17th World Congress on Engineering Asset Management (WCEAM)
Ho Chi Minh City, Vietnam 18 –20 October 2023
Sustainable Management of Engineered Assets in a Post Covid-19 World: Industry 4.0, Digital Transformation, Society 5.0 and Beyond
BOOK of ABSTRACTS

No	Paper No.	Abstract
1	001	**Title: Road User-Oriented Asset Management** Road infrastructure assets facilitate transportation of people and goods. The assets deteriorate over time; hence, it is essential to monitor and assess the condition of road networks and infrastructure so that timely intervention can be implemented to maintain high levels of service. However, the convention on road assessment seems to be derived from legacy and narrowly focused practice of monitoring only the pavement condition, with ramifications on suboptimal and unsustainable interventions. The stakeholders, especially the road users, need to be involved in the decision-making process. This approach is known as user-oriented and service-based approach, in which the requirements and expectations of the prime stakeholders, that is, the road users, are prioritized and included in the decision-making processes of road asset management. Given that the perceptions and priorities of stakeholders vary in different jurisdictions, this paper discusses users' involvement in assessing the condition of road infrastructure in a case study jurisdiction
2	006	**Title: OPTIMISING SOLAR AND BATTERY ENERGY STORAGE SYSTEMS USING YEARLY INTEVAL POWER DATA** Renewable sources of power generation can be cheaper than fossil-based power generation when engineered correctly. Existing solar/battery energy storage systems (BESS) have established sizing practices that obtain data from; peak demand records provided by energy retail companies, software modelling that applies proven renewable asset generation profiles, and average base load power usage recorded from energy management systems. Rarely is asset control factored into the sizing of a renewables system, and dynamic power shifting of asset loads is not practiced nor incorporated into existing battery control systems. This exposes systems to open loop inefficiencies which can degrade lithium and lead-acid based batteries exponentially. To demonstrate what is required to optimise the sizing of solar/BESS installations, this paper presents a numerical model that factors solar, power grid importation using BESS, to reduce grid power charges. The results show that sizing of solar and/or BESS must simulate yearly power interval data impacts from solar generation and battery discharging/charging to optimise the size and cost of a system.

No	Paper No.	Abstract
3	007	**Title: VALVE REGULATED LEAD-ACID BATTERY DEGREDATION MODEL FOR INDUSTRY APPLICATIONS** The demand for battery energy storage systems (BESS) is exponentially growing due to a global focus on sustainability and emissions reductions. VRLA batteries have been used extensively in standby BESS applications due to their wide availability and low cost. However, these batteries are highly susceptible to extreme degradation and loss of life when applied to baseload power variability. This makes the lead-acid battery chemistry unviable in large BESS systems. This paper will demonstrate the battery whole of life impact from irreversible sulphation, active mass degradation, temperature, and state of charge. Furthermore, this paper presents a numerical degradation model that uses base load power requirements to size the batteries and determine the extent of degradation at end-of-life conditions. Thereby providing industry with a low computational cost battery degradation model that is uniquely suitable for industry applications.
4	009	**Title: Integrated Decision-Making Framework in Industrial Asset Management for Assessing and Managing Emerging Risks.** Major challenges for the most used traditional assessment methods of safety risks are the growing complexity and uncertainty of modern systems driven by the digital era which inexorably leads to a rise in emerging risks. These methods for assessing and managing safety risks have their own limits and might not char-acterize all aspects that affect sociotechnical system safety in the context of new emerging risks. Thus, new tools are needed for the new problems. Hence, the need of building comprehensive decision support methodologies arises from those threats associated with the complexity inherent to industry 4.0 and uncertainty associated with natural disasters, in conjunction with new organizational risks as well as biases in human logic. On these grounds, this paper aims at developing an Integrated De-cision-Making Framework in Industrial Asset Management for Assessing and Man-aging Emerging Technology Risks as well as Extreme, Rare and Disruptive Events. This should account both for traditional and new emerging risk safety management. In this regard, we have chosen a duo of concepts that we consider the best ap-proaches, namely, the Functional Resonance Analysis Method (FRAM) and the System-Theoretic Accident Model and Processes (STAMP). These methods are much more efficient than the conventional ones to engineer complexity and uncer-tainty in modern socio-technical systems. In fine, to reveal the usefulness of this framework for identifying and managing industrial

No	Paper No.	Abstract
		asset risks, forthcoming targets will be devoted to performing a case study dealing with a complex socio-techno-logical system. The latter is dubbed LineDrone, a Hydro-Quebec1 robotic platform designed for inspecting and maintaining energized transmission lines.
5	011	**Title: Condition-based Inspection for Rail Track Geometry Degradation** Maintaining railway infrastructure is critical for ensuring the safety and comfort of passengers. However, planning and executing operation & maintenance (O&M) activities are complicated by the fact that railways are typically comprised of hundreds-to-thousands of kilometers of linearly distributed assets. One of the key degradation modes of rail infrastructure is deformation of track geometry caused by repeating loading, and frequent inspection and maintenance activities are therefore required to ensure the safety of rail operations. The maintenance action for track geometry deterioration mitigation is typically tamping, the timing of which is planned using periodic inspection activities via measurements from track recording vehicles (TRV). While TRVs can collect the geometry data of rail tracks quickly, they typically used to inspect thousands of kilometers of rail. Railway operators therefore need methods efficiently planning inspection operations to maximize the safety of the network. In this paper, the authors' previous study is extended to in-clude to analyze the potential benefits of implementing dynamic inspection — i.e. Condition-Based Inspection (CBI) — for track geometry. The key concept and ad-vantage of CBI is that next inspection time is scheduled according to the current inspected conditions. The policy of maintenance following inspections in this work is the same as previous study. The developed CBI is applied with the same real case study of Queensland Rail (Brisbane, Australia) and benchmarking with current pe-riodic inspection planning.
6	015	**Title: An analysis of fault induced impulse signals using a Maximum Correlation Kurtosis Deconvolution and an improved synchro squeezing transform** Abstract Fault induced impulse vibration signals from practical industrial cases often contaminated by strong background noise, which can largely affect the accuracy of fault diagnosis. Furthermore, the condition monitoring signal usually contains non-stationary features due to a changing speed during a machine operation. In order to suppress the noise interference and to enhance the energy of the characteristic

No	Paper No.	Abstract
		frequency component generated by a faulty part, a signal processing technique using a combination of Maximum Correlation Kurtosis Deconvolution (MCKD) and Time-reassigned local maximum synchrosqueezing transform (TLMSST) is proposed in this study. Under this approach, MCKD is applied first to improve the signal-to-noise ratio (SNR) of a noisy signal. TLMSST is then employed to produce an energy concentrated time-frequency (TF) distribution of the characteristic defect signal components from the de-noised non-stationary signal. The time interval between two successive frequency representations in the time frequency distribution is then used to determine the characteristic defect frequency for bearing fault diagnosis. The effectiveness of the proposed technique is validated using a simulated impulse signal and an experimental bearing defect signal acquired under varying speed condition. The result shows that the proposed technique can effectively extract the fault features from a non-stationary signal contaminated by strong noise.
7	016	**Title: An Efficient Predictive Analytics Framework for Asset Management** With access to new data and technology, asset management has evolved, incorporating algorithms, machine learning and artificial intelligence to analyze large volumes of asset data and identify trends that may not be apparent to human analysts relying on conventional technology. However, modern asset management focuses more on sustainability and social responsibility, as investors seek to invest in assets that align with these values. Therefore, these systems also emphasize sustainability and social responsibility, as well as optimizing asset management practices. They are characterized by data-driven, technology-enabled, and socially responsible investment strategies that maximize asset performance while reducing risks. The chapter focuses on the need for contemporary asset managers to have exposure to AI-driven predictive analytics solutions to address the challenges faced in their specialized industry. It explains how predictive analytics models can control the three pillars of any asset or infrastructure- risk, cost, and performance- while staying in tune with asset management's financial and social responsibility elements. The authors explain how asset custodians can utilize a Predictive Analytics Framework invented by Tigernix in various industries, including water, wastewater, road, mechanical, reusable energy, community infrastructure etc.

