Introduction: Computational Intelligence and Mathematical Modelling for Industry and Commerce

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Abstract - Between July 29 and July 31, 2025, Great Zimbabwe University's School of Natural Sciences hosted its second International Conference on Computational Intelligence and Mathematics Modelling for Industry and Commerce, themed 'Unlocking the Potential of the Fourth Industrial Revolution in Knowledge Work.' The conference venue was the Victoria Falls Safari Lodge in Victoria Falls, Zimbabwe. The Minister of Higher and Tertiary Education, Honourable Dr Fredrick Shava, was the guest of Honour. The theme of the conference reflected the imperative to recalibrate the intellectual framework to respond to technological disruptions in the educational space. Great Zimbabwe University, as a Zimbabwean institution, is alert to the urgency of contextualizing the disruption within the national development agenda. The government of Zimbabwe, through flagship policies such as Heritage Based Education 5.0 and National Development Strategy 1, repositioned universities as engines of industrial transformation and national development. What this means is that institutions of higher learning go beyond teaching and learning, embrace innovation and industrialization. It is in this breath that the 2025 conference was relevant and apt. The fields of Computational Intelligence and Mathematical Modelling are emergent foundational academic disciplines to the implementation of Education 5.0.

'The Enablers and Inhibitors of Bad News Reporting on Software Projects in State Universities in Zimbabwe' by Maseko and Tsokota identifies the inhibitors and enablers of bad news reporting on software projects in state universities in Zimbabwe and also comes up with recommendations from the findings. Status reporting on software projects is critical in software project management. It is easier to report positive news than the negative aspects encountered during the project life cycle in software project management. The results show that the main inhibitors of bad news reporting include, but are not limited to, lack of communication, fear of punishment, unfair distribution of work and lack of skills. On the other hand, the main enablers of bad news reporting include open communication, a positive organisational culture, feedback, and achievement motivation. The findings of this study can enhance the reporting of bad news on software projects in state universities in Zimbabwe. Knowledge of these factors aids in status reporting on software project development by project team members. This reduces the chances of software project failure and escalation.

Mafukidze, Shadock, Chitiza, and Nechibvute, in their article 'Framework for the Upskilling for the 4th Industrial Revolution: Challenges, Curriculum and the Way Forward' assert that the Fourth Industrial Revolution (4IR or Industry 4.0) presents a significant shift in the operation of industries and economies. They argue that it is a manufacturing paradigm that integrates cyber-physical systems, artificial intelligence (AI), robotics, and the Internet of Things (IoT) to create more intelligent and more connected industrial systems. Unlike previous industrial revolutions, which introduced mechanisation (1IR), mass production (2IR), and automation (3IR), this revolution offers unprecedented advances, enabling machines to learn, adapt, and make decisions in manufacturing tasks. However, operating, maintaining, and integrating these emerging technologies requires dedicated skill sets to thrive in this new landscape. This work proposes researching and developing a framework for the key skills needed for the fourth industrial revolution workforce and its implementation. In addition to curriculum development, it is hoped that this framework will play a key role in the effective upskilling of communities in the 4IR, especially those in low-resource Sub- Saharan regions. The challenges associated with implementing the 4th Industrial Revolution (4IR) will be identified, and potential solutions will be proposed.

'Artificial Intelligence and Machine Learning Adoption Among Technopreneurs in Gweru, Zimbabwe' by Chapwanya and Munthali interrogates the current state, barriers, and enablers of Artificial Intelligence (AI) and Machine Learning (ML) adoption among Technopreneurs in Gweru, Zimbabwe, a secondary urban centre. Findings indicated an early-stage adoption landscape, with only 26% of Technopreneurs actively implementing AI/ML, while 35% are in exploratory phases. Sectoral analysis revealed higher implementation in fintech (37.5%) and strong exploration in agritech (30%). The study highlighted the compounding effects of an "AI divide" driven by computational requirements and proposed localized recommendations, including establishing AI hubs, developing local cloud facilities, formalizing training and mentorship, and educating investors to accelerate AI-driven Technopreneurship. This research addressed a critical gap in understanding AI/ML adoption dynamics beyond primary innovation hubs in developing economies.

