONFERENCE, SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY [SICTCON, 2024] AUCHI POLYTECHNIC ,AUCHI EDO STATE

ABSTRACT

This paper examines Artificial Intelligence (AI) as an emerging trend in the conduct of objective mass media research. AI is emerging as a significant trend in mass media, impacting data collection, presentation and analysis. It complements human expertise rather than replacing it, offering tools for faster work and improved content quality. In a bid to achieve the aim of this paper, the relevance of AI to mass media research where highlighted. However, relevant literatures were reviewed as technological determinism theory and source credibility theory were employed as the theoretical framework on which the study was underpinned. It was however discovered that despite the fact that AI affects the transparency of media content by introducing challenges and opportunities, it can also enhance transparency by enabling automated content labeling, improving accountability and fostering trust through clear explanations. The paper recommends inter-alia that researchers and other stake holders in research institute should make sure that the ethics of research are not floated

in the course of research and work cum findings should always be subjected to plagiarism test before they are made public.

Keywords: Artificial intelligent, emerging trend, Mass media Research

INTRODUCTION

That artificial intelligence has a significant impact on the media with regard to the conduct of research and news reportage is not in doubt. With the advent of artificial intelligent, the media have been undergoing a technological drastic change leading to nothing less than a revolution in all walks of life. From all indications, AI is transforming scientific research as well as everyday life, from communications to transportation to health care and more.

Since the 1950s, scientists and engineers have designed computers to "think" by making decisions and finding patterns like humans do. In recent years, artificial intelligence has become increasingly powerful, propelling discovery across scientific fields and enabling researchers to delve into problems previously too complex to solve. Outside of science, artificial intelligence is built into devices all around us, and billions of people across the globe rely on it every day. Stories of artificial intelligence-from friendly humanoid robots to SkyNet-have been incorporated into some of the most iconic movies and books (Catch Science Exchange, 2024).

As observed by Akinola (2024) artificial Intelligence research tools are becoming increasingly important in academic environments as they offer various benefits. One significant advantage is the ability to access relevant repositories and analyse complex datasets easily. This allows researchers to gather necessary information efficiently. These tools aid publishers in identifying potential reviewers and combating plagiarism. The integration of AI technologies to academic environments leads to streamlined processes, improved research outcomes, and fosters innovation. Data analysis is a key area where AI is transforming academic research. Researchers can utilise AI algorithms to quickly and efficiently analyse large amounts of data. The integration of AI research tools in academia is revolutionising the landscape, offering researchers and publishers valuable tools to enhance their work and ensure integrity. He emphasises:

> The use of AI in academic research is therefore becoming more prominent, as professionals recognise the advantages it brings in terms of efficiency and productivity. AI tools can be utilised in various aspects of research, including writing, editing, and citing research papers, contributing to the improvement of the overall research process. It is most vital for researchers to be aware of the benefits and opportunities AI offers to enhance research quality. However, it is equally important to

acknowledge the challenges that may arise when incorporating AI tools into academic research.

As AI continues to disrupt and revolutionise different fields, researchers seems to overlook the potential that AI holds in academia. However, embracing AI technology and understanding its potential limitations, researchers can harness its advantages to drive innovation and elevate the quality of their researches. AI is revolutionising the field of academic writing by providing researchers with various tools to enhance their productivity and efficiency. AI tools now enable researchers to generate research grants, write books, and even compose articles for scientific journals. These tools also help researchers in editing their articles, ensuring grammatical accuracy in their writing.

Statement of the Problem

Artificial Intelligence (AI) is becoming increasingly integrated in all walks of life and conduct of mass media research is not an exemption. However, this integration can be liken to a double edge sword with both opportunities and challenges. In this regard, the growing and increasing role of AI in research and information acquisition, has also raised ethical concerns such as potential biases in AI systems, the risk of AI generated misinformation and displacement of human research.

In view of the above, the questions are, to what extent has AI been employed in the conduct of objective mass media researches? And what exactly are the pros and cons of AI in the conduct of researches? These questions and other issues are the focus of this paper.

Literature Review

Artificial Intelligence and Data Analysis

Data analysis is a vital component of research, and AI based data analysis tool enhance efficiency and objectivity in the process. With the overwhelming amount of scientific literature published each year, AI tools can assist in reading and summarizing complex articles saving researchers' valuable time (Akinola, 2024). AI can also aid researchers in attributing sources from extensive literature

Messeri and Crockett (nd) cited in Cummings (2024) classified proposed visions of AI spanning the scientific process that are currently creating buzz among researchers into four archetypes:

- **In study design**, they argue, "AI as Oracle" tools are imagined as being able to objectively and efficiently search, evaluate, and summarize massive scientific literatures, helping researchers to formulate questions in their project's design stage.

- **In data collection**, "AI as Surrogate" applications, it is hoped, allow scientists to generate accurate stand-in data points, including as a replacement for human study participants, when data is otherwise too difficult or expensive to obtain.
- **In data analysis**, "AI as Quant" tools seek to surpass the human intellect's ability to analyze vast and complex datasets.
- **And "AI as Arbiter**" applications aim to objectively evaluate scientific studies for merit and replicability, thereby replacing humans in the peer-review process.

Cumming (2024) however, warns against treating AI applications from these four archetypes as trusted partners, rather than simply tools, in the production of scientific knowledge. Doing so, they say, could make scientists susceptible to illusions of understanding, which can crimp their perspectives and convince them that they know more than they do. He added:

> The efficiencies and insights that AI tools promise can weaken the production of scientific knowledge by creating "monocultures of knowing," in which researchers prioritize the questions and methods best suited to AI over other modes of inquiry.

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And "AI as Arbiter" applications aim to objectively evaluate scientific studies for merit and replicability, thereby replacing humans in the peer-review process, leaves researchers vulnerable to what they call "illusions of exploratory breadth," where scientists wrongly believe that they are exploring all testable hypotheses, when they are only examining the narrower range of questions that can be tested through AI.

For example, "Surrogate" AI tools that seem to accurately mimic human survey responses could make experiments that require measurements of physical behavior or face-to-face interactions increasingly unpopular because they are slower and more expensive to

conduct, Crockett said. The authors also describe the possibility that AI tools become viewed as more objective and reliable than human scientists, creating a "monoculture of knowers" in which AI systems are treated as a singular, authoritative, and objective knower in place of a diverse scientific community of scientists with varied backgrounds, training, and expertise. A monoculture, they say, invites "illusions of objectivity" where scientists falsely believe that AI tools have no perspective or represent all perspectives when, in truth, they represent the standpoints of the computer scientists who developed and trained them (Cummings,2024).

Impact of Artificial Intelligence on Mass Media

With regards to artificial intelligence and the mass media, Ashava (2021) note that media companies can leverage AI throughout their content supply chain to automate operation drive decision making and personalize the consumer experience. Through techniques such as image recognition and speech to text transcription, metadata tagging is the most widen data automatically created by the AI algorithm can be used to drive content monetization strategies. As we rapidly shift towards a world characterized by digitalization, the power of AI expands and stretches till not even the media industry has been able to escape
it's ditches. The industry has also been undergoing a high degree of transformation with the digital media paving its way towards becoming the main focus of interest across all its sub-sectors that includes TV, Print and Radio

- **AI in Controlling Bias**

Overcoming the rising predisposition is one unbearable disgrace which the media has been looking in the present current world. The information being catered to the audience may often be layered with degrees of bias leading to misleading content instead of factual, balanced now.

- **AI in Social Media**

As the use of Social Media expands and booms at an increasing rate over the years, so does the hold Artificial Intelligence enjoy over it:

Facebook. The entire backbone of Facebook is based on understanding and gaining knowledge of the behavior of its users, yet with its massive user base it makes use of several techniques to do the same. Like – Deep learning, Deep text, face Recognition etc.

Twitter.
Twitter makes use of AI algorithm to flag and removes the accounts that are promoting extremist groups or hateful tweets and also recommending tweets on the user's timeline and ensuring that the pertinent tweets are obliged them first. It makes use of Natural language Processing (NLP) to
analyze thousands of tweets per second and provide insight on the inclination of the users

Instagram.
Search suggestions – with millions of photos being shared on the platform every day, Instagram leverages AI to create its search function with its massive database to help users find images related to their own favorite activities and experiences

.Linkedin.
Job/Connection Recommendations makes use of AI for offering job recommendations, suggesting people for the user's to connect with and for delivering specific post on the user's feed.

Theoretical Framework

This paper utilises the technological determinism theory and source credibility theory which are relevant to the issues of discourse in this paper.

Technological Determinism Theory

In 1964, Marshal McLuhan was the one who first formulated the technological determinism theory. The goal of the reductionist theory, known as the technological determinism, is to establish a causal connection between the development of technology and the makeup. It investigates question of whom or what might wield controlling power over human affairs. The theory investigates how technological concerns influence human thought and behavior. The theory's fundamental premise is that various media forms are merely extensions of the natural environment in which human live. According to Asemah (2011), the theory proposes that the media change both the environment in which they are presented and the message they deliver. The media cultivate new behaviors which are likely to persist, while their technologies have the potential to produce novel settings. He went to say that the theory proposes that technologies, particularly the media, play significant role in determining how individuals think, feel and how societies organize themselves and function. The medium determines the content of the communication. [Creative Common]. Our understanding of the world is susceptible to being skewed by the medium's influence. The preponderance of mass communication can no longer be denied (p.215).

As Baran and Davis (2006, page 304) observed, McLuhan declared the media to be the extensions of man and argued that media quite literally extend sight, hearing and touch through time and space. Baran and Davis made this observation; the proliferation of electronic media would present regular people with novel opportunity and instantaneously make possible for us to be everywhere. Despite open up a new vista for ordinary people and instantly enable us to be everywhere.

Still, McLuhan's observations concerning the global village and the role of electronic media in it continue to be prophetic. When satellite communications were just being developed, he seemed to foretell the rise of the Cable News Network with its ability to seemingly make us eyewitnesses to history as it moved on the battlefield or at the barricade. At a time when maintenance computers filled entire floors of office buildings, he envisioned

a time when personal computers would be everywhere, and the internet would give everyone instant access to immense stores of information.

Given the above, one media critic Meyrowitz (1985), noted that to be everywhere is to be nowhere and to have no sense of place. Having access to information is not the same as being able to select and use information effectively. The global village isn't situated in space or time. Despite the criticisms of McLuhan's work, much of it merits attention. Rogers (2000) argued that McLuhan's perspective deserves more attention from mass communication scholars, especially those interested in studying new media. Some young scholars find it an exciting standing point for their thinking (wolf, 1996). It is possible because McLuhan's none is so eccentric and open-ended.

Griffin (1994) says McLuhan traced the emergence of western civilization in stages tied to the media available for human communication, they include; the tribal age, the literate age, the print age and the electronic age. Each period brought a new era with it:

v. **The Tribal Age**: This was when man's perception of his environment was multi-sensory, and his mode of communication was oral. Society was essentially a recollection of the past.

vi. **The Literate Age**: In this stage, McLuhan wrote that the phonetic alphabets fell into the acoustic world like a bombshell, installing sight ahead of the other senses. People who could read exchange an eye for an eye. Literacy brought people out of collection tribal involvement into civilised private detachment. Literacy moved away from the tribal age and left the tribe without being cut off from the floor of information. The age of literacy made visual dependence possible.

vii. **The Print Age**: If the age of literacy made visual dependence possible, the print age made it widespread. Because the print age demonstrated mass production of identical products, McLuhan called it the forerunner of the industrial revolution.

viii. **The Electronic Age**: This age is the ICT era. It is the stage at which communication now transcends national and planet barriers. It could also be referred to as the age of cyberspace or superhighway, with the satellites stationed in geosynchronous orbits. This stage overlaps the print age.

Each stage in McLuhan's theory marked an improvement in the communication process. The electronic age has altered broadcast media. This effect can be seen in newsgathering and dissemination ICT brought with it.

Source Credibility Theory

The Source credibility theory was propounded by Hovland and Weiss in 1951. This theory according to Wikipedia (2022), source credibility is a term commonly used to assume a communicator’s positive behaviour that hinder the receiver’s acceptance of message. Asemah (2011), states that the credibility of the originator determines how the receiver will react to the message. That is the attitude of the message receivers when they receive a message depends to a great extent on how they see the source and how they perceive the source to be.

