

EDITORIAL

POTRAZ ICT Research Journal' -Volume 1 (PICTRJ)

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1. Navigating the Future: Emerging Trends in ICT

The POTRAZ ICT Research Journal (PICTRJ) is a peer-reviewed academic journal dedicated to advancing the field of Information and Communication Technology (ICT). Our aim is to publish original, high-quality research that contributes to the theoretical understanding and practical applications of ICT. As the research landscape of ICT continues to evolve, this inaugural volume of the POTRAZ Journal of ICT explores the critical trends shaping the ICT realm today. Technology and innovation are reshaping multiple domains across industries, affecting everything from educational management to online security, customer behavior analysis, and e-commerce adoption. Hence, in this editorial, in addition to the research contributions from the authors, we also discuss in general the Forth Industrial Revolution as a paradigm shift, the blockchain as a technology beyond the cryptocurrencies, the artificial intelligence (AI) and artificial neural networks as being the dawn of the intelligence systems, the cybersecurity as a means of safeguarding the digital frontier and also the understanding of human perspectives through opinion mining and sentiment analysis.

2. The Fourth Industrial Revolution: A Paradigm Shift

The Fourth Industrial Revolution (4IR) represents a profound transformation characterized by the integration of digital, physical, and biological systems. This industrial revolution, often referred to as Industry 4.0, is marked by advances in technologies such as the Internet of Things (IoT), robotics, 3D printing, and augmented reality which has arguably created a rapid evolution of technologies and the unprecedented interconnections within the emerging technologies (Lee and Lim, 2021, Skilton and Hovsepian, 2018). These innovations are reshaping industries by enhancing productivity, creating new business models, and offering opportunities for economic growth. The 4IR emphasizes cyber-physical systems, AI, and data-driven decision-making, positioning data as the "new oil" of the 21st century (Hirsch, 2013 and Jan et al (2022). These technologies are not only enhancing productivity but are also creating new business models and opportunities and industries are increasingly adopting these innovations to stay competitive, optimize processes, and deliver personalized experiences to customers. The fusion of the physical, the virtual, and the biological lives within cyber-physical

systems through connected automated machines, workpieces, smart networks, sensors, and other digital technologies that communicate and interact with one another, and with human beings, remotely and in real-time as articulated by Butt et al., (2020); Chaka, (2020) and earlier on Penprase, (2018) has given birth to cyberthreats as discussed later in this issue. Its impact has profound implications on both industry and social life in developing and emerging economies such as Zimbabwe.

3. Blockchain: Beyond Cryptocurrencies

Blockchain technology, which was originally developed for cryptocurrencies, has expanded its application to numerous industries. Its special features, such as transparency, decentralization, and security make it useful for overcoming challenges in the financial sector, gambling, logistics and the metaverse among many (Candia et al., 2024, Polyviou et al., 2019). Its potential also extends to healthcare, supply chain management and the music industry as it provides reliable and decentralized methods for data processing, transactions and data transfer. However, blockchain still faces obstacles when it comes to achieving widespread adoption across all industries (Ali, 2023). As ongoing research investigates its diverse applications, blockchain technology showcases its potential to transform traditional business practices and address enduring challenges across different sectors (Ali, 2023).

Developing economies may have failed to exploit blockchain's application in fintech as the industrialised nations did. They, however, have exploited potential solutions to some of their challenges such as weak financial systems, inadequate registration of property ownership, inefficient supply chains exacerbated by a lack of trust and inability to verify and audit organisational processes in a rapid and economical way (Gillpatrick, Boğa and Aldanmaz, 2022). Africa is on record for having over 90% of its rural land in unregistered category while 20 million Indian families are unregistered land owners (Kshetri and Voas, 2018). Blockchain technology could also be used for securing real estate and intellectual property and fostering Foreign Direct Investment (FDI) since FDI and property rights have been found to have a positive relation to protection of property right (Haydaroğlu, 2015) as well as intellectual property (Adams, 2010). Blockchain could also be used for ensuring property records from the people that are displaced by natural disasters, conflicts and climate change (Thompson et al., 2018). Intellectual property especially a critical determinant of investment in high-tech industries (Canals and Şener, 2014).