Mawere, Phiri, and Makoni, in 'From Classroom to Online: Security, Privacy, and Broader Challenges in Higher Education in the Global South,' examines the security, privacy, and broader adoption challenges experienced by higher education institutions in the Global South as they transitioned to online learning during the COVID- 19 pandemic. Using the Technology Readiness and Acceptance Model (TRAM) and a large quantitative survey of 1,248 students and staff at a Zimbabwean university, the study

investigates how factors such as perceived usefulness, ease of use, institutional readiness, optimism, innovativeness, discomfort, and concerns about privacy and security influence the intention and actual use of e-learning platforms. Findings show that all thirteen hypothesized relationships were significant: technology readiness and perceptions of usefulness strongly predict e-learning adoption, while privacy and security concerns reduce optimism and increase discomfort, thereby undermining readiness. The study highlights that beyond infrastructure, psychological and ethical factors such as fear of data misuse, surveillance, and cyber threats are major barriers to sustained online learning adoption in low-resource contexts. It concludes with recommendations for secure infrastructure, transparent data policies, and ongoing digital literacy and ethics training to strengthen trust and promote effective e-learning integration.

Majeke, Nyamambishi, Chikodza, and Sambo, in 'Numerical Computation of Ruin Probability using Hybrid Extreme Learning Machine and Whale Optimization Algorithm,' present a hybrid computational framework for estimating infinite-time ruin probabilities in actuarial risk models, particularly when claim-size distributions lack closed-form solutions. The authors integrate an Improved Extreme Learning Machine (IELM) with the Whale Optimization Algorithm (WOA) to overcome ELM's well-known sensitivity to random initialization of hidden-layer parameters. The framework approximates the renewal-type integro-differential equation governing ruin probability using a trigonometric neural network, combined with numerical quadrature for convolution terms. WOA systematically optimizes network configuration and parameter initialization to minimize approximation error. Numerical experiments across exponential, Weibull, and Pareto claim distributions show that the hybrid ELM–WOA model consistently outperforms standard ELM, achieving lower mean absolute error, reduced root mean square error, better stability, and high predictive fidelity, even in regions where ruin probabilities are small and sensitive to parameter choices. The hybrid approach retains fast prediction times while requiring higher training time due to WOA's iterative search. The paper concludes that metaheuristic-enhanced neural networks provide a robust, accurate, and practical alternative for computing ruin probabilities in complex actuarial settings, and suggests future extensions using other metaheuristics or applications to broader stochastic insurance models.

'Emerging Technologies Utilization and Their Impact on Service Delivery of Academic Libraries in Masvingo District' by Chibidi dwells on library operations. The study begins by noting that the rapid technological advancements in the form of emerging technologies have transformed the way libraries operate. Academic libraries are undergoing a digital transformation driven by such emerging technologies which make libraries ubiquitous and easily accessible to users in tremendous ways. This study identifies emerging technologies being utilized in libraries and their impact on service delivery. The research also examines the impact of emerging technologies utilization on service delivery in libraries. The research revealed that utilization of emerging technologies in libraries improves operational efficiency and service delivery. It was discovered that adoption and utilization of emerging technologies helped libraries to provide better services to patrons. Lack of skills, resources and infrastructure stood out as major impediments to the adoption of these emerging technologies in libraries. The study suggested training of library staff in the use of emerging technologies and adoption of all emerging technologies to improve operational efficiency and service delivery. Technologies like AI, IoT, RFID, Big Data and Cloud Computing were seen to be key technologies for improved library service delivery.

Marima, in 'Driving Education 5.0 through Green Boardrooms: Evaluating the Adoption and Impact of Advanced Technologies in Zimbabwean Higher Education Institutions' examined the level of adoption of advanced digital technologies in Higher Education Institutions to promote green boardrooms in Zimbabwe. Findings highlighted that all Higher Education Institutions have moved towards digitization. This is mainly driven by the Education 5.0 policy. A deployment gap prevailed, where there is high paper reduction, but power-intensive hardware remains. Qualitative insights identified the high cost of technology and infrastructure, the human capital skills gap, and poor connectivity to neutralize the efficiency gains of digital tools. Ultimately, the study confirmed that green governance in Zimbabwean Higher Education Institutions is currently more paperless than sustainable.

Manjeese, in 'A Conceptual Framework for Integrating AI, IoT, and Blockchain to Accelerate Zimbabwe's Sustainable Development: An ICT4D Perspective,' defines information and Communication Technology for Development (ICT4D) as the use of technology with a developmental agenda, especially of the underserved regions, and as instrumental in sustainable development. Combined with Artificial Intelligence (AI), the Internet of Things (IoT), and Blockchain (BC) there has been a new dimension to sustainable development as new prospects are presented by the three technologies in synergy. AI has the capability to provide technicians with new ways of solving challenges efficiently. Industries like health, education and agriculture can be revolutionized as tailor made solutions boost decision making and productivity. IoT can guarantee smooth data exchange, real time monitoring and automation thereby increasing productivity and saving costs. BC is a technology that guarantees transparency, accountability and trust during transacting digitally thus making it ideal for use in governance, finance and supply chain management. The results indicated that AI, IoT, and Blockchain have the potential to positively impact sustainable development in various aspects, including, increased efficiency, improved decision-making, enhanced innovation and for the integration framework to bring positive results it needs to consider ICT4D and sustainable development components such as local context, capacity building and green technology.