17th World Congress on Engineering Asset Management (WCEAM)
Ho Chi Minh City, Vietnam 18 –20 October 2023
Sustainable Management of Engineered Assets in a Post Covid-19 World: Industry 4.0, Digital Transformation, Society 5.0 and Beyond
BOOK of ABSTRACTS

No	Paper No.	Abstract
		Understanding the full-scale implementation of IIoT and AI capabilities will guide the reader in comprehending the actual outcome of using the Predictive Analytics Framework.
8	017	**Title: Real-Time Monitoring and Analysing Environmental Conditions in The Workspace with IoT Components and AWS Cloud Services** Ensuring a high-quality workplace is crucial in today's business world to enhance employee satisfaction and productivity. To create a safe and comfortable working environment, it is essential to have noise detection and air quality control measures in place. However, relying solely on basic human senses and interactions to do so may not be effective and could lead to exposure to toxicity before employees are aware of it. Therefore, in our research, we aim to address the need for technological intervention in the monitoring and analysis of the environmental conditions in office spaces. The main goal of the research is to develop an efficient and user-friendly solution. To elaborate, the project creates an Internet of Things (IoT)ecosystem consisting of various strategically placed sensors along with Arduino microcontrollers to collect data on environmental factors such as indoor air quality, temperature, humidity, and noise levels. The data collected by the sensors are processed by the microcontrollers, before being sent to AWS Cloud Services for storage and visualization. The system utilizes the secure and scalable infrastructure of the AWS Cloud Services, using Amazon Internet of Thing and AWS DynamoDB for connection and data storage respectively. The system also creates a website built by ReactJS and NodeJS to display real-time data analysis and visualization through a user-friendly interface. Via the website, users can also set thresholds for environmental factors and receive alerts when these thresholds are exceeded. The system also integrates with other AWS services such as Amazon API Gateway, Amazon S3 and Amazon Cognito for website building, deployment, and user access control. In general, our project proposes a practical and effective solution for monitoring and analyzing environmental conditions in the workspace.
9	23	**Title: Maintenance Process Improvement Model by Integrating LSS and PM Optimisation** In order to manage service adequately and improve the maintenance process, a guideline model is an important tool that can be used to reach high performance. This paper proposes a new model for vehicle fleet

No	Paper No.	Abstract
		maintenance management that integrates LSS and PM optimization activities to improve maintenances efficiency and effectiveness. This model bridges the service gaps between maintenance providers and customers and balances the requirements of maintenance managers, deliveries and customers by taking the benefits of the Lean speed and the Six Sigma high quality principle, as well as the optimisation process balance. Moreover, the TPM application within the Lean strategy which allows the organisations to develop advanced techniques in maintenance analysis and to be more technical in its approach to problem solving in maintenance. This combination can enhance the management performance of organisations, continuously raise the efficiency and effectiveness of enterprise management, and improve service quality and reliability.
10	024	**Title: Big data as assets: Risk management framework** The utilization of big data has become increasingly prevalent in various domains and is widely recognized as a valuable resource for many organizations. Despite its numerous benefits, the effective management of big data involves addressing numerous challenges, including the potential risks associated with its collection, storage, and processing. Despite the criticality of risk management in big data management, a significant gap exists in terms of adequate attention and resources allocated to this aspect. This gap is primarily due to the reliance on the expertise and experience of the data management team to manage the risk, which often results in inconsistencies and inefficiencies. To address this issue, this research paper proposes a unified framework for risk management in managing big data. The framework is designed from the perspective of asset management, considering the value and significance of big data as a valuable organizational asset. This approach enables a comprehensive understanding of the potential risks associated with big data management and facilitates the development of effective strategies for managing these risks. Overall, this framework provides a structured and holistic approach to big data risk management, enabling organizations to proactively address potential risks and mitigate their impact on organizational operations and performance. By adopting this framework, organizations can enhance their big data management practices and maximize the value and benefits derived from this valuable resource.

No	Paper No.	Abstract
11	025	**Title: Dynamic RUL based CBM Scheduling. A Simulation Model for the Railway Sector.** This paper uses a System Dynamics model to analyze the maintenance scheduling problem of a fleet of assets that is subjected to a CBM (Condition-Based Maintenance) program for critical components under a maintenance 4.0 environment. The paper explores the implications of different CBM capacity levels modelling a cost function. Cost function factors considered are cost of lost RUL, cost of CBM capacity, cost of overdue CBM and cost of asset unavailability due to overdue CBM. Empirically, the paper shows how capacity can be optimized to minimize this cost function. Once all different possibilities to schedule CBM activities are modeled, together with the cost of the selected CBM strategy, the paper compare results with those obtained for a base case where the organization could detect anomalies in components but not schedule CBM activities according to their RUL limitations and the maintenance organization capacity constraints. The paper demonstrates the different benefits of this opportunistic CBM task scheduling, according to assets stops for their predetermined PM activities. The tool that is developed has been tested in the railway sector, for a fleet of trains. Interesting results are obtained for different strategies, and they are discussed to understand possible implications of changes in the different factors and parameters of the problem.
12	026	**Title: Digital Twin Models in CBM Apps. Functionality** **Description & Features Analysis.** The goal of digital twins (DT) is to replicate physical equipment and systems in the digital world by effectively integrating data, models, and decision support systems, promising a step change in productivity and sustainable performance. Despite recent developments in DT solutions, several issues remain to be addressed before the benefits of this technology for maintenance can be realized. For example, it is necessary to generate a better conceptual basis, to facilitate the functional description of the applications, etc. This paper contributes to explain, in a practical way, the functionality and structure of these applications within digital configurations for maintenance management. It proposes a generic framework for the functional description of a DT designed for intelligent maintenance and, in addition, lists a series of characteristics that must be fulfilled when developing these

No	Paper No.	Abstract
		tools, according to the relevant scientific literature. This article is an excerpt from different contributions of the authors on this topic.
13	027	**Title: Blockchain technology adoption and the sustainability of smallholder farmer's agri-food production under climate change** Climate change is causing the risk of crop yield uncertainties and adversely affecting the livelihood welfare improvement of smallholder farmers. The main objective of this study is to explore how blockchain technology adoption can enhance the resilience of smallholder farmers' agri-food production under climate change, and how smallholder farmers should work collectively with wholesalers and policymakers to achieve livelihood welfare improvement through blockchain technology adoption. A thorough review of historical developments and existing integration trends among facilitators and barriers that can influence smallholder farmers' behavioural intentions to adopt blockchain technology along with future research directions outlined in the main literature was conducted. We also propose the sustainable system-of-systems (SSoS) approach to illustrate how smallholder farmers can work collectively with wholesalers and policymakers to achieve livelihood welfare improvement, in terms of social, economic, and natural capital, through blockchain technology adoption. This work establishes a knowledge base on research topics, issues of integration and synergies with a concentration on the potential for blockchain technology adoption to the sustainability of smallholder farmer's agri-food production under climate change.
14	030	**Title: Setting the decision-making framework for municipal asset management** Asset management by municipalities is characterized by a large variety of assets serving the needs of many different stakeholders. Given that the stakeholders may have conflicting values, asset management is not only balancing costs, perfor-mance and risk but also balancing different stakeholder needs. This increased com-plexity is further enhanced by the limited space in an urban environment, notwith-standing the competition for resources with non-asset departments. To deal with these challenges, many municipalities use a form of compartmentalization, limiting the scope of decisions. However, any compartmentalization introduces inefficien-cies and may even result in net destruction of value because of missed interests. A way to address these challenges is to have a uniform decision making framework based on a broad view on stakeholders