According to Corbet et al., (2018) it is critical to conduct research on cryptocurrency because investors remain divided about the financial viability of crypto assets. Selgin (2015) for instance questions whether bitcoin is a currency, digital gold, commodity, or synthetic commodity. Gupta, Mitra and Banerjee's (2023) investigation of the relationship between cryptocurrencies and four traditional assets namely equity, fiat currencies, crude oil, and gold in Nigeria, Vietnam, the Philippines, Turkey, and Peru found that none of the countries had exhibited a bidirectional relationship between traditional assets and the crypto index.' This issue, also adds its voice to the ongoing debate on blockchain by both academics and practitioners.

4. Artificial Intelligence and Artificial Neural Networks: The Dawn of Intelligent Systems

Artificial Intelligence (AI) continues to advance rapidly, driven by breakthroughs in machine learning and artificial neural networks. These technologies are enabling systems to perform tasks that traditionally required human intelligence, such as image and speech recognition, natural language processing, and predictive analytics. Neural networks, inspired by the human brain, are particularly notable for their ability to learn from data and improve over time.

This has been received with divergent views by observers in different domains at different times. The automation of laborious tasks with unprecedented speed and accuracy has been celebrated by many yet the use of AI by students doing assignments has been viewed as a death nail for academic assessment. At the same time the use of AI for mediating learning using chatbots such as intelligent tutors, virtual assistants, voice assistance, intelligent assistants and conversational agents as articulated by Chaka (2023) are highly appreciated. The way the same technology both loved and hated by players in the same higher education sector highlights the double-edged impact of AI. As a result, Popenici and Kerr (2017) posit that the role of the teachers in the execution of pedagogies in the field of higher education requires re-envisioning in the work of AI.

It is, however, undisputable that the integration of AI into the various applications is enhancing efficiency, driving innovation, and creating new avenues for solving complex problems. For instance, Jan et al (2022) posit that adoption of Industry 4.0 (I4.0) ideas and technologies, has the potential to enable lean and just-in-time production through digitisation and the use of smart machines. This is facilitated by AI and machine learning, sensor networks and Internet of

Things technologies, cloud computing, additive manufacturing, and the availability of large amounts of data that can be exploited by these technologies.’

5. Cybersecurity: Safeguarding the Digital Frontier

As the digital landscape expands, so do the threats to our cybersecurity. Protecting sensitive information and maintaining trust in digital systems is more critical than ever. The rise of sophisticated cyberattacks and data breaches underscores the need for robust cybersecurity measures. Emerging strategies, such as AI-driven threat detection and blockchain-based security solutions, are playing a crucial role in fortifying defenses against malicious activities.

Artificial intelligence can be used in threat detection, vulnerability assessment, incident response, and predictive analysis. This can be done by harnessing machine learning algorithms. AI driven systems can facilitate the analysis of vast amounts of data in order to identify anomalous patterns that indicate the possibility of security breaches. These tools enable proactive defense mechanisms that empower the organisation to take pre-emptive risk mitigatory processes as well as safeguard the organisation’s sensitive information (Khan, 2023, Chowdhury, 2024).

In spite of their usefulness in vulnerability assessment, incident response, and predictive analysis, emerging technologies such as AI, raise ethical and privacy imperatives that necessitate their balanced use (Camacho, 2024). They are also capable of being used by both good and bad actors. As we navigate an increasingly interconnected world, investing in advanced cybersecurity practices is of paramount importance.

6. Opinion Mining and Sentiment Analysis: Understanding Human Perspectives

The abundance of data from social platforms, online applications, online review websites, and blogs has motivated governments, customers, business and other organisations to mine these opinions and analyse the sentiments (Sabeti and Saad, 2017). Understanding human sentiment and opinions is highly important for businesses, policymakers, and researchers. Opinion mining and sentiment analysis leverage natural language processing and machine learning to extract insights from textual data. These techniques enable organizations to gauge public perception, track trends, and make informed decisions based on the emotional tone and sentiment of user-generated content. As these tools become more sophisticated, they offer

deeper insights into consumer behavior and societal trends. Of particular interest to this issue is the issue of sentiment analysis in the context of commerce.

The review of products by customers is an important resource that shows users' experience, feelings and propensity to purchase an item (Zhang and Zhong, 2019). This influences the willingness of other customers to purchase an item on the basis of other customer reviews of that product. This is similar to the way people prefer the advice of their friends or relatives before they make a key decision. There is a growing body of research on trust which analyses the reasons behind trust (Kraounakis, Demetropoulos, Michalas, Obaidat, Sarigiannidis, and Louta, 2015). It also analyses and utilises review mining tools that assist customers; behavior patterns on e-commerce sites.