'From Policy to Practice: Evaluation of Telecom Cybersecurity Regulation and Capacity in Southern Africa' by Ranganai, Magoso, Chidoko, Sambo, Mushamainza, and Zivanai interrogates the effectiveness of cybersecurity controls or regulations within the telecommunications industry in Southern Africa and expounds the strengths and weaknesses of the effective governance frameworks. Complex cyber threats are increasingly targeted at digital technology infrastructure, and resilience is important to provide economic stability, consumer protection, and national security. The investigation used a mixed-method design that included surveys of telecom operators, a policy documents study, and interviews with regulators and industry

actors. The research also determines some crucial tendencies. The findings of the research show the inconsistency of policy implementation in a country, disordered compliance with regulations by telecom operator and a lack of enforcement frameworks on a state level. To sum up, it is important to note that despite the significant improvement, the telecom industry in the region is at the lowest level of cybersecurity. The paper takes into account standardization of cybersecurity at the regional level, increased regulatory controls, capacity-building and sensitization efforts through skills and awareness gimmicks, and regional integration to produce a healthier, more sensitive, and secure telecom environment.

'Cybersecurity in the Age of Digital Transformation: Safeguarding Knowledge Work in the 4th Industrial Revolution' by Muwani, Ranganai, Mutipforo, Denhere, Ruvinga and Katsande observes that the rapid advancements of the 4th Industrial Revolution, driven by artificial intelligence (AI), the Internet of Things (IoT), and big data, have not only revolutionized knowledge work but also introduced unprecedented cybersecurity risks. Despite technological progress, organizations struggle to protect sensitive intellectual assets from sophisticated cyber threats, raising concerns about data integrity, privacy, and operational resilience. This research addresses the critical intersection of cybersecurity and the 4th Industrial Revolution, offering insights into securing knowledge work in an era of hyperconnectivity. By identifying vulnerabilities and best practices, the research contributes to organizational resilience, regulatory development, and the sustainable adoption of advanced technologies. The study also evaluates cybersecurity strategies through the lens of the NIST Cybersecurity Framework (Identify, Protect, Detect, Respond, Recover), Zero Trust Architecture for dynamic access control, and human-centric security models to address insider threats and behavioral risks. The findings may suggest AI and automation introduce both defensive capabilities and new attack vectors; and that organizations with adaptive, layered security protocols demonstrate higher resilience. As the 4th Industrial Revolution redefines knowledge work, proactive cybersecurity measures must evolve in tandem. This research underscores the need for agile policies, workforce upskilling, and technology-integrated defenses to unlock the revolution's full potential securely.

In 'Development of a Health Insurance Premium Prediction Model using Machine Learning,' Makoni, Rukwava, Mawere and Chinofunga observe that in Zimbabwe's evolving healthcare landscape, accurately determining health insurance premiums is critical to improving affordability, reducing risk imbalances, and increasing coverage, particularly amid economic constraints and rising health costs. Traditional actuarial models often struggle to represent the complex, non-linear relationships among socioeconomic, health, and lifestyle variables prevalent in the Zimbabwean population. This article develops a machine learning model that more precisely and rationally predicts health insurance premiums. Five supervised regression algorithms, Linear Regression (LR), LASSO Regression (LASSO), K-Nearest Neighbours (KNN), Random Forest (RF), and Gradient Boosting (GB), are evaluated for their effectiveness using a representative health insurance dataset that includes demographic and health-related attributes relevant to Zimbabwe. The results show that ensemble learning methods, particularly Gradient Boosting, significantly outperform traditional linear models, achieving the highest predictive accuracy. Key predictors of premium costs were identified as chronic illnesses, smoking status, and the number of dependents, variables that are particularly pertinent in local risk assessment.

Muneri and Mwanyepedza in 'Urbanisation and Inequality in Zimbabwe: A Disaggregated Analysis' investigate the impact of urbanisation on income inequality in Zimbabwe, using 1992-2022 provincial-level disaggregated data. Employing the Fully Modified Ordinary Least Squares (FMOLS) and the Dynamic Ordinary Least Squares (DOLS) models, the study reveals that urbanisation increases income inequalities in Zimbabwe. These findings suggest that urbanisation in Zimbabwe is associated with urban decay, unequal access to education, employment opportunities, and other socio-economic amenities. It also reveals insufficient urban infrastructure, whose supply fails to keep pace with urban population growth. The study prescribes well-planned urban expansion, inclusive development policies, a strong rural development strategy, and service delivery improvements in rural and peri-urban and informal settlement areas. Addressing inequalities in access to quality education and socio-economic opportunities, coupled with data-driven policy decisions and increased community participation, remains critical to ameliorate inequalities associated with the urban expansion.