The source credibility theory exists between attitude change and the source of a message. When the right source is used to transmit a message, it boosts the chances of having an effective message. But when the wrong channel is used, the response will be poor. Anaeto and Anaeto (2010), note that the source credibility is categorised into three models. These are the factor model, the functional model according to Anaeto and and Anaetor(2010) helps to determine the extent to which the receiver judge the source as credible, the functional model views credibility as the degree to which a source satisfies a receiver's individual needs. There are different media organisations in our society. The journalist should use the right media to disseminate information to the audience.

By and large, the relevance of the technological determinism theory to this study is that it states that media technologies shape how a society operates as we move from one technological age to another. Moreover, new media are not only an addition to existing media, they are also new technologies and therefore do have a deterministic factor as well. Marshall McLuhan made a famous statement that "the medium is the message". This means that the medium used to communicate influences the mind of the receiver. The introduction of news print, television and the internet have all shown how technological advances have an impact on the society in which we live in. while the source credibility theory hinges on the fact that the acceptance of any message in communication is dependent on the communicator's positive characteristics, that is, the credibility of the messenger serve as a major determinant of what the recipient will do to the message.

Methodology

The desktop research methodology was employed in this study. According to Drive research.com (2023), desktop research, also known as secondary research or library research, is a method of gathering information and insights by analyzing and synthesizing existing data and sources rather than conducting primary data collection through fieldwork or survey. Here, literatures were reviewed from both primary and secondary sources. In the study, the desktop was found to be most appropriate for this particular study. The desktop as a research technique was used to obtain data either by reviewing of literature from diverse sources.

The findings and recommendations of this study are hoped to be of immense benefits to both government and other policy makers.

On completion, this work will also serve as a reference material to future researchers who will or may have interest in carrying out research in a relative area of study.

Conclusion

Just as everyday in our modern society is always characterised with all sort of changes, the conduct of mass media researches are not exceptions. However, as AI continues to advance, it will have an increasingly pervasive influence on our lives. To better prepare for this future, a deeper understanding of the differences between AI and human intelligence is necessary. With this, it is crucial to acknowledge the limitations of AI and not expect too much too soon in terms of reducing negative social impacts.

Recommendations

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

4. Researchers and other stake holders in research institute should make sure that the ethics of research are not floated in the course of research.
5. Researchers should be factual and objective in their employment of AI in conducting research.
6. Research work cum findings should always be subjected to plagiarism test before thay are made public.

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ASSESSMENT OF THE MICROBIAL CONTAMINATION OF DOOR HANDLES IN BLOCKS OF OFFICES WITHIN AUCHI POLYTECHNIC, AUCHI

BY

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Abstract
The door handles in blocks of offices are the objects that every staff and students touch at least several times a day. For this reason, many microorganisms collect on them, which can cause infections of varying severity. Therefore, it is very important to observe proper hand hygiene and disinfection of frequently touched surfaces on the door handles. Twenty samples using sterile swab sticks were taken randomly from door handles within Auchi Polytechnic, Auchi. The samples were individually put into swab tubes and labelled accordingly. The samples were immediately taken to the microbiology laboratory, School of Applied sciences for immediate microbiological analysis. Microbiological isolation using culture plates (Nutrient Agar) and further biochemical tests were used to identify *Escherichia coli, Enterococas sp, Staphylococus aurues*, as the bacterial isolates. The high degree of microorganisms (bacteria) indicates contamination from hands, and poor hygiene/lack of disinfectant thereby posing serious health risk. it is therefore recommended that constant cleaning sterilization of door handles to avoid the spread of transmissible disease.
Keywords: *Enteroccocus* spp., *Escherichia coli, Staphylococcus aureus*, office door handles.

INTRODUCTION

Skin is the largest external human organ and the largest protective barrier of the body against external factors. The ecosystem of the skin varies considerably: some surfaces such as forearms and the back are dry, other areas are moist (palms), and some surfaces are quite wet (armpits) (Bacevičienė *et al.*, 2019; Jankauskienė, 2020). The skin a favourable environment for microorganisms to multiply (Jankauskienė, 2020).

Bacteria, fungi, and viruses can be found on environmental surfaces. Microorganisms can enter surfaces during direct contact, in the form of aerosol droplets or body fluids (saliva, blood, urine, etc.). On human hands, there are mostly normal microflora bacteria, but there can also be temporary microorganisms that find their way on the hands from the environment. The probability of transmitting microorganisms through frequently touched surfaces depends on how long the organism can survive in the environment under

the influence of environmental conditions (Odigie *et al.,* 2017). In previous studies, gram-positive *Staphylococci* and gram-negative *Escherichia coli* were found on contact surfaces such as doorknobs and chairs. Gram-negative bacteria have virulent properties and endotoxins in their outer membrane, which cause various infections (Baadhaim *et al.,* 2011). Grampositive bacteria can also cause infections, but they are easier to treat due to the sensitivity of gram-positive bacteria to antibiotics. This is due to the fact that the walls of gram-positive bacteria are not as dense as that of gram-negative bacteria, so larger molecules can pass through (Silhavy *et al.,* 2010).

Staphylococcus epidermidis is found on almost every hand. The number of colonies of these bacteria on healthy hands far exceeds the number of *Staphylococcus aureus* bacteria (Odigie et al., 2017). Corynebacterium, Micrococcus species, and some bacteria of the Enterobacteria family are also found on the hands. The most common temporary bacteria on the hands that cause diseases are *E. coli*, *Salmonella* species, *Shigella* species, *Clostridium perfigens*. Viruses such as norovirus and hepatitis A virus are also found on hands (Odigie *et al.,* 2017). Poor hand hygiene facilitates the entry of pathogenic bacteria from environmental surfaces into the human body (Tsaku *et al.,* 2017). Staircase door handles touched by people in multi-apartment buildings harbour potentially pathogenic bacteria and may act as sources of infectious agents.

The aim of this study was to assess the microbial contamination of door handles in offices across Auchi Polytechnic.

Materials and Methods

Materials

Culture media (Nutrient Agra) for bacteria, sterile swab sticks/cotton wool swabs, sterile swab tubes, sterile distilled water.

Sample Area

Buildings that housed offices and class rooms within Auchi Polytechnic, Auchi.

Sample collection

Samples were collected from door handles within Auchi polytechnic by means of sterile cotton swab sticks. The swab sticks was wiped firmly on the entire surface of the door handles. Each swab stick was placed in small tube, labeled and immediately taken to the Microbiology Laboratory of Auchi Polytechnic, Auchi for further microbiological analysis.

Sample Preparation

The swabs were soaked in a little quantity of distilled water from where a sterile wire loop was used for the inoculation using the streaking method.

Nutrient agar media for bacterial growth was prepared according to manufacturer's specification.

Each properly labelled tube sample, a sterile wire loop was used to take at aliquot of the inoculums and aseptically transferred to the plates and streaked. The isolates were purified by repeated sub culturing of distinct colonies. the inoculated Nutrient agar plates were incubated at 37^0c for 24hrs. After 24hrs of culturing, growth colonies were identified based on cultural,

morphological and biochemical characteristics and identified according to Holt *et al.,* 1994, Bergey's manual of determinative bacteriology.

RESULTS AND DISCUSSION

The study searched for the main infectious agents: *P. aeruginosa*, *Enterococcus* spp., *S. aureus*, and *E. coli* bacteria.

All samples collected from door handles within Auchi Polytechnic recorded microbial population and growth. Microscopy, cultural morphology of colonies and biochemical test showed that bacteria was isolated and identified. Bacteria load of door handles samples is shown in table 1

Table 1

Bacteria load of door handles sampled in Auchi Polytechnic

Samples	**Bacterial (cfu/ml)**
1	11.0×10^3
2	10.0×10^3
3	8.0×10^3
4	9.0×10^3
5	6.0×10^3
6	9.0×10^3
7	8.0×10^3
8	6.0×10^3
9	2.0×10^3
10	4.0×10^3
11	7.0×10^3
12	4.0×10^3
13	4.0×10^3
14	5.0×10^3
15	10.0×10^3
16	7.0×10^3
17	9.0×10^3
18	5.0×10^3
19	8.0×10^3
20	8.0×10^3

The research results showed that 3 (three) bacterial isolates were identified. Bacterial isolates were *Staphylococcus aureus*, *Escherichria* coli, *Enterococus sp.*

Discussion

The study on door handles within Auchi Polytechnic Auchi revealed that Bacterial load was high. Bacterial load was recorded in all the samples analyzed. Bacterial load of assessed door handles ranged from 2.0 to 11.0 x 10^3cfu/ml contamination of door handles was not surprising because of poor hygiene conditions and sterilization. The degree of bacteria contamination of door handles was high and possible causative agents of human disease. The

result of this study shows that *Escherichia coli* have a higher percentage following closing by *Staphylococcus aureus* before *Enterococcus spp.* The presence of this microbes is line with a recent study conducted by Mulongo *et al.,* 2021, that showed microbial collusion of elevators and door handles in hospitals.

Staphylococus aureus is known to cause wound infections, food poisoning and other intestinal infections. *Escherichia coli* and *Enterococcus spp* are intestinal/enteric and their presence may be related to fecal oral note contamination (Orogu *et al.,* 2018). Infections arising from Enteric microorganisms include abdominal pain, diarrhea, vomiting *Escherichia coli* infections may also cause urinary tract infection. Generally all microorganism (Bacteria and Fungi) are potential pathogens and can cause infectious disease on human/users door handles. Handrails and handles are commonly touched by hands. Various microorganisms can be found on them, which can be transferred from one person to another.

Conclusion and Recommendation.

The door handles in blocks of offices were contaminated with *Escherichia coli* most *Enterococcus spp.* Recent studies have showed that door handles inconstant used and easily contaminated. Door handles in Auchi Polytechnic were contaminated with potential pathogens, this of serious health risk to users in the polytechnic.

1. It is therefore recommended that, regular cleaning of door handles be done.
2. Ensure effective sterilization/disinfecting technology
3. Use of technologies that will avoid constant touch at such surface.

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MICROBIOLOGICAL SURVEY OF STAIR CASE RAIL ASSESSING SERVICE OFFICES IN AUCHI POLYTECHNIC

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Abstract

Twenty samples using sterile swab sticks were taken randomly from stair case rails within Auchi Polytechnic, Auchi. The samples were individually put into swab tubes and labelled accordingly. The samples were immediately taken to the microbiology laboratory, School of Applied sciences for immediate microbiological analysis. Microbiological isolation using culture plates (Nutrient Agar and Potatoes dextrace Ager) and further biochemcial tests were used to identify *Escherichia coli Enterococas sp*, *Staphylococus aurues*, *Klebsiella* sp and *Pseudomonas sp* as the bacterial isolates. The only fungal isolate was *Aspergillus sp* The high degree of microorganisms indicates contamination from hands, and poor hygiene/lack of disinfectant thereby posing serious health risk. it is therefore recommended that constant cleaning sterilization of stair case rails to avoid the spread of transmissible disease.

Keywords; Stair case rails, Microbiological, Transmissible disease.

Introduction

Human hands usually harbor microorganisms both as part of body normal flora as well as transient microbes contacted from the environment.

In the polytechnic environment, students have access to service offices regularly for different purpose and some of these offices are upstairs and they must be accessed via staircase rails. given that the staircase rails are not routinely disinfected, the opportunity for the transmission of contaminating microorganisms is great. Although is accepted that the infection risk in general community is less than that associated with patients in hospital (Scott *et al.,* 2004). The increasing incidence of epidemic out breaks of certain diseases and its rate of spread from one community to the other has become a major public health concern even at this critical time of the corona pandemic (Nworie *et al.,* 2012).

People believe that microbes are only present in research laboratories or in hospitals and clinics and thus they have a misleading feeling of security in other places. this is due to the lack of knowledge about where bacteria cause the health problem. researchers considered that 80% of infections are spread through hands contact with hands or other objects (Al-Ghamdi *et al.,* 2011). The main reasons are difficulties to prevent the transfer of microbes that are already present in human bodies (Odigie *et al.,*. 2017). Hand washing is fundamental cautionary measure to protect against the spread of diseases and is one of the primary practices to reduce the transfer of bacteria from person to person , or from person to food contact surfaces (Chinakwe *et al.,* 2012). It is established that unwashed hands can transmit pathogens, especially fecal pathogens, to food product after visit to the toilet.