No	Paper No.	Abstract
		interest. In this paper we describe the ap-proach that was followed by the city of Rotterdam including the results. Starting point in this approach were active policy documents. These were translated into a set of guiding principles and a value framework using state of art insights. The re-sults were validated within the asset management organization with hands-on pilots on actual cases. Key elements in the approach were communication and collabora-tion with the entire organization and its partners. Given the encountered enthusiasm Rotterdam is now planning the large scale rollout of this new framework.
15	031	**Title: Determination of the exact economic time for the component replacement using condition-based maintenance** In most industrial assets, determining the preventive interval is a task carried out by the maintenance engineer. In non-critical assets, the optimization process of the interval must consider the costs of operation and maintenance, as well as the income generated by its operation. The result is the economic determination optimal moment to perform preventive intervention (PM). Mathematically, an expression can be found that relates these variables to the failure occurrence process. However, when the equipment is critical to the business, it is necessary to avoid the occurrence of failure. For this purpose, investment is made in techniques that determine asset degradation (CBM). In this case, not only must the failure occurrence process be controlled, but the degradation of the asset must also be analyzed. To determine the economically optimal moment for the preventive replacement of a component subject to CBM, a semi-Markovian model has been developed. The model considers degradation as a Wiener process and integrates it with the failure occurrence process, adjusted to a Weibull distribution. The result is two mathematical formulas to determine the interval for preventive replacement, optimizing costs, income, degradation and failure distribution, and the optimal degradation threshold.
16	035	**Title: Machine learning model for predictive maintenance of modern manufacturing assets** Predictive maintenance is considered a powerful practice for manufacturing assets, facilitating the identification of potential failure occurrences. By proactively addressing such failures, manufacturers can avoid unplanned downtime and allocate necessary resources for required maintenance activities. Machine Learning (ML) methods have emerged as a promising tool for preventing equipment failures in Predictive Maintenance

17ᵗʰ World Congress on Engineering Asset Management (WCEAM)

Ho Chi Minh City, Vietnam 18 –20 October 2023

Sustainable Management of Engineered Assets in a Post Covid-19 World: Industry 4.0, Digital Transformation, Society 5.0 and Beyond

BOOK of ABSTRACTS

No	Paper No.	Abstract
		applications. However, the effectiveness of Predictive Maintenance applications is largely determined by the Machine Learning techniques utilized. In this research, we adapted the cross-industry standard process for data mining to develop a predictive maintenance model for a unique, large, and complex manufacturing asset, utilizing various machine learning techniques. Specifically, we applied Random Forest, Support Vector Machines, K-Nearest Neighbors, extreme Gradient Boost, and Logistic Regression algorithms to the asset failure records. Following the fitting of all models, Random Forest emerged as the best-performing model based on the recall parameter. Additionally, an exploratory data analysis process was conducted on the data to derive insights into the failure pattern of the machine.
17	037	**Title: Modelling Traffic Conditions in Developing Urban Areas: A Combined Approach of Explainable Artificial Intelligence and Mobile Crowdsourcing** Traffic congestion remains a persistent and challenging issue in major urban centers, particularly in developing countries where transportation infrastructure struggles to keep pace with rapidly growing demand. This paper proposes innovative solutions to address this issue by introducing mobile crowd-sourcing based approaches for traffic condition estimation. Scalable framework is outlined for the efficient collection, integration, and analysis of traffic-related data contributed by mobile crowds. Furthermore, the paper addresses critical issues related to reliably predicting traffic conditions where prediction interpretation is unavailable, utilizing an machine learning model backed by Explainable Artificial Intelligence. By leveraging the explain ability of the model, valuable insights can be extracted to enhance traffic conditions and improve overall social welfare.
18	038	**Title: Compressive and Shear Loading Test for a** **Concrete Cylinder with Concrete Joint** Concrete must be placed at a site within the time interval prescribed in the code, so that several batches of concrete must be integrated after hardened. However, a defect of the concrete joint, what we called, "Cold joint" could beoccurred. When the condition that is better than cold join, for example, a combination of a much smaller gap and color difference would be observed, the judge to repair would be complicated, because of insufficient test data.

No	Paper No.	Abstract
		In this paper, to evaluate the material strength with concrete joint, 64 pieces of concrete cylinder specimen with time interval of zero to three hour were made and compressive and shear loading test was performed. Test results were examined and reached several conclusions. We examined the test data of the compressive, shear and frictional stress. They were decreased following increasing of the time interval of the concrete placement. However, the shear stress was 1.12 times of the short term of allowable shear stress in all specimen. On the other hand, the average load was decreased to 88% from 0.5 to 3.0 of T. Therefore, the loading test should be performed when the concrete joint was observed.
19	041	**Title: Unlocking the potential of Construction 4.0 for Asset Management: factors for success in Ca Mau and Tra Vinh provinces, Vietnam** This study seeks to evaluate the feasibility of using Construction 4.0 (C4.0) technologies for asset management in a developing context, with a particular focus on the Vietnamese provinces of Ca Mau and Tra Vinh. The research employed the Fuzzy Delphi methodology and gathered data from construction experts, includ-ing government officials, consultants, contractors, and clients. The findings indicate that using C4.0 technology to manage buildings and infra-structure has the potential to contribute to facility management and sustainable de-velopment in developing nations such as Vietnam. The study proposes a framework and highlights critical success factors, such as collaboration, data sharing, operation planning, support software, and project member participation for C4.0 adoption. This study has significance for policymakers, industry experts, and academic re-searchers working towards applying digital technologies for asset management in developing countries.
20	042	**Title: Digital Transformation for Construction Facility Management in Developing Countries: A review of BIM applications** This review article provides insights on utilizing digital technologies to manage facilities in developing countries. Through the adoption of digital models, the construction owners can gain key benefits such as

No	Paper No.	Abstract
		better facility operation and maintenance, better collaboration, enhanced safety and security, and effective space management. Despite the potential benefits, the review also identifies significant challenges to the adoption of digital models in developing countries, including the lack of skilled personnel, infrastructure, and governmental support. These challenges have hin-dered not only the widespread diffusion of digital tools, but also facility management practices in construction. The review contributes to the literature on digital transformation in construction by providing an overview of Building Information Modelling for facility management in developing countries**.**
21	043	**Title: Understanding Opinions and Emotion s of Generative Artificial Intelligence Assets using the Gartner Hype Cycle and KKübler Ross Change Curve** Asset management today encompasses not just on-premises properties but also cloud services. Companies have been adopting software services like Office 365 or Google Apps and managing them as assets for over a decade. Adopting those services into their businesses often required time, both technically and managerially and psychologically. It is well known that for digital transformation projects to be successful, organizations and their workers must be ready in advance. It is now the age of Generative Artificial Intelligence (AI) services such as ChatGPT, Bing AI, and Microsoft Office Copilot. Understanding the opinions and emotions about such assets in organizations will aid in the consolidation of our theories of technology acceptance and will guide businesses in their technology adoption. Based on Gartner Hype Cycle and Kübler-Ross Change Curve, this study hypothesises that the process of adopting generative AI services into organisations will go through stages of technology trigger, the peak of inflated expectations, the trough of disillusionment, the slope of enlightenment, and the plateau of productivity, while at the same time passing through the feeling of shock, denial, frustration, depression, experiment, decision and integration. Using the sentiment and emotion analysis approach, this study collected a significant number of tweets from Twitter, and then quantize their contents into sentiment scores and emotions to assess these hypotheses. Prior research has shown the binary sentiment landscape at a single point in time but not the range of sentimental scores and multilevel emotions