Ranganai, Magoso, Zivanai, Sambo and Muwani in 'AI Readiness Metrics in Public Sector Organizations: Zimbabwe Organizations Case Study Africa' note an urgent need to find out the drivers of preparedness since AI is becoming more mainstream in the hands of governments in an attempt to increase governance and service delivery. Key elements of AI preparation, such as skills of the workforce, organizational culture, data, and technological infrastructure are defined and measured by authors in quantifiable terms. The results indicate that the degree of preparedness in the firms has considerable differences that can be attributed to a combination of diverse factors including the opportunity to train and resource allocation. The research paper provides the urgent need of the customized plans of optimizing the AI application in the state sector in Zimbabwe. In addition to equipping policymakers and government administrators with operational knowledge enabled to achieve innovation and enhance governance, this study may be applied to create successful implementation strategies of AI, since the study may offer an effective metrics framework. Finally, to make sure that the AI technology could be successfully adopted by the public sector organizations to promote the services delivery and communication with citizens, AI Metrics on public sectors as recommended by the authors.

Masiya and Machaya in 'Justice v Corruption: The Judiciary's Role Battle for Economic Prosperity in Zimbabwe' maintain that corruption remains a global cancerous disease that undermines economic development while eroding public trust in institutions. In Zimbabwe, corruption has been a persistent issue, with the country scoring 21 out of 100 on the 2024 Corruption Perceptions Index. The economic ramifications are severe, with corruption contributing to inefficiencies in governance, misallocation of resources, and diminished investor confidence. In response to this, Zimbabwe has established several legal instruments and institutions to combat corruption. The paper aims to examine the role of the

judiciary, as an independent legal institution in Zimbabwe that is 'central to the rule of law', in curbing corruption and its impact on economic growth. The Constitution of Zimbabwe promotes transparency and accountability, with Chapter 13 establishing key anti-corruption bodies. Judicial oversight remains the key bottleneck for all anti-corruption enforcement efforts. The findings of this paper shall highlight the judiciary's role as a legal institution in shaping regulatory frameworks and enforcing anti-corruption measures. The paper suggests an integrated approach to combat corruption that is cognisant of the existing multifaceted frailties to enhance transparency, rebuild public trust, and support sustainable development.

Shambira and Shambira produced a review on 'Artificial Intelligence in the Zimbabwe Banking Sector.' The review explores the integration of Artificial Intelligence (AI) in Zimbabwe's banking sector, highlighting its transformative potential. The study argues that AI applications, such as automated report generation, customer service automation, robotic process automation, predictive compliance modelling, and AI-driven loan analysis, are enhancing operational efficiency, risk management, and customer service. However, there are challenges of limited AI knowledge, resource constraints, and governance concerns exist. The study recommends the adoption of AI tools, emphasizing the necessity for continual training and skill development, but human customer service remains critical in more complicated tasks. Human analysts will still be needed to interpret the data, make informed decisions and develop mitigation strategies.

Sikozho, Winji and Mawere in 'An Application of the Naïve Bayes Algorithm as a tool for Predicting Cases of Poaching in Wildlife Management' observe that poaching presents a serious threat to both wildlife management and tourism sustainability, making proactive, data driven interventions necessary. This study explores the application of predictive data mining in crime management within Zimbabwe's wildlife sector, focusing on the use of the Naïve Bayes algorithm to predict poaching occurrences in protected areas. Secondary data from ranger patrol logs, incident reports, weather observations, and spatial datasets were collected from selected wildlife management areas between 2015–2023. Findings show that predictive data mining can promote crime prevention, enhance resource allocation, and reinforce wildlife protection in Zimbabwe. The study recommends including predictive analytics into conservation planning to protect the country's wildlife resources.

Chinofunga, Chipepa, Makoni, Gwatidzo, Mawere and Chirima, in 'Protection of HIV incidence trends in Zimbabwe using Incremental Mixture Importance Sampling,' note that HIV prevalence has remained high in Zimbabwe due to continued use of Antiretroviral therapy (ART). Their article observes that incidence is now a better measure of the programmatic efforts in response to the epidemic. Chinofunga et al further note that Mathematical modeling remains the main tool for assessing incidence trends. The study also observes that an increase in the use of ART reduces HIV incidence. Scaling up HIV counselling and testing activities in provinces or districts with high force of infection will help reduce the force of infection in these areas as the number of people on ART will increase, consequently reducing the infectiousness of infected people. Intervention programmes should address cultural differences