Investigation of food borne illness showed that poor personal hygiene, primarily, in effective hand washing is an important contributor to foodborne illness (Lambrechts *et al.,* 2014). Staircase rails of buildings leading to offices and laboratories in Auchi Polytechnic, Auchi were investigated for bacterial contamination. the researcher found that 86.7% were positive (Nworie *et al.,* 2012).

Hand rail is referred to as a rail that is design to be grasped by the hand so as to provide stability, support, or guard when climbing stairs. The presence of viable pathogenic Bacteria or other microorganisms on fomite such as; hand rail, has been reported by researcher such as; Tsaku *et al.,* (2017), therefore when the hands are in contact with the formite, the hand serve as a medium for the propagation of micro-organism from place to place and from person to person. Although, it is nearly impossible for the hand to be free of micro-organism, therefore the presence of pathogenic microorganisms may lead to chronic or acute illness (Oranusi *et al.,* 2013). The human hands also harbor micro-organisms both as part of body normal flora as well as transient microbes' contacted from the environment (Lindberg *et al.,* 2014).

It is generally acknowledged that inanimate objects can carry microorganisms originating from the surrounding environment. these attached microorganisms possesa bio-transfer potential that is the ability to be transferred to another substratum where growth is possible, for example on food, or on the human body (Baceviciene *et al.,* 2019). The spread of infectious diseases through hand contact has been an area of major concern. according to study conducted by Baceviciene *et al.,* 2019.

Enteric bacteria such Escherichia coli, *Klebsiella* spp and Fungi-*Aspergilus* sp were found to contaminate various contact surfaces including staircase rails and many other common house hold fixtures (Baceviciene *et al.,* 2019).

Microorganism that cause infections can be found in soil, air, water and food as well as environmental surfaces or objects (Neely and Sittig, 2012). Most of the microorganism found by researchers are normal flora in the skin, mouth and nasal passages that can pass to our hands. Although many of these microorganism won't hurt unless the immune system becomes weak. (Oluduro *et al.,* 2011), (Mulongo *et al.,* 2021).

The Aim of this research study is to determine the microbiological status of stair case rails assessing offices in Auchi having in mind that these stair case rails are in constant use by both staff and students of Auchi Polytechnic and Hardly are stair case rails cleared/sterilized/disinfected. Other objectives are to determine what type of microbes are present on the stair case rails and in what load. To also determine if these microorganisms poise any Health risk to users.

Materials and Methods

Materials

Culture media (Nutrient and potatoes dextroxe Agra) for bacteria and Fungi respectively, sterile swab sticks/cotton wool swabs, sterile swab tubes, sterile distilled water.

Sample Area

Buildings that housed offices and class rooms within Auchi Polytechnic, Auchi.

Sample collection

Samples were collected from staircase rails within Auchi polytechnic by means of sterile cotton swab sticks. The swab sticks was wiped firmly on the entire surface of the rails. Each swab stick was placed in small tube, labeled and immediately taken to the Microbiology Laboratory of Auchi Polytechnic, Auchi for further microbiological analysis.

Sample Preparation

The swabs were soaked in a little quantity of distilled water from where a sterile wire loop was used for the inoculation using the streaking method.

Nutrient and potatoes dextrose agar (media for bacterial and fungal growth were prepared according to manufacturer's specification.

Each properly labelled tube sample, a sterile wire loop was used to take at aliquot of the inoculums and aseptically transferred to the plates and streaked. The isolates were purified by repeated sub culturing of distinct colonies. the inoculated Nutrient agar plates were incubated at 37^0c for 24hrs. After 24hrs of culturing, growth colonies were identified based on cultural, morphological and biochemical characteristics and identified according to Holt *et al.,* 1994, Bergey's manual of determinative bacteriology.

Inoculation method is repealed for all samples but this time using Potatoes destrose agar and incubated at 25^0c for 48 hours.

Results

All samples collected from stair case rails within Auchi Polytechnic recorded microbial population and growth. Microscopy, cultural morphology of colonies and biochemical test showed that Both bacteria and Fungi were isolated and identified. Microbial load of stair case rail samples is shown in table 1

Table 1

Microbiological load of stair case rail sampled in Auchi polytechnic

Samples	**Bacterial (cfu/ml)**	**Fungi (cfu/ml)**
1	9.0×10^3	2.0×10^3
2	10.0×10^3	
3	8.0×10^3	
4	9.0×10^3	1.0×10^3
5	5.0×10^3	
6	10.0×10^3	1.0×10^3
7	8.0×10^3	1.0×10^3
8	6.0×10^3	
9	2.0×10^3	
10	4.0×10^3	1.0×10^3
11	7.0×10^3	2.0×10^3
12	3.0×10^3	
13	4.0×10^3	
14	5.0×10^3	
15	10.0×10^3	2.0×10^3
16	6.0×10^3	
17	9.0×10^3	
18	5.0×10^3	
19	8.0×10^3	1.0×10^3
20	6.0×10^3	

The research results showed that 5 (five) bacterial isolates and 1 (one) fungal isolate were identified. Bacterial isolates were *Staphylococcus aureus, Escherichria* coli, *Pseudomonas sp., Klebsiella* sp, *Enterococus sp* While the fungi isolate was *Aspergillus sp.*

Discussion

The study on stair case rails within Auchi polytechnic Auchi revealed that Bacterial load was high compared to fungal load. Bacterial load was recorded in all the samples analyzed while Fungi load was not recorded in some samples. Bacterial load of assessed stair case rails ranged from 2.0 to 10.0 x 10^3cfu/ml while fungal load ranged from 1.0 to 2.0 x 10^3 cfu/ml. contamination of stair case rails was not surprising because of poor hygiene conditions and sterilization. The degree of bacteria contamination of stair case railing was high and possible causative agents of human disease *Staphylococcus aureus* isolated and identified made about 30% of the bacterial.

Staphylococus aureus is known to cause wound infections, food poisoning and other intestinal infections. *Pseudomnas* sp causes many infections that may show mild or no symptoms but may become severe with low immunity. *Escherichia coli* and *Enterococcus spp* are intestinal/enteric and their presence may be related to fecal oral note contamination (Orogu *et al.,* 2018). Infections arising from Enteric microorganisms include abdominal pain, diarrhea, vomiting *Escherichia coli* infections may also cause urinary tract infection. Generally all microorganism (Bacteria and Fungi) are potential pathogens and can cause infectious disease on human/users or stair case rails.

Conclusion and Recommendation.

Stair case rails in Auchi Polytechnic were contaminated with potential pathogens, this of serious health risk to users in the polytechnic.

1. It is therefore recommended that, regular cleaning of stair case railings be done.
2. Ensure effective sterilization/disinfecting technology
3. Use of technologies that will avoid constant touch at such surface.

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ENHANCING PUBLIC SAFETY MESSAGING IN FRAGILE ECONOMIES: THE ROLE OF ICT IN NIGERIA'S CRISIS COMMUNICATION LANDSCAPE

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Abstract

Nigeria faces persistent security and economic challenges, including insurgency, communal conflicts, and economic instability, which significantly impact public safety. Effective crisis communication is crucial in mitigating these challenges, yet Nigeria's reliance on traditional communication methods hampers timely and accurate information dissemination. This study examines the role of Information and Communication Technology (ICT) in public safety messaging within Nigeria, assessing current utilization, identifying barriers, and exploring avenues for improvement. Employing a qualitative case study approach, data were collected through interviews with key stakeholders and analysis of past crisis communication efforts. Findings reveal that while ICT tools like mobile alerts and social media have been employed, their effectiveness is limited by infrastructural deficits, policy inconsistencies, and digital literacy gaps. The study underscores the need for an integrated, context-specific ICT strategy to enhance crisis communication and public safety in Nigeria.

Introduction

Nigeria's socio-economic landscape is marred by recurring security threats and economic instability. The country grapples with insurgency, particularly in the Northeast, communal conflicts, banditry, and kidnappings, which have resulted in significant loss of lives and displacement of populations (Nwankwo et al., 2023). Economically, Nigeria faces high inflation rates, unemployment, and a significant portion of the population living below the poverty line, exacerbating the vulnerability of its citizens (World Bank, 2023).

In such a fragile context, timely and accurate public safety messaging during emergencies is paramount. Effective crisis communication can facilitate rapid response, reduce panic, and save lives. The advent of ICT offers innovative avenues for disseminating information swiftly and efficiently. Tools such as mobile alerts, social media platforms, and community broadcasting have transformed crisis communication globally (Kateule et al., 2022). In Sub-Saharan Africa, countries like Kenya and Ghana have leveraged ICT to enhance emergency responses, demonstrating its potential in similar contexts (Otieno & Oluoch, 2019).

Despite the proliferation of ICT tools, Nigeria's crisis communication systems remain inadequate. The country continues to rely heavily on traditional methods such as radio and television broadcasts, which may not reach all segments of the population promptly. This over-reliance on conventional media limits the speed and effectiveness of emergency responses, particularly in remote or conflict-affected areas where access to such media is restricted (Ali & Sulaiman, 2020).

Furthermore, the lack of a centralized and standardized communication protocol among emergency management agencies leads to fragmented messaging. Infrastructural challenges, including unreliable power supply and limited internet penetration, further hinder the deployment of ICT in crisis communication (Sulaiman et al., 2018). These shortcomings underscore the need to assess and enhance the integration of ICT in Nigeria's public safety messaging systems.

This study aims to examine the utilization of ICT tools in public safety messaging within Nigeria, assessing their effectiveness and identifying barriers to their optimal use. By analyzing current practices and challenges, the study seeks to propose strategies for improving ICT deployment in crisis communication, thereby enhancing public safety and emergency response in Nigeria.

Research Questions

1. How are ICT tools currently employed in Nigeria for public safety and crisis communication?
2. What barriers hinder the effective use of ICT in crisis communication within Nigeria?
3. What strategies can be adopted to improve the deployment and effectiveness of ICT tools in Nigeria's crisis communication systems?

The findings of this study hold significant implications for policymakers, emergency management agencies, and stakeholders in Nigeria's communication and technology sectors. By highlighting the current gaps and challenges in integrating ICT into crisis communication, the study provides evidence-based recommendations for developing a more robust and responsive public safety messaging framework. Moreover, the study contributes to the academic discourse on ICT utilization in fragile economies, offering insights that may be applicable to other developing countries facing similar challenges.

2. Literature Review

Information and Communication Technology (ICT) tools have become integral to public safety messaging, facilitating rapid dissemination of information during emergencies. Key tools include mobile alerts, SMS, social media platforms, mobile applications, and radio broadcasts.

Mobile alerts and SMS are widely used due to their ability to reach a broad audience quickly. In Kenya, the Red Cross Society utilized SMS to disseminate information during disasters, enhancing community preparedness and response (Mung'ou, 2016). Similarly, in Ghana, mobile-based ICTs have been instrumental in promoting agricultural value chain efficiency, indicating their potential in public safety messaging (Kiambi, 2018).

Social media platforms like Twitter and Facebook have transformed crisis communication by enabling real-time updates and interactive engagement. During the 2017 elections in Kenya, social media was pivotal in emergency communication, allowing for rapid information sharing and community mobilization (Otieno & Oluoch, 2019). In Nigeria, social media has been employed to disseminate health information, particularly during the COVID-19 pandemic, highlighting its role in public health emergencies (Ezeah et al., 2020).

Mobile applications have also emerged as effective tools for public safety alerts. For instance, in the United States, mobile apps have been developed to enhance community security and awareness by providing timely alerts and safety information (Moldstud, 2023). Although similar applications are less prevalent in Africa, the increasing penetration of smartphones presents opportunities for their adoption in public safety messaging.

Radio remains a vital communication tool, especially in rural areas with limited internet access. In Ghana, community radio stations have been used to disseminate information on health and safety, reaching populations that may not have access to digital platforms (Munthali et al., 2020). This underscores the importance of integrating traditional media with digital tools to ensure comprehensive coverage.