No	Paper No.	Abstract
		over some time, and consequently could not demonstrate the complete process of hyping and adopting as envisioned by the Gartner Hype Cycle and Kübler-Ross Change Curve. Additionally, previous research examined the adoption of new technology from the perspective of information seekers, but not from the perspective of information creators. Furthermore, because generative AI services have just recently been released for public use, there is still a gap in our knowledge of their receptive and adaptive responses. Theoretically, this study contributed to the empirical confirmation of the Gartner Hype Cycle and Kübler-Ross Change Curve in implementing generative AI services. In practice, it aids organizations in the process of planning the implementation of new generative AI assets together with their managerial and psychological training to increase company-wide productivity.
22	044	**Title: Battery Refurbishment Technologies in the World: A Review** The increasing demand for batteries in various industries has resulted in the problem of battery waste. An industry 4.0 will need to tackle this kind of envi-ronmental problem. With the need for a more sustainable solution, battery refur-bishment technologies have emerged as a way to reduce the environmental impact of battery waste, conserve resources, and save costs. In this review, we will discuss the existing battery refurbishment technologies in the world, including their ad-vantages and disadvantages.
23	046	**Transformer architecture for botnet detection** Botnets, networks of compromised computers controlled by malicious actors, pose a significant threat to cybersecurity. Traditional signature-based methods for botnet detection are effective for known botnets but struggle to identify new and evolving threats. Machine learning based approaches have been proposed to address this limitation; however, they often require manual feature engineering and may fail to capture complex patterns of botnet behavior. In this paper, we propose a novel approach for botnet detection based on the transformer architecture, which has achieved state-of-the-art performance in natural language processing tasks. Our transformer-based model processes raw network traffic data and automatically learns meaningful representations for botnet detection, eliminating the need for manual feature engineering. We conduct extensive experiments on real-world network traffic datasets, demonstrating the effectiveness of our

No	Paper No.	Abstract
		approach in accurately detecting various types of botnets, including previously unknown threats. Our approach outperforms baseline methods and exhibits robustness to adversarial evasion techniques. The proposed transformer-based model represents a significant advancement in the field of botnet detection and has the potential to enhance the security of networks against evolving cyber threats. Keywords: botnet · cybersecurity · transformer
24	050	**PREDICTING OPTIMISATION OPPORTUNITIES FOR CLINICAL SPACE UTILISATION** Can machine learning be used to predict optimisation opportunities for clinical space utilisation? This research seeks to demonstrate the capacity of machine learning on 2.78 million clinical occupancy data points to support future optimisation of clinical space utilisation. Increasing clinical space utilisation leads to reduced infrastructure expansion and/or reconfiguration. Previous research demonstrated the capacity of Internet of Things (IoT) technology to identify low historic occupancy periods; future utilisation prediction remained a challenge. Machine learning algorithms are applied to 24 months of historical occupancy data previously gathered by privacy-preserving IoT devices in a live public-healthcare environment. Predicted data was visualised via. graphical interface, and user-manipulated through time and location filters. Preliminary results demonstrate the capacity for machine learning to identify future optimisation opportunities for clinical space utilisation, achieving accuracies of 82% using a 'K Nearest Neighbours' algorithm. The resultant data-dashboard combined human experience/intuition with model predictions supporting dynamic exploration of future clinical occupation patterns. Previous research demonstrated the capacity of IoT devices to support identification of historic occupancy gaps. This research demonstrates improved capacity for resource planning to improve consumer experience, reduce reliance on more intensive/expensive downstream services, and lower healthcare costs.
25	054	**Application of Industry 4.0 technological advancements in teleoperation of industrial robots** Technology development in Industry 4.0 era results in a progressive inte-gration of robotic systems into manufacturing processes. This study implements the advancements in industrial automation, Internet of Things (IoT), and Virtual Reality (VR) to develop an approach for real-time teleoperation of industrial robots in re-mote working environment where human access is limited. The proposed frame-work addresses the current

No	Paper No.	Abstract
		challenges in robot's posture perception by presenting the potential of VR to enhance the user's spatial awareness and intuition of control-ling robots. The real-time robot control is conducted by tracking user hand move-ment via VR controllers and the feedback signal from the robot is recorded for sys-tem monitoring. In addition, the intermediary cloud server is utilised for data transfer between stations via the Internet. The practical experiments with an indus-trial robot are conducted and investigated to verify the system performance. The proposed system is to be implemented in supporting engineering technicians to ef-fectively monitor and manage robots in the automation line. Keywords: Robotics, Virtual reality, Teleoperation.
26	056	**Lessons learnt from building an Enterprise Resource Planning (ERP) system using serverless cloud architecture** This paper presents findings from a case of building a large-scale enterprise resource planning system using serverless cloud services. It is suggested that serverless could be a solution to overcome the innovation and resource shortage challenges faced by small technology start-ups. Serverless provided these firms with a flexible, scalable, and cost-effective infrastructure that leverages cloud computing technologies. By adopting a serverless design, start-ups can focus on developing their core business applications, rather than worrying about the underlying infrastructure. Findings from this study provides lessons for small start-ups to optimize their resources and minimize costs, while still achieving high levels of scalability and performance. The paper also highlights the benefits of the serverless design and provides practical examples of how it can be implemented in small tech start-ups.
27	057	**Smart camera for asset management: a novel hybrid solution of edge and cloud computing** This paper presents a novel approach for asset management using a smart camera system that utilizes both edge and cloud computing. The proposed system is designed to monitor and track assets in real-time, providing valuable insights into their status and location. By combining the processing power of edge

No	Paper No.	Abstract
		computing with the scalability of cloud computing, the system can handle large amounts of data while still providing low latency responses. The smart camera system can be used in a variety of applications such as logistics, manufacturing, and retail, where real-time tracking and management of assets is critical for operational efficiency. The results of the study demonstrate the effectiveness of the proposed system in improving asset management and reducing operational costs.
28	062	**A Comparative Study Regarding Information Quality of Data Acquisition Methods for Gravel Road Condition Measurement** Gravel roads connect rural areas to urban centres, providing essential access for residents and entrepreneurs. Maintaining these roads at an acceptable level of service is cru-cial for improved ride quality and efficient and safe transportation of goods and services. They have a high deterioration rate compared to paved roads. Currently, visual windshield inspections are the primary approach to evaluate the state of gravel roads by conducting, but they are unreliable and susceptible to human judgement errors. Technological advancements, particularly sensor technology, have presented opportunities for improved condition moni-toring and data collection for gravel roads. However, the quality of information varies for various available technologies, consequently affecting the condition assessment results. For effective decision-making, high-quality information is required. This paper investigates and compares the information quality of the data collected using smartphone sensors and an In-tegrated Circuit Piezoelectric (ICP) accelerometer from three gravel roads. The empirical analysis is based on the hypothesis that the quality of information from the smartphone and ICP sensors are comparable. Statistical properties and the instantaneous power for eight (8) frequency bands of the data from the Smartphone and ICP (resampled) sensors for RT1, RT2 and RT3 were compared. The power spectral density (PSD) was also compared. The results from the ICP sensor yield higher-quality information than smartphone sensors and can be complemented by video recordings and visual windshield inspections for better maintenance decision-making. Assessing the condition of gravel roads using methods that offer high-qual-ity information is vital to efficient decision-making and is achieved by using objective and automated data acquisition methods based on sensor technology.

17th World Congress on Engineering Asset Management (WCEAM)

Ho Chi Minh City, Vietnam 18 –20 October 2023

Sustainable Management of Engineered Assets in a Post Covid-19 World: Industry 4.0, Digital Transformation, Society 5.0 and Beyond

BOOK of ABSTRACTS

No	Paper No.	Abstract
29	63	**Developing New Method for Optimizing the Maintenance Strategy of Electrical Mobile Working Machines And Reduce Operating And Maintenance Costs, using Markov Decision Process** **Abstract** As a way to contribute to resolving the current climate issues, automobile industries invest heavily in the development of electrical working machines (loaders, drilling and bolting rigs and haul trucks). A key aspect of these new technologies that should be addressed is their maintenance management, as the existing maintenance models are mainly focused on fuel engine driving machines. As a result, it is necessary to develop a maintenance strategy to optimize availability of heavy electrical working machines and reduce operating and maintenance costs. After examining the existing maintenance strategies and maintenance planning for fuel engines, this paper presents a new maintenance method that optimizes the maintenance strategies of electrical mobile working machines using Markov decision processes. Based on the machine's condition and the maintenance costs, an optimal cost-effective maintenance policy is determined, which includes the appropriate maintenance action to be taken. A Markov Decision Process is applied to the study using MATLAB and Maple V. Keywords: heavy electrical working machines, availability, maintenance costs, operating costs
30	65	**Topics: Asset and maintenance complexity: predictive maintenance solutions used by airports around the world and some suggestions for the Vietnamese Airports** The day-to-day airside and landside operations are complex with more than thou- sands individual assets, multiple siloed maintenance and inventory systems, work- flows dating back sometime up to 1980, and dozens of contractors working onsite. As such, the airport's manual processes lead to costly and frustrating communica- tions challenges—and issues often left unresolved. Asset management solutions tai- lored for airports that include analytics can provide an integrated approach to man- aging all discrete or complex assets