7. Research Articles in this Issue

In this volume, we present eight research papers that illustrate the practical applications of 4IR technologies across different sectors. These include a blockchain-based certificate verification system, public-led innovation accelerators, an optical encryption approach for enhancing cybersecurity, and a sentiment analysis system for improving customer satisfaction. Furthermore, the volume features studies on integrating Artificial Intelligence (AI) into Zimbabwe's education curriculum, examining e-commerce adoption drivers for ZIMPOST, implementing prescriptive maintenance for processing plants, and evaluating digital literacy among Zimbabwean teachers.

The goal of this volume is not only to showcase these technological solutions but also to highlight the broader implications of emerging technologies for developing and emerging economies. From driving economic growth and ensuring data security to empowering educators and fostering innovation, the research presented herein offers critical insights into the transformative potential of technology in creating an inclusive and sustainable future.

The following are the research articles in this issue:

7.1 Blockchain-Based Academic Certificate Verification: Revolutionizing Credential Authentication

The first paper, authored by Masunda et al titled “*Blockchain Based Online Certificate Verification Portal: A Case for Telone Centre for Learning*”, addresses the pressing issue of

academic certificate forgery. This problem has long plagued educational institutions and employers alike, undermining trust in educational credentials. Traditional verification methods are both inefficient and vulnerable to manipulation. By utilizing blockchain technology, the authors present a revolutionary solution aimed at Telone Centre for Learning (TCFL), creating a tamper-proof, decentralized platform for certificate verification.

Blockchain technology offers features such as immutability, security, transparency, and decentralization, making it highly suitable for managing sensitive information like academic certificates. By leveraging these features, the proposed system ensures that once certificates are stored on the blockchain, they cannot be altered or tampered with, thereby reducing the risk of fraud. A prototype of this system was developed, and user testing confirmed its effectiveness in terms of accuracy, user-friendliness, and overall performance.

The authors highlight the challenges of scalability and adoption, but remain optimistic about future research and technological advancements that could address these challenges. The study presents a compelling argument for adopting blockchain technology in the educational sector to enhance the security and efficiency of academic certificate verification.

7.2 Key Success Factors for Public-Led Innovation Accelerators

The second study, *Investigating Factors Critical for the Successful Performance of Public Led Innovation Accelerators* by Mlambo and Masaire focuses on the public sector's efforts to promote innovation through public-led innovation accelerators. These accelerators are designed to support entrepreneurship, boost startup growth, and enhance overall economic competitiveness.

The research identifies critical factors for the successful establishment and performance of these accelerators by analyzing data from public sector employees and entrepreneurs. Regression analysis revealed significant positive correlations among various predictors, including marketing strategies, funding allocation, regulatory policies, educational initiatives, university-industry collaboration, and cultural support. Approximately 61.3% of the variance in innovation performance was attributed to these factors, highlighting the importance of targeted strategies in fostering innovation within the public sector.

The study recommends the establishment of public-led innovation accelerators to boost economic competitiveness, increase startup lifespan, and contribute to job creation. By aligning

policies, regulations, and educational initiatives with the needs of the innovation ecosystem, the public sector can play a crucial role in driving sustainable growth and development.

7.3 Cybersecurity and Optical Encryption: Enhancing Data Security

As the digital landscape expands, cybersecurity becomes increasingly critical. The rise of sophisticated cyberattacks and data breaches necessitates robust cybersecurity measures. The study, *Phase Reconstruction of the LG Mode Using Photonic Crystal Fiber and the Gerchberg-Saxton Algorithm for Cyber Security* by Zengeni et al., explores the use of optical encryption to enhance data security.

Optical encryption, as demonstrated in the study, involves the use of a modified Gerchberg-Saxton (GS) algorithm in photonic crystal fiber-based communication systems. The GS algorithm accurately converts target modes from a source mode, demonstrating its potential for use in cryptographic applications. This innovative approach integrates photonic crystal fiber with the GS algorithm to provide a secure and efficient method for optical encryption, making it a valuable tool for cybersecurity.

The study emphasizes the need for unconventional approaches to cybersecurity, especially given the sophistication of modern cyber threats. By employing optical encryption techniques, organizations can improve data security and reduce the risk of unauthorized access and data breaches.

7.4 Sentiment Analysis for Enhanced Customer Satisfaction

In the era of social media, customer feedback is more accessible than ever before, presenting opportunities for businesses to understand and respond to customer sentiments. The fourth study, *Opinion Mining and Sentiment Analysis Based on Customers' Comments on the X Platform: A Case of a Selected Bank in Zimbabwe*, authored by Gombiro et al., delves into the development of an opinion mining and sentiment analysis system to analyze customer comments and improve service delivery.