Crisis Communication in Fragile Economies

In fragile economies, effective crisis communication is essential for mitigating the impacts of emergencies. Digital systems support emergency responses by facilitating timely information dissemination, coordination among stakeholders, and community engagement.

In Nigeria, ICT has been leveraged to enhance security through improved communication and information sharing. The Nigerian Police Force, for example, has deployed ICT tools such as the Crime and Incident Tracking System (CITS) to track criminal activities and

enhance response efficiency (Nath, 2023). These systems demonstrate the potential of ICT in supporting emergency responses in fragile contexts.

Cultural and linguistic appropriateness is crucial in crisis communication. In multicultural societies, language barriers can hinder the effectiveness of emergency messages. Technology can assist in engendering culturally and linguistically appropriate communication by enabling message tailoring and translation (Palenchar et al., 2018). In Nigeria, where over 500 languages are spoken, incorporating local languages into digital communication platforms can enhance message comprehension and community engagement.

Challenges in Nigeria's ICT Public Messaging Landscape

Despite the potential of ICT in public safety messaging, Nigeria faces several challenges that hinder its effective utilization.

Infrastructure deficits, such as unreliable power supply and limited internet penetration, impede the deployment of digital communication tools. These challenges are more pronounced in rural areas, where access to electricity and internet services is limited (Sulaiman et al., 2018). Consequently, populations in these areas may not receive timely emergency information.

Digital literacy gaps also pose significant barriers. Many Nigerians lack the necessary skills to access and interpret digital information, limiting the reach and effectiveness of ICT-based communication (Ezeah et al., 2020). Addressing digital literacy is essential for maximizing the benefits of ICT in public safety messaging.

The spread of misinformation and disinformation through digital channels presents a complex challenge. While digital communication can enhance transparency, it can also be used to spread false or misleading information, potentially undermining emergency responses (Abasilim & Edet, 2015). Developing strategies to combat misinformation is critical for maintaining public trust in digital communication platforms.

Policy and implementation issues further complicate the ICT landscape. The absence of a centralized and standardized communication protocol among emergency management agencies leads to fragmented messaging and coordination challenges (Ali & Sulaiman, 2020). Establishing clear policies and frameworks is necessary for effective ICT integration in crisis communication.

The literature reveals several gaps in Nigeria's ICT public safety messaging landscape.

There is an absence of context-specific ICT strategies tailored to Nigeria's unique socio-cultural and infrastructural realities. Most existing approaches are adapted from developed countries without adequate consideration of local contexts, leading to implementation challenges (Chigona & Licker, 2008). Developing strategies that reflect Nigeria's specific needs and conditions is essential for effective crisis communication.

Limited integration between public safety agencies and ICT tools hampers coordinated responses during emergencies. The lack of interoperability among different communication platforms and agencies leads to delays and inefficiencies in information dissemination (Ali &

Sulaiman, 2020). Enhancing collaboration and system integration is vital for improving emergency responses.

Furthermore, there is a need for sustainable and inclusive ICT solutions that consider the diverse linguistic and cultural landscape of Nigeria. Incorporating local languages and cultural nuances into digital communication platforms can enhance message comprehension and community engagement (Palenchar et al., 2018). Such inclusivity is crucial for ensuring that all segments of the population receive and understand emergency information.

Methodology

This study adopted a qualitative case study approach to explore the use and effectiveness of ICT tools in public safety messaging in Nigeria. The qualitative method was chosen because it allows for an in-depth understanding of complex social phenomena, particularly the experiences and perceptions of stakeholders involved in crisis communication (Creswell, 2013). By focusing on Nigeria—a country grappling with both economic and security challenges—this study seeks to generate rich, contextual insights into how ICT is used to support emergency communication in a fragile environment.

Data collection was carried out through a combination of semi-structured interviews and document reviews. Interviews were conducted with key stakeholders, including officials from the National Emergency Management Agency (NEMA) and State Emergency Management Agencies (SEMA), as well as representatives from telecom service providers and non-governmental organizations (NGOs) involved in disaster management. These participants were selected using purposive sampling to ensure that only those with direct experience in emergency communication were included in the study. The interviews aimed to gather insights into current ICT practices, perceived challenges, and suggestions for improvement in public safety messaging systems.

In addition to interviews, the study also included a comprehensive review of communication documents and reports from past emergency situations in Nigeria. This included crisis response data from events such as the Boko Haram insurgency, major floods, and disease outbreaks. These documents were analyzed to trace patterns in ICT usage and to evaluate the timeliness and effectiveness of information dissemination during those emergencies.

The collected data were analyzed using thematic analysis, which is well-suited for identifying, analyzing, and reporting patterns (themes) within qualitative data (Braun & Clarke, 2006). Thematic coding was applied to transcribed interviews and documents to uncover recurring issues and strategic approaches related to ICT use in public safety messaging. This analysis provided a structured understanding of the strategies employed, their successes, limitations, and areas requiring policy or technological enhancement.

Findings and Discussion

The findings from interviews and document reviews reveal that the use of ICT tools for public safety messaging in Nigeria has seen gradual adoption but remains hampered by systemic and contextual challenges. Mobile phones and SMS alerts are the most commonly used ICT tools in emergency communication, particularly during crises such as flooding or insurgent attacks. Participants from NEMA and telecom companies emphasized the role of SMS-based early warnings, which have proven effective in reaching a large number of people

quickly, especially in urban and peri-urban areas. However, in rural regions with poor network coverage, such systems are far less reliable, reducing their overall impact (Ajayi, 2020).

Social media platforms such as Twitter and Facebook are also being utilized, especially by state-level emergency agencies, to provide real-time updates. However, issues of digital literacy and internet accessibility significantly limit their reach in less-developed areas. Additionally, misinformation remains a pressing concern, as false or unverified information spreads rapidly on these platforms, often exacerbating panic during emergencies (Okoro & Nwafor, 2021).

Document reviews of past emergency responses highlighted the absence of a cohesive ICT communication strategy. While various stakeholders use different ICT tools, there is limited integration or coordination, which often results in fragmented messaging. The interviews also revealed that policy-level inconsistencies and inadequate training among communication officers further hinder effective ICT deployment.

The discussion suggests that while ICT holds promise for transforming public safety messaging in Nigeria, it requires deliberate policy intervention and infrastructural investment. Integration of ICT tools with local languages, improved coordination among agencies, and community-based awareness campaigns are essential to make public safety communication more inclusive and impactful (Adewuyi, 2022). Strengthening these elements could transform ICT into a robust, sustainable solution in Nigeria’s emergency communication landscape.

Conclusion

The integration of Information and Communication Technologies (ICT) into public safety messaging systems in Nigeria represents a critical step toward enhancing emergency preparedness and response. This study has explored the current landscape of ICT usage in Nigeria’s crisis communication and highlighted significant gaps, including infrastructural limitations, coordination challenges among agencies, digital literacy barriers, and the proliferation of misinformation. Despite these constraints, ICT tools—particularly SMS alerts, mobile apps, and social media platforms—have demonstrated notable potential in improving the timeliness and reach of public safety messages during emergencies.

Findings from stakeholder interviews and document analyses underscore the urgent need for a more coordinated, context-specific approach to ICT deployment in Nigeria's public safety architecture. A major takeaway is that while tools are available, their effectiveness is hindered by fragmented policies, underutilization in rural areas, and limited integration with local languages and cultural nuances. Addressing these issues requires government commitment, private sector support, and civil society collaboration to design and implement sustainable ICT strategies tailored to Nigeria’s socio-political realities.

Going forward, investment in ICT infrastructure, community sensitization, and cross-sectoral partnerships will be essential. When well-leveraged, ICT has the capacity not only to inform but to protect—becoming a transformative force in securing lives and strengthening Nigeria’s resilience in the face of persistent economic and security challenges.

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LEVERAGING ICT FOR CRISIS COMMUNICATION IN NIGERIA'S FRAGILE SOCIO-ECONOMIC CONTEXT

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Abstract

Nigeria, like many developing nations, grapples with persistent economic instability and rising insecurity that continue to pose substantial threats to public safety. These challenges are compounded by ineffective crisis communication mechanisms, which often lead to widespread misinformation, public panic, and delayed responses during emergencies. Despite the proliferation of information and communication technologies (ICTs), their use in managing crises remains suboptimal in many parts of the country. This paper examines how ICT tools—such as mobile alerts, social media platforms, and community broadcasting—can be leveraged to enhance emergency communication in Nigeria. Using a qualitative case study approach, data were collected through interviews with key stakeholders and content analysis of past crisis communication efforts. The study aims to explore current practices, identify limitations, and recommend context-specific strategies to integrate ICT in public safety messaging. The findings offer insights into how ICTs can be sustainably employed to bridge communication gaps in fragile economies and conflict-prone environments.

Introduction

Nigeria's socio-economic landscape has been characterized by recurring insecurity and economic hardship, a trend that has intensified over the past two decades. Issues such as insurgency, communal clashes, kidnappings, and natural disasters like floods and epidemics continue to threaten the country's stability and public safety (Onwubere & Ogbuagu, 2021). Compounding these challenges is the absence of a robust, responsive crisis communication infrastructure capable of delivering timely and accurate information to affected populations. According to Okereke (2019), inadequate communication during crises in Nigeria often results in confusion, rumor propagation, and a lack of coordinated responses by relevant agencies.

The significance of effective crisis communication cannot be overstated in fragile contexts. Studies from African countries, including Kenya and Ghana, show that ICT tools have been instrumental in bridging communication gaps during crises (Adebayo & Oyediran, 2020; Mensah, 2018). In Kenya, for example, mobile SMS alerts and community radio were used to disseminate information rapidly during political unrest and disease outbreaks, contributing to increased public awareness and reduced panic (Otieno & Oluoch, 2019). However, in Nigeria, the full potential of ICT in emergency communication remains underutilized due to infrastructural limitations, policy inconsistencies, and digital literacy gaps (Ali & Sulaiman, 2020).

This paper investigates the role of ICT in crisis communication within Nigeria's unique context. Specifically, it explores how technologies such as mobile applications, SMS systems, and social media platforms are currently used to communicate during emergencies. The study is guided by the following research questions:

1. How are ICT tools currently employed in Nigeria for public safety and crisis communication?
2. What barriers hinder the effectiveness of these tools?
3. What sustainable, localized strategies can be adopted to enhance ICT-based crisis communication in Nigeria?

The importance of this study lies in its potential to contribute to policy formulation and practical strategies for strengthening crisis communication systems in Nigeria. By identifying what works and what does not in existing ICT deployments, the research seeks to offer evidence-based recommendations for future interventions.

In addressing these issues, the paper positions ICT not merely as a tool but as a transformative innovation capable of enhancing resilience in fragile and conflict-prone regions. As highlighted by Chigona and Licker (2008), the integration of ICT into public governance and safety systems in Africa requires both technological and social considerations, including community engagement, training, and infrastructure development.

Ultimately, this research underscores the need for an inclusive and coordinated national communication strategy that utilizes ICT for timely, accurate, and localized crisis messaging. It contributes to the growing body of literature on sustainable technological innovation as a means to address socio-economic and security challenges in developing countries.

Literature Review

Information and Communication Technologies (ICTs) have become indispensable in modern crisis communication, offering tools that enhance the speed and reach of information dissemination. Key ICT applications include SMS alerts, mobile applications, radio broadcasts, and social media platforms.

SMS Alerts have proven effective in reaching large populations swiftly, even in areas with limited internet connectivity. For instance, in South Africa, the use of cell broadcast and location-based SMS has been instrumental in maximizing the effectiveness of public emergency alerts (Mabaso & Moyo, 2023).

Mobile Applications offer interactive platforms for crisis management. Apps like COVID Alert SA provide users with real-time alerts and safety information, demonstrating the potential of mobile technology in crisis situations (Mabaso & Moyo, 2023).

Radio Broadcasts remain vital, especially in regions with limited digital infrastructure. They provide continuous updates and instructions during crises, ensuring information reaches those without access to digital devices (Adegbola, 2023).

Social Media Platforms have transformed crisis communication by enabling real-time information sharing and public engagement. Platforms like Twitter and Facebook are used by emergency agencies to disseminate alerts and counter misinformation (Adegbola, 2023).