No	Paper No.	Abstract
		in the airport inventory. They can help overcome challenges rooted in aging infrastructures or insufficient human assets and bring unity to the typical airport's siloed or disconnected systems. Predicting the impacts on civil infrastructure over decades is challenging — and 45% of all maintenance efforts are ineffective. Assets are constantly moving and exposed to nonstop usage as well as ever-changing conditions. Because materials react differently to different stimulus over time, the condition of an asset today will not reflect the condition in a month, a year, or ten years from now.
31	067	**Framework for mapping activities in desalination plant for sustainable maintenance** Seawater desalination plants are complex facilities that require careful management and maintenance to ensure that they operate efficiently and reliably over their lifespan. Desalination equipment can suffer from various failures that can impact the efficiency and productivity of the plant. Some of the most common failures include: corrosion, mechanical failures, electrical failures and biological growth. The latter is very specific for this type of system. Biological growth, such as algae or bacteria, can occur in the intake system, pipes, and other equipment. This can reduce flow rates, increase energy consumption, and cause fouling and corrosion. From a sustainability perspective, there are several concerns associated with the operations and maintenance of desalination plants, including: energy consumption, water consumption (While desalination provides a reliable source of drinking water, it also requires a significant amount of seawater for the process and this can have negative impacts on marine ecosystems), chemical use (Desalination may require the use of chemicals such as chlorine to maintain the quality and efficiency of the process. These chemicals can have negative environmental impacts if not properly managed, including impacts on aquatic life and ecosystems). From a methodological point of view, the paper will apply methodologies to improve the maintenance management to obtain better performances in terms of operations efficiency and

No	Paper No.	Abstract
		sustainability. Maintenance models theory is accordingly applied in order to identify the main issues related with this specific business and type of technical systems.
32	075	**Simulating and optimizing the standard tending station with ABB robots** Machine tending station is a recent trend in manufacturing, especially in the era of Industry 4.0. The adoption of an automatic feeding station is crucial for advancement and innovation in the industry and making a significant progress in manufacturing and automation industry. In this paper, we aim to simulate and optimize a machine tending station for milling mechanical parts that will be implemented into main systems. This station will improve the workflow efficiency and accuracy to prevent errors and hazardous injuries. The communication between stations will be manipulated by the Omicron controller through a control cabinet. The workflow will be controlled by RAPID code through RobotStudio. Furthermore, sensors will be utilized for detecting different shapes of parts for the robot to have appropriate grabbing extensions motion for pick and place tasks.
33	076	**Supply Chain Quality Management 4.0 Frameworks: A Case Study in the Health Care Industry** Research focusing on the integration of three concepts, which are Industries 4.0, Quality Management, and Supply Chain Management – SCQM4.0 (Supply Chain Quality Management 4.0) to evaluate the impact of Industries 4.0 on the supply chain quality management, has been an emerging area among academics and industry practitioners. The literature identified various benefits of the integration including cost reduction, increased supply chain performance, and improved customer satisfaction. However, it is still unclear for firms to assess their maturity level in implementing SCQM4.0. Managing SCQM4.0 competences enable firms to gain competitive advantages in supply chain operations and performance. This paper provides an overview of SCQM4.0 concept and proposes a maturity framework for SCQM4.0 based on four constructs including supply chain performance, supply chain operations, disruptive technologies, and infrastructure practices. The proposed SCQM4.0 framework identifies four maturity stages of Incidental, Intentional, Integrated, and Optimized. Our SCQM4.0 framework is then evaluated in a a medical device manufacturer in Vietnam. Key findings and discussion are provided.

No	Paper No.	Abstract
34	077	**Analysis of interrelated distress types using Naïve Bayes method for provincial highway network in Pakistan** Highways play a vital role in regional development. However, due to the focus of road authorities in these countries on the construction of new highways, the existing highways are left unattended. Small distresses that develop on these roads after short periods and can be remedied relatively cheaper are left to convert into more complex types that cost more to repair. An understanding of how these distresses evolve would be useful for scheduling maintenance activities and reducing maintenance costs. In this research, the probability of occurrence of a particular distress type due to the other distress types with time was studied by using a probabilistic algorithm known as Bayes classifier. The study was conducted by analyzing data from the provincial highway network of Khyber Pakhtunkhwa province of Pakistan. Data on 12 types of distresses that occurred in pavement aged up to 7 years were utilized in the study. The results of the study showed the probability of occurrence of severe distress types like block cracks increased due to delay in treatment of less severe distress types like edge cutting, alligator cracks, potholes and transverse cracks highlighting the need for preventive maintenance.
35	080	**Evaluation of Project Performance and Sustainability in the Nepal Road Infrastructure Sector** Infrastructure construction considering environmental and social aspects supports sustainable development. However, the implementation of mitigation measures is often neglected. This may affect the performance of a project, as well as the sustainability of the infrastructure. This research examines the environmental and social aspects considered in road infrastructure projects in Nepal and their effect on project performance. The data of road and bridge construction contracts are analyzed to evaluate the time and cost performance of projects in relation to environmental and social considerations. The comparative study of projects financed by the Government of Nepal (GoN) and foreign financing institutions was performed using descriptive statistics and the Mann-Whitney U test considering the non-normal distribution of data. The results showed that international financing institution-supported projects have more robust institutional, governance, and resource management with proper environmental and social consideration. Finally, this research suggests the

No	Paper No.	Abstract
		use of proper institutions, governance mechanisms, and resource management to improve performance achieving sustainability.
36	081	**Assessing the transferability of the Highway Safety Manual crash prediction model in the context of the mountainous rural two-lane highway of Nepal** Road safety management focuses on mitigating the occurrence of crashes by building safer roads, and crash prediction is one effective technique for achieving this goal. The crash prediction methodology developed by AASHTO and explained in the Highway Safety Manual (HSM) is the most common model among road management authorities and researchers. The manual provides calibration techniques to make the model flexible and applicable for roads that differ from the base conditions. However, the transferability of the HSM crash prediction model needs to be assessed before using it for real-life crash estimations. The objective of this study is to assess the transferability of the HSM crash model in the case of a mountainous two-lane rural highway in Nepal. Through this study, two major issues were identified in the HSM model: 1) the homogenous segmentation approach would lead to the formation of numerous short road segments with zero crashes and thus would be unpragmatic to consider, and 2) the function for crash modification factor for horizontal curves contributes to overpredicting road crashes because of curves with a smaller radius and shorter lengths. This shows that special considerations are required for applying the HSM to mountainous roads.
37	082	**FUNDAMENTAL STUDY ON THE OVER TORQUE TEST METHOD TO ASSESS THE CONCRETE STRENGTH** In this study, we developed the over torque test method with a small drill. The method is independent of the worn condition of the drill edge and the drilling pressure. In the method, at first, a small guide hole is drilled. Secondary, a small concrete screw is driven while measuring the torque. Finally, the concrete strength is assessed compared with the concrete strength and the torque property relationship. A lot of the over torque test were performed while measuring the torque and the test results were examined. The torque was sharply increased at the start screw-in Next, the torque is kept while driving drill to some