Using Natural Language Processing (NLP), the system classifies customer sentiments into positive, neutral, and negative categories, allowing the bank to identify areas that require attention. The research highlights the importance of leveraging unstructured data from social media to gain insights into customer opinions. Understanding customer sentiments enables

businesses to tailor their products and services to better meet customer needs, thereby improving satisfaction and loyalty.

The study also recommends enhancements, such as implementing multi-linguistic analysis and real-time sentiment polarity assignments, to further improve the system's performance. Sentiment analysis proves to be a powerful tool for customer relationship management and business intelligence.

7.5 Integrating AI in Education: Preparing Zimbabwe for the Future

Revesai and Hapanyengwi presents the fifth paper titled “*Integrating Artificial Intelligence in Zimbabwe's Education Curriculum: A Call for Global Collaboration*”, explores the potential of integrating Artificial Intelligence (AI) into Zimbabwe's education system to prepare students for a future driven by technology. AI offers significant opportunities for enhancing critical thinking, problem-solving, digital literacy, and interdisciplinary learning.

Currently, Zimbabwe lacks a comprehensive and systematic approach to AI education. The authors argue for a national initiative to embrace AI education, positioning the country at the forefront of technological advancement. The study identifies challenges such as resource constraints, ethical issues, and access equity, and proposes practical strategies for integrating AI principles into every academic subject. By doing so, Zimbabwe can equip its students with the skills needed to thrive in an AI-driven world and contribute to the global AI ecosystem.

The study also reflects on the double-edged impact of AI, where automation of laborious tasks is celebrated, yet the use of AI by students for assignments is criticized. Despite these divergent views, integrating AI into education presents opportunities for enhancing learning outcomes.

7.6 E-Commerce Adoption at ZIMPOST: Understanding the Drivers

The sixth paper, Towards a Click-and-Enter Business Model: Modelling E-Commerce Adoption Drivers and Digital Consumer Behaviour at ZIMPOST by Makudza and Chinyerere, investigates the factors influencing e-commerce adoption at ZIMPOST. Despite improvements in Zimbabwe's e-commerce infrastructure, ZIMPOST struggled to generate traction for its platforms.

The research identifies key e-commerce adoption drivers, such as utility, simplicity, infrastructure, social influence, and digital literacy. Interestingly, simplicity was found to have

an insignificant impact on customers' adoption intentions, suggesting that other factors such as utility and infrastructure are more influential in driving e-commerce behavior. Based on these findings, the study recommends revising ZIMPOST's e-commerce platform to enhance the utility, infrastructure, and digital literacy aspects, thereby improving customer adoption levels.

7.7 Prescriptive Maintenance for Processing Plant Equipment: Improving Reliability and Efficiency

The seventh paper, Prescriptive Maintenance Approach to Online Condition Monitoring Using Sensor Data and Artificial Neural Network (ANN) Models for Processing Plant Equipment: Case for Platinum Processing Plant by Washayanyika and Mushiri explores the use of prescriptive maintenance to enhance the reliability and efficiency of platinum processing plants. Given the wide variety of fault signatures and failure modes, it can be challenging to derive cost-effective and accurate models for early detection of faults.

The study proposes a prescriptive maintenance approach using sensor data collected from critical components of the processing plant. The condition monitoring system was developed in MATLAB, using support-vector-machine (SVM) and Artificial Neural Network (ANN) models to detect abnormalities. Findings from the study show that the developed models achieved a classification accuracy of 96.7% and were effective in detecting faults, predicting equipment failure, and supporting maintenance strategies.

Prescriptive maintenance goes beyond traditional preventive maintenance by not only identifying faults but also recommending specific actions to mitigate potential failures. By implementing this approach, the processing plant can prevent breakdowns, reduce costs associated with unplanned equipment failure, and optimize maintenance schedules. The implications of this study are significant for industries seeking to enhance operational efficiencies, minimize downtime, and reduce maintenance costs.

The study also highlights the importance of integrating sensor data and machine learning algorithms to develop predictive maintenance models. By harnessing the power of data and AI, industries can move towards more proactive and data-driven maintenance strategies, leading to increased productivity and cost savings.