International best practices emphasize the integration of multiple communication channels to maximize reach and effectiveness. For example, during the COVID-19 pandemic, countries that employed a combination of SMS, mobile apps, radio, and social media achieved better public compliance with health directives (Adegbola, 2023).

Crisis Communication in Fragile Economies

Fragile economies, particularly in Africa, Latin America, and South Asia, face unique challenges in crisis communication due to limited resources and infrastructure. Case studies from these regions highlight the importance of digital infrastructure and literacy in effective crisis management.

In **Africa**, the adoption of ICT tools is often hindered by inadequate infrastructure. However, initiatives like the Digital Transformation Strategy for Africa aim to address these gaps by investing in digital infrastructure and promoting ICT integration across sectors (Denis, 2021).

In **Latin America**, the World Bank's education projects have emphasized the role of digital tools in crisis response, particularly in maintaining educational continuity during emergencies (World Bank, 2024).

In **South Asia**, countries like India have implemented mass notification systems that utilize SMS and mobile apps to disseminate emergency information, demonstrating the effectiveness of leveraging existing mobile networks for crisis communication (Kumar & Singh, 2023).

These case studies underscore the critical role of digital infrastructure and literacy in enhancing crisis communication. Investments in these areas can significantly improve a country's ability to manage emergencies effectively.

Challenges in Low-Resource Settings

Implementing ICT-based crisis communication in low-resource settings presents several challenges:

- **Infrastructure Issues**: Limited access to electricity and internet connectivity hampers the deployment of digital communication tools. In many rural areas, the absence of reliable power sources and network coverage restricts the use of mobile apps and online platforms (Okiy, 2013).
- **Policy Gaps**: The lack of comprehensive policies and regulatory frameworks for ICT integration in crisis management leads to uncoordinated efforts and inefficiencies. Without clear guidelines, the deployment of ICT tools can be inconsistent and ineffective (Okiy, 2013).
- **Misinformation**: The spread of false information during crises can exacerbate panic and hinder response efforts. Social media platforms, while useful for information dissemination, can also facilitate the rapid spread of rumors and misinformation (Adegbola, 2023).
- **Access Barriers**: Socioeconomic factors, such as poverty and low digital literacy, limit individuals' ability to access and utilize ICT tools. Efforts to improve crisis communication must address these barriers to ensure inclusivity (Okiy, 2013).

Addressing these challenges requires a multifaceted approach that includes infrastructure development, policy formulation, public education, and targeted interventions to bridge the digital divide.

Despite the potential of ICT in crisis communication, several gaps hinder its effective utilization in Nigeria:

- **Lack of Localized, Integrated Systems**: There is an absence of cohesive systems that integrate various ICT tools tailored to local contexts. Developing localized platforms that consider linguistic, cultural, and regional differences can enhance the effectiveness of crisis communication (Nwogu, 2018).
- **Need for Sustainable, Context-Specific Solutions**: Sustainable ICT solutions must be designed with the specific needs and constraints of Nigerian communities in mind. This includes developing low-cost, user-friendly tools that can function in environments with limited resources (Nwogu, 2018).

Addressing these gaps involves collaborative efforts among government agencies, private sector stakeholders, and community organizations to develop and implement ICT strategies that are both effective and sustainable.

Methodology

This study employed a qualitative case study research design to explore how ICT tools are used in crisis communication strategies in Nigeria, with a particular focus on public safety messaging during major emergencies. The qualitative approach was chosen due to its strength

in uncovering deep insights into contextual experiences, behaviors, and perceptions related to the use of ICT in real-world settings. By focusing on Nigeria, this case study seeks to provide a detailed and context-specific analysis of how communication strategies are implemented and what outcomes they produce during national emergencies.

Primary data were gathered through semi-structured interviews with key stakeholders, including representatives from the National Emergency Management Agency (NEMA), selected non-governmental organizations (NGOs) involved in disaster response, and telecommunication companies responsible for infrastructure and SMS alert systems. These interviews were designed to capture expert knowledge on the challenges, successes, and limitations associated with deploying ICT tools in crisis situations. Participants were selected based on their involvement in emergency communication and ICT deployment in past crises, ensuring relevance and depth in the responses collected.

In addition to interviews, secondary data were collected from various published sources. These included government and NGO reports, academic journal articles, and documented case studies of past events such as the Boko Haram insurgency, where public safety communication played a crucial role in emergency response. These materials provided historical and contextual grounding for the findings and enabled triangulation of information obtained from interviews.

The data were analyzed using thematic analysis, which involved coding interview transcripts and documents to identify recurring patterns and themes. This method facilitated the examination of communication strategies, ICT tool deployment, and their perceived outcomes during crises. Themes such as accessibility, infrastructure challenges, misinformation, and coordination between agencies were systematically analyzed to draw conclusions about the effectiveness and limitations of ICT-based crisis communication in Nigeria.

Findings and Discussion

The findings from the interviews and secondary data reveal several key insights into the use of ICT tools in crisis communication in Nigeria. First, mobile phones and SMS-based alert systems are the most widely used ICT tools for disseminating emergency information. Interviewees from the National Emergency Management Agency (NEMA) noted that these tools are essential for reaching large populations quickly, especially during sudden-onset disasters such as floods or insurgent attacks. However, their effectiveness is often undermined by network disruptions and inadequate collaboration between service providers and emergency management agencies.

A second major finding is the role of social media platforms—particularly WhatsApp, Twitter (now X), and Facebook—in the rapid spread of information during emergencies. While these platforms have proven useful for both official communication and community-based alerts, several NGO representatives emphasized the challenge of misinformation. In crisis contexts, false information spreads rapidly, creating confusion and hampering response efforts. This issue is compounded by low digital literacy in rural and conflict-affected areas, limiting the public's ability to verify sources and interpret messages correctly.

The analysis also showed that while some progress has been made in using ICT tools for crisis communication, systemic challenges persist. These include unreliable infrastructure,

inconsistent power supply, and limited internet penetration, especially in northern Nigeria. Moreover, the lack of a centralized and standardized communication protocol among agencies often results in fragmented messaging. Respondents highlighted the need for a more integrated ICT framework that leverages local languages, community radio, and mobile technologies in a coordinated manner.

In summary, while ICT tools offer significant potential for improving crisis communication in Nigeria, their effectiveness is constrained by infrastructural, organizational, and educational barriers. A coordinated, inclusive approach that prioritizes digital literacy and cross-agency collaboration is essential for maximizing the benefits of ICT in public safety messaging.

Conclusion

This study highlights the significant yet underutilized role of ICT in enhancing crisis communication and public safety in Nigeria. Despite the increasing reliance on mobile phones, SMS alerts, and social media for emergency messaging, systemic challenges such as digital illiteracy, infrastructure deficiencies, and uncoordinated communication strategies continue to hinder the effective use of these tools. The findings underscore the urgent need for a more integrated, context-specific approach to ICT deployment in crisis scenarios—one that involves collaboration between government agencies, NGOs, telecom providers, and local communities.

To bridge existing gaps, efforts must focus on improving digital literacy, expanding ICT infrastructure into underserved areas, and creating standardized communication protocols that accommodate linguistic and regional diversity. Lessons from successful use cases within Nigeria and similar fragile economies suggest that when properly leveraged, ICT tools can significantly improve response time, reduce misinformation, and enhance public trust in emergency communication systems. Ultimately, sustainable investment in ICT for crisis communication will not only strengthen Nigeria's disaster preparedness but also contribute to broader national security and development goals.

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EMPERICAL ANALYSIS OF PATIENTS WITH TUBERCULOSIS IN NIGERIA

BY

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ABSTRACT

The essence of this paper is to apply descriptive Statistics on patients with Tuberculosis. A sample of 363 out of 1199 patients was selected through systematic sampling. Variables of interest include age, gender, sex, marital status and location were analyzed using SPSS Version 17. A simple descriptive statistics were carried ***out*** *and it was discovered that the data were on cases of Tuberculosis from 363 patients of which 198 were male and 165 female. The descriptive analysis of the data showed that there were 85 Christians and 193 Muslims in the study. It was observed that 31.1% of the TB patient Survived. While 41.6 % which represent 47 female and 58.2% which represent 66 male patients. So by implication, 2 out of every 3 TB patients survived while others died. The length of stay of patients whether dead or alive showed that a vast majority of patients 356 died between 1-10days of stay in the hospital, while others survived (180). It was further observed that day 61-70 recorded no death and one (1) survived. The statistic for the length of stay showed that at first quarter, Median, Mean and Third quarter has a corresponding Period of 6,12,17 and 22 days respectively.*

KEYWORDS Descriptive Statistics, Empirical Analysis Tuberculosis, Statistical Package for Social Sciences, Survival Analysis, Patients.

1.0 INTRODUCTION

Empirical analysis refers to a analytical method that involves the direct engagement with the local community and the use of primary data and field studies to gather information and draw conclusion. It required evidence to prove any theory. Tuberculosis (TB) is one of the oldest deadly diseases know to humanity. Tuberculosis is a chronic infectious disease usually caused by the bacterium Mycobacterium tuberculosis (Indian Tuberculosis Report, 2023). Nigerian has the highest TB burden in Africa. The disease kills 268 people in the country every day. Yet TB cases are under reported, increasing the high risk of transmission. Tuberculosis generally affects the lungs, but involvement of the lungs account for more than 80% of TB cases. Tuberculosis affecting the lungs is called Pulmonary Tuberculosis (PTB) while those affecting other organs are called Extra Pulmonary Tuberculosis (EPTB) (Emura

et al, 2019). The most important source of infection is an untreated Pulmonary Tuberculosis (PTB) patient. When such a person coughs, spits or sneezes, tiny droplet nuclei containing the tubercles are released. Transmission is through inhaling these droplet nuclei (Federal Ministry of Health 2010). Most infections do not have symptoms, known as latent tuberculosis. About 10% of latent infections progress to active disease which, if left untreated kills about half of those infected. According to Bakoyannis et al (2021), the classic symptoms of active TB are a chronic cough with blood-containing sputum, fever, night sweats, and weight loss. The historical term "consumption" came about due to the weight loss. Infection of other organs can cause a wide range of symptoms.

Tuberculosis is spread through the air when people who have active TB in their lungs cough, spit, speak, or sneeze. People with latent TB do not spread the disease. Active infection occurs more often in people with HIV/AIDS and in those who smoke. Diagnosis of active TB is based on chest X-rays, as well as microscopic examination and culture of body fluids. Diagnosis of latent TB relies on the tuberculin skin test (TST) or blood tests.

According to World Health Organization (2023), an estimated 10.8 million people fell ill with TB worldwide, including 6.0 million men, 3.6 million women and 1.3 million children. TB is present in all countries and age groups. TB is curable and preventable. Multidrug-resistant TB (MDR-TB) remains a public health crisis and a health security threat. Only about 2 in 5 people with drug resistant TB accessed treatment in 2023. Global efforts to combat TB have saved an estimated 79 million lives since the year 2000. US$ 22 billion is needed annually for TB prevention, diagnosis, treatment and care to achieve the global target by 2027 agreed at the 2023 UN high level-meeting on TB. Ending the TB epidemic by 2030 is among the health targets of the United Nations Sustainable Development Goals (SDGs).

1.1 Statement of Problem

The nation has recorded 125,000 fatalities and 467,000 TB cases by 2021, resulting in a death to infection rate of 26.77 percent. As of 2023, over 361,000 cases of TB have been reported in Nigeria, with 9 percent of those cases occurring in children. The prevalence rate of tuberculosis is of increase in the past year. One-third of the world's population is thought to be infected with TB. New infections occur in about 1% of the population each year. In 2014, there were 9.6 million cases of active TB which resulted in 1.5 million deaths. More than 95% of deaths occurred in developing countries. The number of new cases each year has decreased since 2000. About 80% of people in many Asian and African countries test positive while 5–10% of people in the United States population tests positive by the tuberculin test. Tuberculosis has been present in humans since ancient times and still a chronic disease occurring in West Africa countries particularly in Nigeria. Therefore, carrying out empirical analysis on Tuberculosis patients using descriptive Statistics becomes very important to study.

1.2 Significance of the study

This study would be useful to the researchers on medical statistics, and above all the Nigerian government in tacking the prevalence rate of tuberculosis and control of the cases in Nigeria.