No	Paper No.	Abstract
		extent. Finally, the torque was sharply dropped down with the over torque. Just a drilled small hole was left as damage. The relationship between the concrete strength and torque property was shown and we confirmed that the over torque test method could be highly valuable to assess the concrete strength.
38	084	**SMART SYSTEM OF OBSERVATION AND MONITORING IN SHRIMP AQUACULTURE MANAGEMENT USING THE INTERNET OF THINGS (IOT)** This paper investigates to analyze, design, and fabricate a smart monitoring and observing system in aquaculture management via using LoRa and IoT technology. In the paper, recent developments of the automatic monitoring and observing technology in aquaculture in Vietnam is presented and analyzed. Firstly, a solution is proposed to improve life span of measurement devices of water quality. Conceptual design of a smart system of monitoring and observing system is generated via an integration of smart DO measurement system, feeding machine, waterwheel and other related components via Lora, internet of things (IoT), and automation technology. In addition, machine learning algorithm is used in the integrated control system, in which water parameters are automatically monitoring basing on environmental conditions. fabricated system and experimental testing are deployed to validate the proposed solution.
39	088	**PAPER: "SOLVING THE EXAMINATION TIMETABLING PROBLEM USING A HYBRID EVOLUTIONARY ALGORITHM"** Designing a feasible examination timetable for universities is a complex task that involves numerous practical constraints. This problem is particularly challenging in universities in Vietnam, where there is often a shortage of facilities such as classrooms and laboratory sessions. The efficient use of resources is crucial when scheduling examinations. In this study, a novel approach to solve the examination timetabling problem using a meta-heuristic that combines Particle Swarm Optimization (PSO) and Grey Wolf Optimizer (GWO) is proposed. This method has not been previously applied to this problem and is evaluated using a small case study and

17th World Congress on Engineering Asset Management (WCEAM)
Ho Chi Minh City, Vietnam 18 –20 October 2023
Sustainable Management of Engineered Assets in a Post Covid-19 World: Industry 4.0, Digital Transformation, Society 5.0 and Beyond
BOOK of ABSTRACTS

No	Paper No.	Abstract
		compared to IBM-CPLEX solutions. Additionally, a multi-search method is incorporated to improve the approach's search capability. The proposed approach delivers reasonable results even for large-scale studies, such as in the case of the International University, where it solved a problem with over 400 exams, while IBM-CPLEX could not find an appropriate solution.
40	091	**ICT for sustainable development: Designing a Smart IoT platform for online water quality monitoring** Water quality monitoring is crucial in protecting the environment. However, most of water quality monitoring systems in Vietnam are manual, time-consuming, and require well-trained personnel. Some systems utilize specialized components imported from abroad, which drives up the cost and make them expensive to maintain. In this paper, we present a design and implementation of an online water quality monitoring system that is cost-effective and easy to maintain using readily available components in Vietnam. The system consists of one or more sensor units collecting water parameters like pH, temperature… etc. Those data are then transmitted wirelessly to a central unit for monitoring and data analysis when needed later. The result of the study shows that the designed system performs adequately in measuring water quality. Furthermore, to evaluate its accuracy and reliability, the system is submitted to inspection authority and subsequently certified.
41	092	**Digital Transformation in Transportation Management System: Challenges for Vietnam Businesses** Abstract. Digital transformation is a journey with multiple connected interme-diary ends, in the long run, striving towards constant improvement across opera-tions, divisions, and systems in the hyper-connected era by building the right bridges between the front end and back end for all stakeholders within organizations to participate in. In this present era of the Fourth Industrial Revolution, digital trans-formation has emerged as a significant phenomenon in economic development. Pri-vate and public organizations around the world strike to adopt technology applica-tions and their impact on managing and developing activities to drive better

No	Paper No.	Abstract
		performance efficiency. The adoption of digital transformation plays an important role in firms having competitive advantages in the market by increasing productiv-ity and providing a better customer experience, which leads to growth opportunities. In Vietnam, a developing country in Asia, the adoption of digital transformation in transportation management systems has gained significant attention. This re-search examines the challenges faced by Vietnam businesses in their pursuit of dig-ital transformation in the transportation management system. The study draws upon reliable data and statistics to provide an in-depth analysis of the current landscape. In the logistics sector, while each step in the traditional supply chain is responsible for a specific function, the End to End (E2E) supply chain introduces a more inter-connected process. This approach encompasses a comprehensive workflow that starts with product design and the procurement of raw materials, extends through scheduling, production, and concludes with the final delivery of the finished product to the customer. By adopting the E2E supply chain model, organizations aim to achieve greater efficiency and integration throughout the entire logistical journey, ensuring a more cohesive and streamlined process from start to finish. By addressing the challenges, stakeholders in Vietnam's transportation industry can navigate the complexities of digital transformation and develop effective strategies for successful implementation as well as take advantage of potential opportunities.
42	094	**Vietbank – A successful digital transformation case in Engineering Asset Management** This paper investigates the successful transformation of Viet Nam Thuong Tin Commercial Joint Stock Bank (Vietbank) from intensive labour management procedure of investment, operation, maintenance and retirement for engineering assets to highly automation via digital transformation. The research was conducted with the support from Vietbank's internal documentations, procedures and interviews with team of senior information technology (IT) infrastructure personnel. Vietbank had successfully achieved great saving in term of operation efficiency, human resources and financial after applying digital transformation. Their successful case can be used

No	Paper No.	Abstract
		as a framework for other similar size of operation banks to base on in their digital transformation process in engineering assets management.
43	097	**Risk-based inspection plan: a case study in a loading tanker truck system of chemical company** The proposed work is carried out in a chemical company of Chile, which processes and distributes chemical products as raw materials industries throughout the country. A new loading system was built to improve the distribution processes of the company, which consists of piping networks divided into 19 circuits. To optimize the maintenance strategies for the piping networks, a risk-based inspection plan was proposed. The API 580/581(standard of American Petroleum Institute) methodology was chosen to quantify the probability and consequences of an event occurring, as it is a quantitative methodology created for the petrochemical industry context. The operational context and technical information of the system were identified, and the baseline risk was evaluated. Therefore, an inspection plan was carried out according to standard, which includes the minimum requirements for maintaining the mechanical integrity of the system. Finally, a proposal was developed for an inspection plan based on thickness measurement using UT. It identifies the points to be measured in each of the circuits and their position, according to the consolidation of information in field and management spreadsheets, taking into account the company's considerations. The proposed inspection plan aims to reduce the occurrence of any events and ensure that the distribution processes are carried out safely and efficiently.
44	101	**A novel method for gearbox fault diagnosis based on shift-invariant and shared dictionary learning** Gearbox fault diagnosis is a very crucial part in the field of mechanical diagnosis, and many methods are proposed to solve this problem. Either way, the core idea of fault diagnosis is to extract the class-specific features from the signals collected by different sensors. Although different types of faults own different class-specific features, they also generally possess common features, and it's essential to eliminate them for highlighting the class-specific features. Especially for gearboxes, there are many complex components in the vibration signals, where many features may belong to more than one fault class, so analyzing and removing these common features before feature extraction is a quite significant process for a more efficient diagnosis. However, at present, few articles are proposed to solve the problem of common features. Inspired by a shared idea, we

No	Paper No.	Abstract
		proposed a novel fault diagnosis method named shift-invariant and shared dictionary learning (SISDL), which consists of shared dictionary and diagnostic dictionary with shift-invariant. The shared dictionary is responsible for learning the common features from different fault classes. Meanwhile, the diagnostic dictionary is responsible for learning the class-specific features. Besides, a feature extraction scheme based on energy distribution (FEED) with hidden Markov model (HMM) is proposed to extract the sparse features and diagnose faults. Our proposed method with other five state-of-the-art dictionary learning methods is applied in two experimental gearbox cases, and the results verify the advantage of SISDL over the others.
45	102	**Autonomous drone-based imaging system for detection of potholes in rural road** As a country with a high percentage of motorbikes, the appearance of potholes has a serious impact on people. Today, detecting and repairing potholes takes a long time. Therefore, this research paper aims to provide solutions for inspectors to save time in detecting potholes. In this study, the authors used drones to collect data combined with the common computer vision model YOLOv5 to produce pothole detection models for images taken from drones. From the identification results, we calculate the size and location of the potholes so that the inspectors can identify the danger range and come up with a reasonable repair plan. The current model reached the precision, recall, and F1 score at 0.946, 0.961, and 0.95, respectively
46	105	**Application of Unmanned Aerial Vehicle and YOLOv5 Model to Identify Water for Risk Assessment of Dengue Fever** **Abstract:** Dengue is a viral disease that is emerging rapidly as a pandemic in tropical and subtropical countries, primarily transmitted via mosquitoes. Mosquito surveillance and control are challenging due to dynamic interaction between humans and landscapes. The use of drones could be beneficial in mosquito surveillance and control programs in the future. The authors aim to identify potential mosquito breeding sites using drones for large-scale data acquisition and try to extract the water areas from the raw imagery datasets with 2 different approaches. A Photogrammetry based approach can build high-resolution 2D maps of these areas, but the