7.8 Evaluating Digital Literacy Among Zimbabwean-In Service Secondary School Teachers

The eighth paper, authored by Dabengwa et al., *Validation of the DigComp Tool and Evaluation of the Level of Digital Literacy Skills Among Zimbabwean In-Service Secondary School Teachers*, examines the digital literacy of secondary school teachers in Zimbabwe. In an ever-evolving digital world, it has become essential for educators to possess digital skills to effectively deliver lessons and engage with students.

The study utilised the European Commission's DigComp tool to assess the digital competence of over 2,000 teachers across Zimbabwe. This marks the first application of the DigComp tool in Africa, providing valuable insights into the digital skills of educators in a developing context. The selection encompassed a variety of school types, ensuring a diverse representation of teachers.

The results indicated that Zimbabwean secondary school teachers generally exhibited intermediate digital literacy, with competencies ranked in order of increasing difficulty as follows: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Problem Solving, and Safety. Additionally, the findings suggest that competencies in Communication and Collaboration vary by gender, highlighting the need for targeted interventions to address gender disparities in digital skills.

The study recommends that the Ministry of Primary and Secondary Education provide in-service teachers with professional development opportunities to help them reskill and upskill, ensuring their relevance in an increasingly digital world. By investing in teacher training, the education sector can ensure that educators are equipped with the skills needed to effectively integrate digital technologies into the classroom and enhance student learning outcomes.

Digital literacy is a critical skill for educators, as it enables them to use technology effectively for instruction, assessment, and communication. As technology continues to play a central role in education, ensuring that teachers possess the necessary digital competencies is essential for creating a modern and effective education system. The findings of this study have significant implications for education policymakers, as they highlight the importance of digital literacy in preparing teachers for the challenges of the 21st century.

8. Conclusion

The eight research papers presented in this editorial demonstrate the transformative potential of technological innovation in addressing a variety of challenges in different sectors. From improving academic certificate verification with blockchain technology, to advancing publicly led innovation accelerators, improving cybersecurity with optical encryption, leveraging sentiment analysis for customer satisfaction, integrating AI into education, and understanding the drivers of e-commerce adoption, —these studies collectively highlight the power of technology to drive progress and growth.

In addition, the papers highlight the value of predictive maintenance in processing plants and emphasize the importance of digital skills for educators to remain relevant in an increasingly technology-driven educational landscape. Each study provides an insightful perspective on how the application of ICT can improve efficiency, safety and overall performance in different contexts. They also provide a roadmap for the adoption and implementation of these technologies in sectors that have historically been underserved or prone to challenges such as fraud, inefficiency and rapid technological obsolescence.

A common theme throughout the papers is the critical importance of collaboration and strategic planning for the successful adoption of these technologies. Whether through partnerships between industry and educational institutions, aligning public sector policy with innovation needs, or using sensor data to improve operational efficiency, these studies emphasize that no single entity can work in isolation. Collaboration and knowledge sharing are essential components of effective technology adoption.

Further, the findings in this volume emphasize the need for targeted strategies to address specific challenges. Whether it's implementing blockchain solutions to prevent academic fraud, integrating AI into the classroom to prepare students for an AI-driven future, or using sentiment analysis to improve decision making in organisations, each solution is presented as a context-specific response to real-world problems. By understanding the intricacies of each domain and tailoring technology solutions to meet those needs, we can create safer, more efficient and user-friendly systems.

The convergence of 4IR technologies such as blockchain, AI, machine learning and digital communication systems signifies a new era of innovation and opportunity. Harnessing and understanding these trends will be critical for stakeholders in all sectors, including education,



government, industry and commerce. Integrating these technologies offers a way to optimize operations, improve decision-making and provide personalized services that meet the evolving needs of customers and citizens.

In the ever-evolving technology and innovation landscape, it is critical that researchers, policy makers, educators and practitioners work together to identify challenges and develop effective solutions. By fostering a culture of innovation, embracing new technologies and taking a collaborative approach, we can create a future where technology serves as a powerful tool for positive change in all areas of society. These eight research papers are a testament to the potential of technology to change our world for the better, improving safety, performance and efficiency while empowering individuals and institutions to achieve their goals.

The way forward will depend on how effectively we utilize these technological advances and the extent to which we integrate them into our daily lives, industries and communities. The research presented in this volume challenges us to not just be passive observers, but to actively participate in shaping a future that is innovative, inclusive and prepared for the next wave of technological development. By investing in research, building partnerships and supporting the development of new technologies, we can unlock new opportunities and address the challenges of our time by creating a world that is more connected, safer and empowered by technology.