1.3 Aim and Objectives of the Study

The overall objective of this study is to carry out Empirical analysis on tuberculosis patients using descriptive statistics and specific objectives are to:

i. examines the prevalent rate of Tuberculosis in male and female patients,

ii. study the prevalent rate of Tuberculosis based on marital status. religion and age.

iii. evaluate the life expectancy of Tuberculosis patients.

Research Questions:

i. Is there any significant difference in the percentage prevalent rate of tuberculosis in male and female among?

ii. Is there any significant relationship in the percentage of marital status, religion and age?

2.0 Method of data collection

The method of data collection that was employed in this study is a documentary method data on tuberculosis cases extracted from the record of Patients in University of Ibadan Teaching Hospital, Oyo State.

2.1 Area of Study

The area of study will be limited to survival confirmed case of tuberculosis (TB) patients treated in University of Ibadan Teaching Hospital, Oyo State.

3.0 Population of the Study

The population for this study 1199 tuberculosis patients registered (treated as outpatient and admitted from January 2006 to December 2016) in the University of Ibadan Teaching Hospital, Oyo State.

3.1 Sample of the Study

The sample for this study was 363 tuberculosis patients out of the 1199 registered tuberculosis patient in the University of Ibadan Teaching Hospital, Oyo State.

3.2 Method of Data Analysis

The method of analysis used is percentages and descriptive statistics. Descriptive statistics are collection of statistical techniques used to summarize data. They are also used to compile, present, analyze and interpret data for quality decision making.

Data were collated, tallied and analyzed with the aid of a Statistical Package for Social Sciences (SPSS, version 17). Descriptive statistics were used to analyze the data and the results were presented in tables as percentages and means.

4.0 Exploratory Data Analysis (EDA)

4.0.1 Gender, Religion and Marital status distribution of TB patients

There are three hundred and sixty-three (363) patients examined for this study. Among this, there are one hundred and sixty-five (165) female TB patients and one hundred and ninety-eight (198) male patients. In percentage, 54.5% are male and 45.5% are female patients.

Table 1: Gender of patients

Gender	**Frequency**	**Percentage**
Female	165	45.5
Male	198	54.5

religion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ISLAM	193	53.2	53.2	53.2
	CHRISTIANITY	85	23.4	23.4	76.6
	OTHERS	85	23.4	23.4	100.0
	Total	363	100.0	100.0	

The result shows that, 23.4% of the patients are Christian by faith and 53.2% practice Islam. Only 23.4% practice other forms of religion.

Furthermore, gender distribution according to religion practiced also revealed that, 50.3% of the female patients are Muslim and 40% are Christian while 40% of the female patients practiced other forms of religion. Similarly, 49.7% of the male patients practice Islam and 60% are Christian, while 60% practice other forms of religion. Detailed result in Table 2.

Table 2: Gender-Religion Distribution

sex * religion Crosstabulation

		religion			
		ISLAM	CHRISTIANITY	OTHERS	Total
sex	MALE	96	51	51	198
	FEMALE	97	34	34	165
Total		193	85	85	363

Table 3: Gender-Marital status Distribution

sex * mstatus Crosstabulation

Count

		mstatus				
		SINGLE	MARRIED	DIVORCE	WIDOW	Total
sex	MALE	50	98	19	31	198
	FEMALE	50	86	16	13	165
Total		100	184	35	44	363

However, 9.6% of the patients are Divorcee, 50.7% are married, 27.5% are single adults and 12.1% are widow. While 2.7%, 15.7%, 8.8% and 2.3% of the female patients respectively are divorcee, married, single adults and widow. 3.1%, 15.2%, 7.5% and 5.0% of the male patients are divorcee, married, single adults and widow respectively. Table 3 give more detailed information.

4.0.2 Gender, status (dead or alive) and age distribution of TB patients

The result revealed that most of the TB patients died, only 31.1% survived. And among this (those that survived), 28.5% are female and 39.3% are male patients. By implication, ***1 out of every 2 TB patients*** (of both sexes) will die or died (at this hospital or location of study).

Table 4: Gender-Status (dead or alive) Distribution

Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DEAD	250	68.9	68.9	68.9
	ALIVE	113	31.1	31.1	100.0
	Total	363	100.0	100.0	

sex * status Crosstabulation

Count

		Status		
		DEAD	ALIVE	Total
sex	MALE	132	66	198
	FEMALE	118	47	165
Total		250	113	363

Table 5: TB occurrences by age group

agegroup * status Crosstabulation

Count

		status		
		DEAD	ALIVE	Total
Agegroup	Between 1 and 19 years	46	9	55
	Between 20 and 40 years	120	59	179
	Between 41 and 65 years	59	35	94
	Between 66 years and above	25	10	35
Total		250	113	363

The result further revealed that, most victims of TB (those that died) are in their adulthood (between 20 and 40 years) and in their old age (between 41 and 65 years).

Table 6: Table of statistics for age distribution of patients.

Statistics	1st Quart.	Median	Mean	3rd Quart.	Min.	Max.
Values	24 years	32 years	36.5years	48 years	1 year	88 years

The average (mean) age of TB patients is 36.5 years with median settling at 32 years. The youngest TB patient is 1 year old and the oldest is 88 years old. Table 6 give detail statistics.

4.2.3 Gender, status (dead or alive) and location distribution of TB patients

The result revealed that, most patients resident in the Urban location survived TB compare to patients resident in the Rural location (across both sexes), however, dead rates are equally high at both Urban and Rural location. Table 7 give complete information.

Table 7: Status-Location Scenario

location * status * sex Crosstabulation

Count

Sex			status		Total
			DEAD	ALIVE	
MALE	location	RURAL	66	30	96
		URBAN	66	36	102
	Total		132	66	198
FEMALE	location	RURAL	60	21	81
		URBAN	58	26	84
	Total		118	47	165

4.2.4 Stay-time of TB patients

We examine if the number of days a patients stay on treatment prevent (death)/contribute to the patient status (dead or alive) at the end of the treatment. The result show that, number of day stayed does not determine or mean that patient will live or die. As shown in the table and result below it, number of days stayed does not prevent or improve survival significantly.

Table 8: Length of stay on status (dead or alive)

stay2 * status Crosstabulation

Count

		Status		
		DEAD	ALIVE	Total
stay2	1-10 days	91	64	155
	11 - 20 days	75	23	98
	21 - 30 days	44	14	58
	31 - 40 days	17	7	24
	41 - 50 days	7	1	8
	51 - 60 days	8	1	9
	61 - 70 days	0	1	1
	71 - 80 days	2	1	3
	81 - 90 days	1	0	1
	91 days plus	5	1	6
Total		250	113	363

Hence, the average days of (mean) stay of TB patients is 17 days with median settling at 12 days on the average. The highest stay time is 114 days and the shortest stay is 1 day. Table 9 give detail statistics.

Table 9: Statistics on the length of stay of TB patients

Statistics	1st Quart.	Median	Mean	3rd Quart.	Min.	Max.
Values	6 days	12 days	17 days	22 days	1 day	114 days

On fitting the distribution of the stay length as observed, the stay time does not follow a normal curve. As shown below.

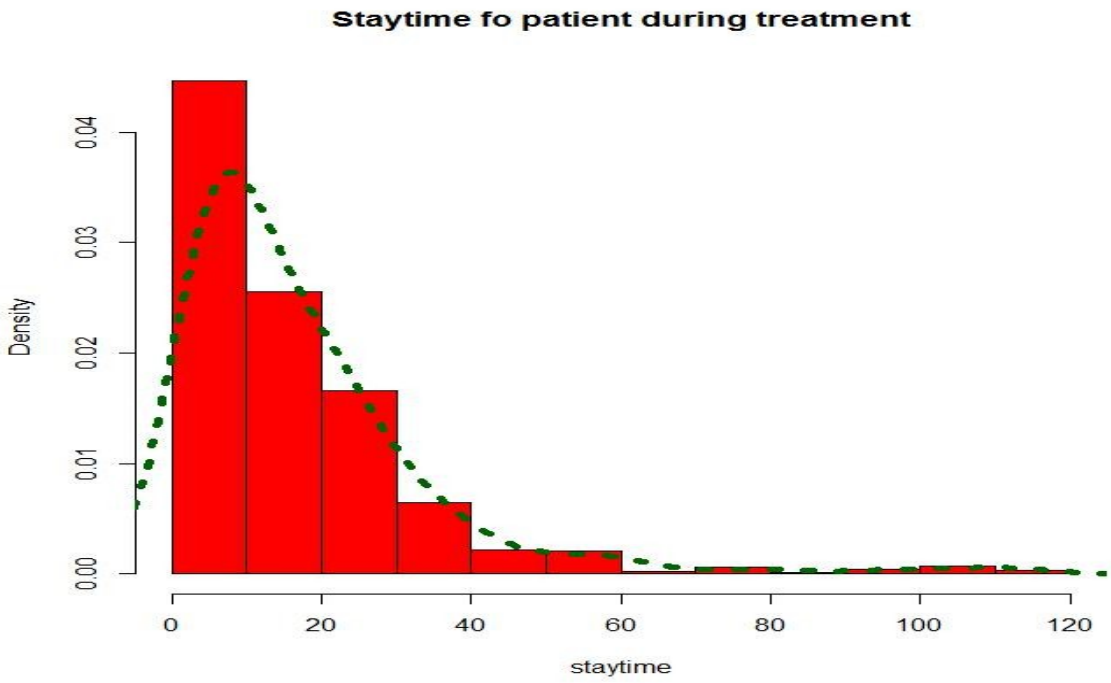

***Figure 1*:** Distribution curve of stay time of TB patients.

5.0 SUMMARY

. Tuberculosis (TB) is one of the oldest deadly diseases known to humanity. It is a chronic infectious disease usually caused by the bacterium Mycobacterium tuberculosis. It is spread through the air when people who have active TB in their lungs cough, spit, speak or sneeze.

The data used was collected from the University of Ibadan Teaching Hospital. The data was on cases of Tuberculosis total number of 363 patients which 198 were male and 165 female. A descriptive analysis of the data showed that there were 85 Christians and 193 Muslims in the study. It was observed that 31.1% of the TB patient Survived. While 41.6 % which represent 47 female and 58.2% which represent 66 are male patients. So by implication, 2 out of every 3 TB patients survived while others died.

The length of stay of patients whether dead or alive showed that a vast majority of patients 356 died between 1-10days of stay in the hospital, while others survived (180). It was further observed that day 61-70 recorded no death and one (1) survived. The statistic for the length

of stay showed that at first quarter, Median, Mean and Third quarter has a corresponding Period of 6,12,17 and 22 days respectively.

5.2 FINDINGS

1. Tuberculosis is a contagious disease once contacted, the patient should be quarantined. A follow-up treatment should be given to the patients in isolation.
2. The government should create awareness campaign to let the masses know the danger of tuberculosis. This awareness could channel via social or communication media.
3. The government/NGO should ensure that drugs are readily available. Hospital and clinic should be set up for the sole purpose of treating tuberculosis patients.

5.3 CONTRIBUTION TO KNOWLEDGE

1. It has been observed that more patient die as a result of the contamination of Tuberculosis. Early detection is advised to check the spread of the disease on time.
2. The survival rate of Females is smaller than that of their male counterpart. Hence, Females are more likely to die of Tuberculosis than their male counterpart. It is therefore, advisable that husbands should always ensure that their wives don't keep secret of their ailment.

5.4 CONCLUSION

It has been observed that tuberculosis is increasing in population. Survival rate of TB at this time is very low. The chances of surviving TB is 1 out of every 3 TB patients while 1 out of every 2 patients die of TB. By implication, going by the death rate from TB and if care is not taking, anyone having or infected with TB in the next few years may automatically be considered dead.

5.5 RECOMMENDATIONS

i proffer the following recommendations:

1. Adequate health care services for TB patients in the region and continuous improvement of services to ensure increase in survival rates and if possible turn around the present situation in the favour of survival rate.
2. Education and orientation of the populace to desist from activities that may encourage TB infections. More so, people should be educated on how to prevent the spread of the disease and report any cases of TB immediately to the health care workers or to the nearest hospital for care.
3. Local and national Government of the region should provide a national and local orientation of the disease so as to create awareness about the dangers in TB related activities and vices.