No	Paper No.	Abstract
		rendering of their exploitation by filters may not be very precise and will be dependent on the quality of the images. Another approach is to train deep learning algorithms to detect stagnant water using the YOLOv5 instance segmentation model. A well-trained deep learning model combined with good data acquisition via drones can effectively detect water areas and can be used for further assessing the risk of disease outbreaks.
47	110	**Issues and Challenges in fault detection for commercial solar panels with Smart AI image processing techniques – A case study in an Australian utility company** In recent years, renewable energy has become a high-priority choice in utility companies to reduce their carbon emission footprint and cut overall energy costs. As a result, worldwide utility companies are building solar farms to supply electricity for operation usage. Since solar PV panels are relatively new assets for the organization to manage, organizations are continuously seeking insightful understandings to develop and optimize their solar panel maintenance programs. For example, some organizations utilize Unmanned Aerial Vehicle (UAV) technologies combined with an AI-driven image processing technique for condition monitoring to improve the efficiency and safety of the solar maintenance program. While the emerging AI technologies sound promising, this research found that the existing solar panel maintenance programs could still be time-consuming, unsafe, and costly as they might require personnel to visually inspect these assets due to various issues associated with the AI technologies. Therefore, based on a case study, this research investigated the challenges and issues in the existing solar panel maintenance process from technology, organization, and people perspectives. These findings can contribute to a more effective and efficient commercial solar panel maintenance approach.
48	111	**Cyber Security for Critical Information Infrastructure Assets under Nontraditional Security Lens in Vietnam** As Industry Revolution 4.0 (IR4) is exerting its influence across continents and countries, it is becoming increasingly pressing for engineering asset managers worldwide to adopt this new mantra and adapt accordingly. With surging cyber physical systems being invested in an ever-popular trend, it is necessary for (engineering) asset managers, especially those in charge of critical information infrastructures to look beyond for a new and perhaps more comprehensive threats and risks management framework, in order to ensure safety, resilience

No	Paper No.	Abstract
		and asset values under their possessions. This paper presents a slice of the current situation in Vietnam in terms of CII (assets) management, focusing on cybersecurity aspects using nontraditional security analytic framework, developed by (Hoang et al., 2022) that has been applied in areas such as finance (Nguyen and Hoang Dinh, 2021), marketing (Hoang, Ta and Bui, 2022), engineering and technological security (Hoang and Nguyen, 2023)* . The paper also explores how several large enterprises and organizations of Vietnam perceive cyber threats and risks as well as their opinions on CS importance.
49	113	**Exploring the Challenges and Opportunities in Operationalising ICTbased Asset Management Maintenance Practices within Emerging Telecom Industry: – The Case of Nigeria Telecom.** Telecommunication network operators in emerging markets are operating in an increasingly demanding environment due to deficiencies in basic infrastructure, increased internet penetration, regulatory policies and growth in subscribers' connections and usage. In several instances, these demands, and subscriber growth have translated into the deployment of physical assets, which leads to enormous tension in the telecom base transceiver stations (BTS) that house the assets. Under these conditions, network operators need to operate and manage their infrastructure or assets efficiently to add to the overall performance of their operations and customer satisfaction. However, several studies have not provided a clear perspective, as there is no developed maintenance strategy concerning asset management practices across the emerging telecoms environment. Therefore, the research aims to explore current asset management and maintenance practices across the Nigeria telecoms environment and then suggest measures and approaches to addressing the research context. A survey case study strategy was adopted using a mixed-method approach and a technology acceptance model (TAM2) to define the most efficient management and maintenance intervention required to maximize the asset lifecycle and sustainable network service. The study findings intend to show that asset management and maintenance practices in Nigeria's telecoms environment face critical management and maintenance issues. Because physical assets must be managed and maintained strategically, weak monitoring and non-application of an ICT-powered predictive-based asset management model for asset visibility are critical challenges in the researched domain. These results could explain how a predictive and human-centric approach's ICT capabilities addresses and enhance asset problems and performance.

No	Paper No.	Abstract
50	114	**Development Perspective of Electrostatic Machine** **Abstract.** The electromagnetic motors have been dominated the industrial and house-hold market so far. The main cost of these machines stems from metallic ma-terials, iron cores and/or permanent magnets. The problems associated with these machines are the increasing cost and the lower availability of rare earth for producing permanent magnet. In addition, the production of the metals such as aluminium, copper heavily deteriorates the environment by the emission of industrial wastes. This paper presents a development perspective of the electrostatic machine including the general design and analysis of different machine topologies and their applications.
51	115	**Integrating Blockchain Technology to Manage Telecommunications Infrastructure: A Case Study** The Covid-19 pandemic had a profound impact on all sectors of society. In the telecommunications sectors, the pandemic led to a massive increase in demand for mobile communication and network services. Among other things, the pandemic also created the need for investment to rapidly expand existing infrastructure as well as to establish new capacity in telecommunications assets systems to keep track of the evolution in, for instance, subscriber growth and internet usage. The rapid evolution boosted by the pandemic raises questions about how to manage the systems of assets such as, equipment, machinery and infrastructural facilities that underpin the telecommunications sector. A particular question is how to deploy 4IR technologies to facilitate the management of rapidly expanding and evolutionary assets in the telecommunications sector. This paper discusses an exploratory case study on the application of blockchain technology to facilitate the management of telecommunications infrastructure.
52	116	**Assessment design before and after the emergence of generative AI**

No	Paper No.	Abstract
		The birth of generative AI has had a profound impact on assessment design in the field of software programming courses. This study investigates the changes in assessment methodologies before and after the emergence of generative AI technology. Traditional assessment approaches in programming courses often involved manual code reviews, quizzes, and practical assignments. However, with the advent of generative AI, new assessment methods have emerged, leveraging automated code analysis, intelligent feedback generation, and adaptive testing. This abstract highlights the paradigm shift in assessment design, emphasizing the potential benefits of generative AI in enhancing assessment accuracy, efficiency, and personalized learning experiences for software programming students. By examining the evolution of assessment practices in the context of generative AI, this study aims to contribute to the ongoing discussions on the integration of AI technologies in software programming education.
53	117	**Remote Identification of Mining Dump Truck Operations Based on Vibration Signal** A mining dump truck is one of the most essential pieces of equipment for transportation in an open-cast mine. The trucks carry out cyclic material movement operations such as loading at excavation points, hauling material on mine roads, and unloading at dumping sites. While performing these operations, the body of dump trucks is impacted by loading and roads of mines which cause damage to them over time. This paper shows the remote operation monitoring of dump trucks based on vibration sensors mounted on different parts of it. The vibrations sensors are installed on the left-right frame, cabin floor, and engine of the dump truck. Vibration is recorded from dump truck when they carry out these mining operations and is transferred to the cloud simultaneously. These processes are accomplished with the help of a specifically designed system. Data in the cloud is extracted remotely and analysed to detect loading, dumping, hauling, and idling operations using time features and frequency domain features of the signal. Kalman filters are used to denoise the measured vibration signals and remove any outliers in the estimated features. Also, it is found that frames and cabin floor vibration help identify the mining operations more effectively than engine vibration, where loading and hauling operations are detected in low-frequency regions. The experiments were conducted in real-time in an open-cast coal mine in eastern India