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SURVIVAL ANALYSIS OF PATIENTS WITH TUBERCULOSIS IN NIGERIA.

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ABSTRACT

The essence of this paper is to apply survival analysis on patients with Tuberculosis. A sample of 363 out of 1199 patients was selected through systematic sampling. An inferential analysis of the data using SPSS Version 17 showed that the Cox survival probability estimate revealed the cumulative probability of patients' survival from age 1 to 60 and above. A chi-square test of independence was performed for all the covariate (independent variables). The test was significant as the pvalue (0.015) is less than the set significance level of 0.05. A further test was carried out to ascertain the variables that actually contributed to the significance of the entire independent variable. It was observed that Sex (X_1), Year (X_3), Marital Status (X_4), Location (X_5) and Age (X_6) contributed to the adequacy of the model while year, religion, and tuberculosis type did not contribute.

KEYWORDS: Inferential Statistics, Tuberculosis, chi square, cox proportional hazard model, Survival Analysis, Patients.

1 INTRODUCTION

Survival analysis is a collection of statistical procedures for data analysis, for which the outcome variable of interest is time until an event occurs. It is the study of time between entry into observation and a subsequent event. The term 'Survival analysis' came into being from initial studies, where the event of interest was death. Now the scope of the survival analysis has become wide. Today scientists are using it for time until onset of disease, time until stock market crash, time until equipment failure, time until earthquake, and so on.

Tuberculosis (TB) is one of the oldest deadly diseases know to humanity. Tuberculosis is a chronic infectious disease usually caused by the bacterium Mycobacterium tuberculosis. According to Indian Tuberculosis report (2024), Tuberculosis generally affects the lungs, , but involvement of the lungs account for more than 80% of TB cases. Tuberculosis affecting the lungs is called Pulmonary Tuberculosis (PTB) while those affecting other organs are

called Extra Pulmonary Tuberculosis (EPTB) (Federal Ministry of Health, 2010). The most important source of infection is an untreated Pulmonary Tuberculosis (PTB) patient. When such a person coughs, spits or sneezes, tiny droplet nuclei containing the tubercles are released. Transmission is through inhaling these droplet nuclei and most infections do not have symptoms, hence, they are known as latent tuberculosis (Dorre, A, 2021). About 10% of latent infections progress to active disease which, if left untreated kills about half of those infected.(World Health Organization 2023), The classic symptoms of active TB are a chronic cough with blood-containing sputum, fever, night sweats, and weight loss. The historical term "consumption" came about due to the weight loss. Infection of other organs can cause a wide range of symptoms.

Tuberculosis is spread through the air when people who have active TB in their lungs cough, spit, speak, or sneeze. People with latent TB do not spread the disease. Active infection occurs more often in people with HIV/AIDS and in those who smoke.(Ha and lie, 2021), Diagnosis of active TB is based on chest X-rays, as well as microscopic examination and culture of body fluids. Diagnosis of latent TB relies on the tuberculin skin test (TST) or blood tests.

2 Statement of Problem

Tuberculosis has been present in humans since ancient times and still a chronic disease occurring in West Africa countries particularly in Nigeria. A total of 1.25 million people died from tuberculosis (TB) in 2023 (including 161 000 people with HIV). Worldwide, TB has probably returned to being the world's leading cause of death from a single infectious agent, following three years in which it was replaced by corona virus disease (COVID-19). It was also the leading killer of people with HIV and a major cause of deaths related to antimicrobial resistance.

Therefore, modeling the survival rate of Tuberculosis patients become very important to study. As a result, the survival rate of patients suffering from Tuberculosis in order to examine the pattern of decrease or increasing rate in the recent year.

3 Aim and Objectives of the Study

The overall aim of this study is to determine the life expectance of tuberculosis patient and specific objectives are to:

i. Estimate survival Time (ST), of event for the group of individual.

ii. Assess the relationship between predictor variables and survival time.

iii. Assess the association of covariate explanatory time of event.

4 Research Questions:

i. Is there any significant difference in survival of male and female among age groups?

ii. Is there any significant relationship among covariate and survival time?

5 Hypotheses

H_{01} : There is no significant difference in survival of male and female among age groups

H_{11}: There is significant difference in survival of male and female among age groups.

H_{02} : There is no significant relationship among covariate and survival time

H_{12}: There is significant relationship among covariate and survival time.

6 Method of data collection

The method of data collection that was employed in this study is a documentary method data on tuberculosis cases extracted from the record of Patients in University of Ibadan Teaching Hospital, Oyo State.

7 Area of Study

The area of study will be limited to survival confirmed case of tuberculosis (TB) patients treated in University of Ibadan Teaching Hospital, Oyo State.

8 Population of the Study

The population for this study was 1199 tuberculosis patients registered (treated as outpatient and admitted from January 2006 to December 2016) in the University of Ibadan Teaching Hospital, Oyo State.

9 Sample of the Study

The sample for this study was 363 tuberculosis patients out of the 1199 registered tuberculosis patient in the University of Ibadan Teaching Hospital, Oyo State.

10 Method of Data Analysis

Survival analysis is a collection of statistical procedures for data analysis, for which the outcome variable of interest is time until an event occurs. It is the study of time between entry

into observation and a subsequent event. The term 'Survival analysis' came into being from initial studies, where the event of interest was death. Now the scope of the survival analysis has become wide. Today scientists are using it for time until onset of disease, time until stock market crash, time until equipment failure, time until earthquake. The model for analysis include; Cox-proportional hazard model and Kaplan-Meier product estimation function. Data were analyzed with the aid of a Statistical Package for Social Sciences (SPSS, version 17) using chi square analysis.

11. COX REGRESSION ANALYSIS

The table below provides summary of data used for analysis. The "staytime" variable was used as the dependent variable. 250 persons (censored) were alive till the end of the study and 113 persons died before the end of the study.

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	113	31.1%
	Censored	250	68.9%
	Total	363	100.0%
Cases dropped	Cases with missing values	0	.0%
	Cases with negative time	0	.0%
	Censored cases before the earliest event in a stratum	0	.0%
	Total	0	.0%
Total		363	100.0%

a. Dependent Variable: staytime

The table below shows the variables

in the regression equation and how they were coded into SPSS

Categorical Variable Codings[c,d,e,f,g]

		Frequency	(1)[b]	(2)	(3)
sex[a]	0=MALE	198	1		
	1=FEMALE	165	0		
tbC[a]	0=ATB	182	1		
	1=MTB	181	0		
religion[a]	0=ISLAM	193	1	0	
	1=CHRISTIANITY	85	0	1	
	2=OTHERS	85	0	0	
mstatus[a]	0=SINGLE	100	1	0	0
	1=MARRIED	184	0	1	0
	2=DIVORCE	35	0	0	1
	3=WIDOW	44	0	0	0
location[a]	0=RURAL	177	1		
	1=URBAN	186	0		

a. Indicator Parameter Coding

b. The (0,1) variable has been recorded, so its coefficients will not be the same as for indicator (0,1) coding.

c. Category variable: sex

d. Category variable: tbC

e. Category variable: religion

f. Category variable: mstatus

g. Category variable: location

Test of the Overall Parameter In The Model

The table below contains loglikelihood and chi-square test for the cox regression equation. From the estimate we have below, the pvalue is seen to be lesser than 0.05. therefore the H_0

(null hypothesis) is rejected. This implies that there is a significant difference between the variables (independent).

Omnibus Tests of Model Coefficients[a,b]

-2 Log Likelihood	Overall (score)		
	Chi-square	df	Sig.
1137.640	21.984	10	.015

a. Beginning Block Number 0, initial Log Likelihood function: -2 Log likelihood: 1158.765

b. Beginning Block Number 1. Method = Enter

Test of Each Parameter in the Model

The table below contains loglikelihood and chi-square test for the cox regression equation. From the estimate we have below, the pvalue 0,015 is seen to be lesser than 0.05. Therefore, the H_0 (null hypothesis) is rejected. This implies that there is a significant difference between the variables (independent).

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)	95.0% CI for Exp(B)	
							Lower	Upper
Sex	.056	.201	.078	1	.001	1.058	.713	1.570
TbC	-.036	.198	.033	1	.856	.965	.654	1.422
Year	.147	.055	7.104	1	.008	1.159	1.040	1.292
Religion			.619	2	.734			
religion(1)	-.156	.235	.439	1	.508	.856	.540	1.356
religion(2)	-.205	.282	.529	1	.467	.814	.468	1.416
Mstatus			6.108	3	.006			
mstatus(1)	-1.242	.663	3.511	1	.001	.289	.079	1.059
mstatus(2)	-.720	.410	3.086	1	.009	.487	.218	1.087

mstatus(3)	-.466	.447	1.090	1	.296	.627	.261	1.505
Location	-.178	.193	.845	1	.008	.837	.573	1.223
Age	-.004	.014	.065	1	.009	.996	.970	1.024

All of the parameter estimates are estimated taking the other predictors into account. After accounting for Age, Sex, Year, Marital-Status and Location, there is no statistically significant association or contribution of TBC types and Religion in the overall model. This is not to say that these risk factors are not associated with Religion; their lack of significance is likely due to confounding (interrelationships among the risk factors considered.

$$\ln \frac{h(t)}{h_0(t)} = 0.056\,X_1 + 0.147\,X_3 \vee + \begin{pmatrix} -1.242 \\ -0.72 \end{pmatrix} X_4 - 1.78\,X_5 - 0.04\,X_6$$

The model above shows a positive relationship between Sex (X_1) and the staying time. The variable "Year" (X_3) also shows a positive relationship with staying time. The Marital Status (X_4) contributed negative to staying time of patients in the hospital. Location (X_5) and Age (X_6) of patient also show a negative relationship to patients staying time in the hospital.

Correlation Matrix of the Co-variates or Independent Variable

The table below shows the covariates of the independent variables. There is a positive association between Tuberculosis (ATB & MTB) and sex. There are also positive association between year and sex, religion and sex, and while others have negative association.

Correlation Matrix of Regression Coefficients

	sex	tbC	Year	religion (1)	religion(2)	mstatus(1)	mstatus(2)	mstatus(3)	location
TbC	.158								
Year	.019	-.009							
religion(1)	.098	-.075	-.050						
religion(2)	-.038	-.074	-.095	.573					
mstatus(1)	-.025	-.051	-.078	-.003	.068				
mstatus(2)	.008	.000	-.112	.028	.104	.869			
mstatus(3)	.124	.163	-.053	-.023	-.031	-.268	-.113		
Location	-.048	-.148	-.002	-.022	.050	.013	-.026	.021	
Age	-.109	-.050	-.073	.013	.072	.885	.780	-.482	-.023

12. SURVIVAL ANALYSIS

The package SPSS was used for the survival analysis of this work. Our aim is to illustrate some survival rate per time of TB patients in this region under consideration. We consider survival analysis function of the TB patients. As reported in the descriptive section, the survival rate is 31.1% with every 2 out of 3 patient dyeing.

However, the Table 4.5 below gives the survival rate on the median scale and 95% confident limit of the TB patients in the hospital. On the confidence scale of 95% confidence interval, 6 - 12 patients will survive TB in every events of 6- 23 TB infection or TB patients. The upper confident limit is unknown because we cannot predetermine the number of patients that will survive.

Table 10: Survival rate of TB patients.

N	Events	median	0.95LCL	0.95UCL
6	6	22.5	12	NA

SURVIVAL AND HAZARD PLOT

The table below shows the mean value of all the covariate (independent variables). Pattern 1 & 2 indicates the values used in plotting the hazard and survival function in figure 1 to 4.

Covariate Means and Pattern Values

	Mean	Pattern	
		1	2
Sex	.545	1.000	.000
TbC	.501	.501	.501
Year	2013.262	2013.262	2013.262
religion(1)	.532	.532	.532
religion(2)	.234	.234	.234
mstatus(1)	.275	.275	.275
mstatus(2)	.507	.507	.507
mstatus(3)	.096	.096	.096
Location	.488	.488	.488
Age	37.022	37.022	37.022

FIGURE 1: Survival Function For Tuberculosis Patients

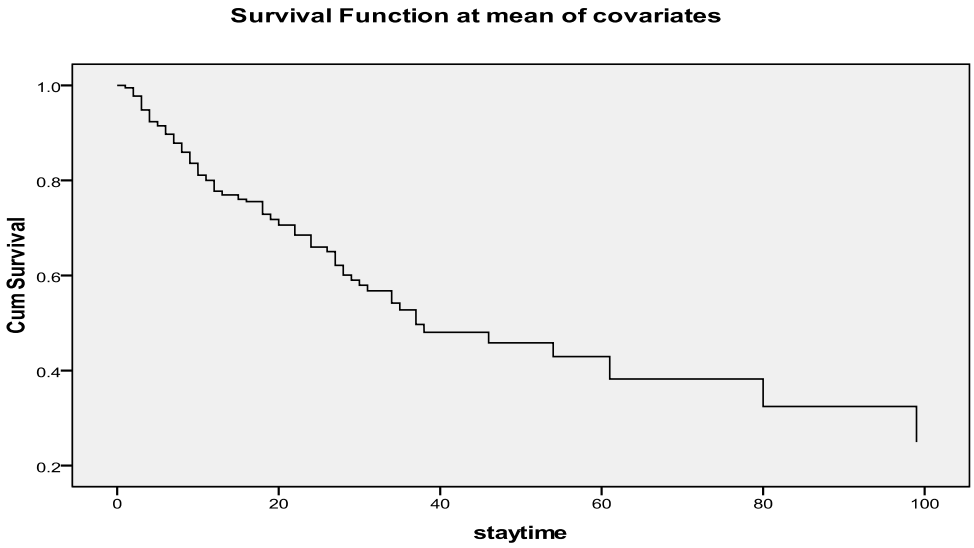


FIGURE 2: Survival Function For Male and Female

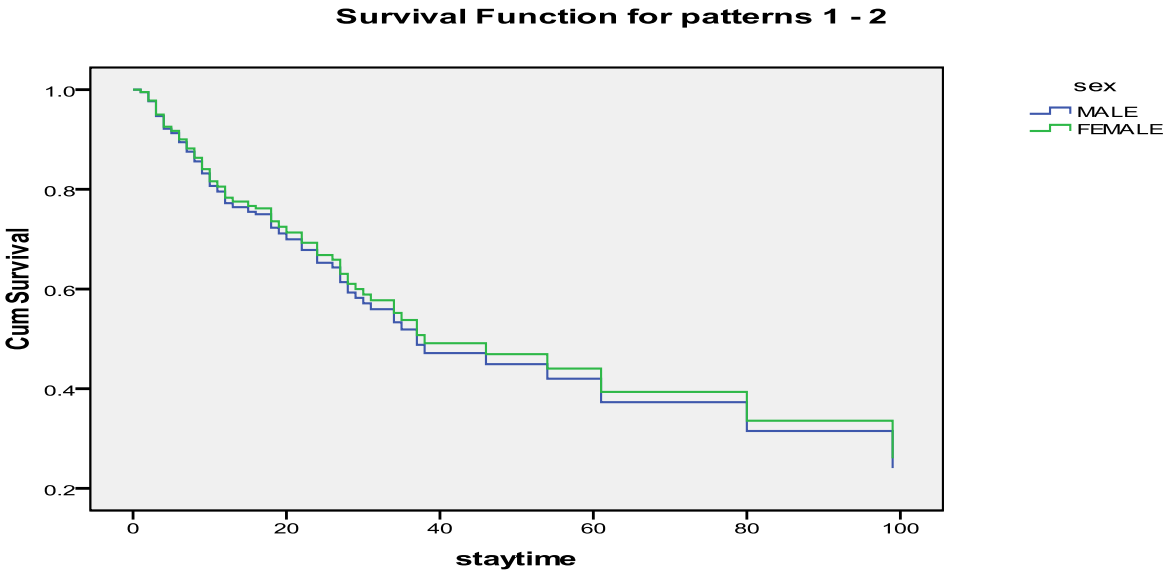


Figure1-2 plotted the survival function of the TB patients with time. As shown, the survival function descends with time. What this implies is that, at time zero, survival rate (function) is sure (equals= 1). That is, the probability of survival; when there is no TB infection is sure (equal =1). The moment there is TB, it implication, the tendency of patients surviving TB in this region reduces per time. A time will come when none of the TB patient in the region will have any chance of survival.

FIGURE 3: Hazard Function for Tuberculosis Patients

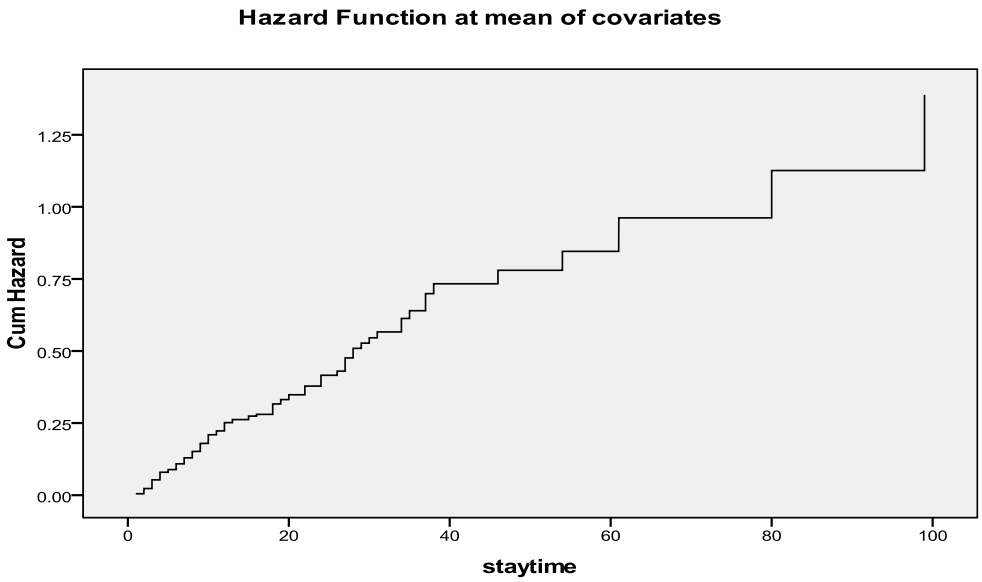
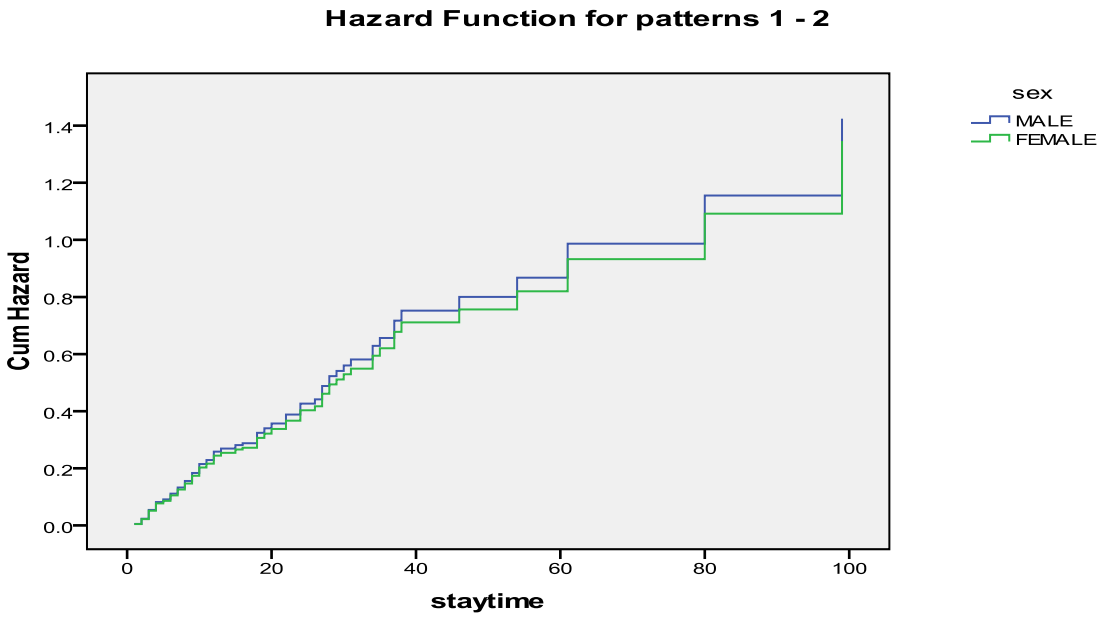


FIGURE4: Hazard Function for Male And Female



Cumulative hazard function in figure3 and 4 indicates that the probability of dying at time t=0 (when there is no TB) is zero. This implies that a person without TB has no chance of dying. As time increases, the risk of dying between time 0 and time 100, also increases. The

hazard plot above indicates that as the "staytime" increases, the chances that patients die of tuberculosis also increases.

13. Discussion of results

Results and analysis have shown that, survival rate of TB at this region is very low. As stated, 1 out of 2 TB patients die. In addition, the cox regression (with 95% CI bond) also revealed that, survival rate diminishes with time. Thus, the survival probability of the people in this region is very slim as time goes by. From the analysis, survival function descends with time. By implication, going by the death rate from TB and if care is not taking, anyone having or infected with TB in the region in the next few years may automatically be considered dead.

14. SUMMARY

A chi-square test of independence was performed for all the covariate (independent variables). The test was significant as the pvalue (0.015) is less than the set significance level of 0.05. A further test was carried out to ascertain the variables that actually contributed to the significance of the entire independent variable. It was observed that Sex (X_1), Year (X_3), Marital Status (X_4), Location (X_5) and Age (X_6) contributed to significance of the entire model and hence was captured in the final model.

$$\ln \frac{h(t)}{h_0(t)} = 0.056\,X_1 + 0.147\,X_3 \vee + \begin{pmatrix} -1.242 \\ -0.72 \end{pmatrix} X_4 - 1.78\,X_5 - 0.04\,X_6$$

It seen from the model that Marital Status, Location and Age had a negative impact on patient staying time in the hospital while Sex and Year had a positive impact on patient staying time. By implication, going by the death rate from TB and if care is not taking, anyone having or infected with TB in the region in the next few years may automatically be considered dead. The covariate matrix showed that there is more negative association between variable than positive. The survival plot in figure 1-2 showed that the tendency of patients surviving TB in this region reduces as time increases. The hazard plot in figure 3-4 showed that as the stay time increases, the chances that patients die of tuberculosis also increases.

16. FINDINGS

4. Tuberculosis is a contagious disease once contacted, the patient should be quarantined. A follow-up treatment should be given to the patients in isolation.
5. The government should create awareness campaign to let the masses know the danger of tuberculosis. This awareness could channel via social or communication media.

6. The government/NGO should ensure that drugs are readily available. Hospital and clinic should be set up for the sole purpose of treating tuberculosis patients.

17. CONTRIBUTION TO KNOWLEDGE

3. It has been observed that more patient die as a result of the contamination of Tuberculosis. Early detection is advised to check the spread of the disease on time.
4. The survival rate of Females is smaller than that of their male counterpart. Hence, Females are more likely to die of Tuberculosis than their male counterpart. It is therefore, advisable that husbands should always ensure that their wives don't keep secret of their ailment.

18. CONCLUSION

It has been observed that tuberculosis is increasing in population. Survival rate of TB at this time is very low. The chances of surviving TB is 1 out of every 3 TB patients while 1 out of every 2 patient's die of TB. By implication, going by the death rate from TB and if care is not taking, anyone having or infected with TB in the next few years may automatically be considered dead.

Marital Status and Sex contributed positively to the final model fitted for tuberculosis patient. The measure of association between covariates showed more positive relationship.

19 RECOMMENDATIONS

We proffer the following recommendations:

4. Adequate health care services for TB patients in the region and continuous improvement of services to ensure increase in survival rates and if possible turn around the present situation in the favour of survival rate.

5. Education and orientation of the populace to desist from activities that may encourage TB infections. Moreso, people should be educated on how to prevent the spread of the disease and report any cases of TB immediately to the health care workers or to the nearest hospital for care.

6. Local and national Government of the region should provide a national and local orientation of the disease so as to create awareness about the dangers in TB related activities and vices.

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