No	Paper No.	Abstract
54	118	**Exploring Asset Management Performance: A Knowledge Management Perspective** Asset management is a crucial index for the yearly performance evaluation of state-owned higher education institutions (HEIs) in China. Although studies have investigated asset management in HEIs from various perspectives, few have explored the predictive role of knowledge conversion in asset management performance. To fill this research gap, this study embraces structural equation modelling analysis to identify the relationship between knowledge conversion and asset management at both the institutional and individual levels. It also explores institutional and personal enablers of implementing knowledge management to contribute to HEIs' asset management performance. The analysis was based on questionnaires collected from university leadership organizations, administrative officers, and academic faculty members from 60 universities across China. The findings show that a collaborative culture advocates for knowledge contribution through the application of human interactions in HEIs' asset management mechanisms. Knowledge management facilitates personal motivation and the promotion of asset management in HEIs' performance evaluation.
55	119	**Fault Diagnosis based on Graph Convolutional Network for Industrial Robot Harmonic Reducers** With the widespread application of industrial robots in automated production, strengthening health monitoring and ensuring reliability and accuracy through fault diagnosis have become crucial. Harmonic reducers, which are critical transmission components in industrial robots, can experience faults that result in performance degradation or downtime, making accurate fault diagnosis essential. In this study, we propose a graph convolution-based approach that constructs a graph structure from the vibration signal data of harmonic reducers and applies graph convolutional networks (GCNs) for end-to-end fault diagnosis. We validated our method through experiments using real-world collected data, and conducted comparative experiments on different graph construction methods, demonstrating the feasibility and effectiveness of our approach. Furthermore, we discuss the potential future prospects of the proposed method.
56	120	**Intelligent fault diagnosis method of robot joint—harmonic reducer**

No	Paper No.	Abstract
		As the core component of a robot, the harmonic reducer is a high precision, high-torque transmission device that has a wide range of applications in the field of robotics. However, owing to the complex internal structure of the harmonic reducer and the large amount of friction and heat generated during operation, it is more prone to failure unexpected which has a significant impact on the operation of the robot. Therefore, a fault diagnosis method based on empirical mode decomposition (EMD) and support vector machine (SVM) was proposed. First, the fault data are decomposed by EMD, and the eligible IMFs are screened for reconstruction according to the steepness value of each eigenmode function (IMF) and the number of correlations with the signal before decomposition. Second, the reconstructed signal is band-pass filtered according to the recommended center frequency and bandwidth, and the square envelope is demodulated after filtering. Third, the time-domain and frequency-domain features of the square envelope signal are input into the SVM classifier for training and testing and obtain classification results. Finally, a comparative experiment is conducted, and the comparison results show that the proposed method has high accuracy for the fault identification of the harmonic reducer, which can provide theoretical support for ensuring the safe operation of the harmonic reducer and robot.
57	122	**Integrating Predictive Analytics with RAMS Analysis to Quantify Performance Improvement** Traditional RAMS analyses such as FMEA and RBD rely on a mix of work history and the assessment of experienced personnel to estimate probability of failure of components within systems. In this paper we present an improved approach to manage delay data from equipment downtime logs into probability density functions that assist with quantifying potential savings. The analytics include data conditioning to classify types of faults and support standard Weibull calculations for MTTR and MTBF to classify failure modes to specific blocks representing components within the system. The approach relies on a data model that handles a wide range of codification schemas with plain English interpreters to convert commentary to failure modes which can then be allocated to the blocks. The outcome of this work is the automated treatment of the many problems impacting complex systems of equipment, rolling up component-level issues to the system level and advising on reliability improvements.
58	123	**Optimisation of Asset Management with Qualitative Risk Profiling**

No	Paper No.	Abstract
		Assessing the risk in physical assets considers their multi-criteria criticality and the likelihood that they will no longer function as intended, thereby realising risk. Quantifying this risk provides an important ranking scheme for prioritising investment and additional work on the assets to manage down the likelihood of the worst-case outcome. Criticality ranking determines this outcome for a range of criteria and considers mitigating factors which are typically investments in control, redundancy of operation and fail-safe measures. The more complex consideration is the probability that the worst-case risk may be realised. This may be calculated either as deterministic measures associated with physical degradation of the asset or probabilistic estimates based on commonly collected maintenance and inspection information. This paper examines practical implementation of these considerations in complex facilities which comprise thousands of assets. Consideration is given to how risk may be better managed once it is quantified.
59	124	**Evaluation of the effect of different factors on pavement roughness, rutting and cracking; A case study** A well-maintained transportation infrastructure system is an indicator of a wellfunctioning economy. Road degradation is often considered to be unpredictable due to the effect of various influential factors including environmental and geographical conditions. Even though, the real trends of the pavement deterioration under different combinations of environmental and geographic factors have not been much explored and they are not implemented in the optimum pavement designs. Therefore, this study examines the effect of different factors when considered individually and collectively on the performance of the flexible roads based on real field data of IRI, rut depth and crack area measurements. The distribution of values of each distress in two road clusters; urban and rural is studied to identify the behavioural patterns with various external factors including rainfall, terrain type and drainage condition. The study is based on the monitoring data collected over 15 years across Australia. 60 unique combinations of factors including 5 different rainfall classes, 4 terrain types and 3 drainage conditions are analysed to identify the trends in the spatial distribution of each distress. The results reveal clear trends of IRI, rut depth and crack area values with rainfall, terrain type and drainage condition of the road when considered as individual factors while the combined effects of different factors show contradictory behaviours.

No	Paper No.	Abstract
		The results can be used in the pavement maintenance decisions and in the design and construction of the new road sections.
60	126	**Incorporating environmental impacts and end-of-life potentials for sustainable asset management decision making** Civil infrastructure sector contributes up to 40% of global annual carbon emissions. Different sustainability rating systems and circular indices are currently being developed to quantify and reduce emissions in the industry. While a methodology to quantify carbon emissions considering the entire life cycle of the built environment has yet to be fully developed. A better approach would optimize the management of civil infrastructure assets by focusing on the life cycle emissions and end-of-life impacts to deliver a circular economy. This paper proposes a novel index for capturing the whole-life-cycle environmental impact and circularity of an infrastructure asset. The integrated methodology to develop the Digital sustainability index (DSI) from material passports is presented by conducting a comprehensive literature study. For the demonstration of this index, a methodological framework has been constructed. This novel index will enable building owners and managing authorities to adopt strategic initiatives for reducing emissions associated with the life cycle of building assets with a clear knowledge of quantified benefits in mind.
61	128	**Vibration Analysis and Troubleshooting of Large Synchronous Motors and Generators: Common Faults and Solutions** Large synchronous motors and generators can experience high vibration due to various mechanical and electrical faults. This paper focuses on mechanical faults such as unbalance, misalignment, mechanical looseness, structural resonance, oil instability (i.e., oil whirl or insufficient oil flow), rubbing, and bearing wear. Vibration can be measured using accelerometers located on the bearing housing or proximity probes for journal bearings. These sensors can serve as protection sys-tems, tripping the machine when high vibration is detected, or provide condition monitoring services and machine diagnostics. Common vibration analysis tools

No	Paper No.	Abstract
		in-clude FFT spectrum, waterfall plot, orbit plot, shaft centreline plot, polar plot, and bode plot, which can be generated using computer software. This paper presents a list of the most common causes of high vibration in large synchronous motors and generators, including recommendations for checks to diagnose the issue and correc-tive actions to solve the problem. Industrial examples will also be provided. The findings of this study can help asset managers and maintenance professionals trou-bleshoot and resolve high vibration issues in large synchronous motors and genera-tors, improving their reliability and extending their lifespan.
62	129	**A Review of Personalised Gamified Applications.** Human factors play a critical role in asset management, impacting the effectiveness and efficiency of asset management processes. It encompasses the psychological, social, and organization aspects that influence how individuals in-teract with assets, systems, and processes in asset management. In the transporta-tion sector, human error contributes significantly to crashes including the use of alcohol, failure to use a seat belt, and risky or aggressive driving. Gamification features serve to inform the driver about their driving characteristics (acceleration, braking, cornering, speeding, idling etc.) in an engaging format. To be effective, gamification features in an eco-driving application must support the driver's atti-tudes, subjective norms, and perceived behavioral control toward eco-driving. Al-so not understood is whether the relative importance of these factors changes ac-cording to personality type. Accordingly, there is a need to develop gamification tailored to the driver's eco-driving behavioral intention. This work presents a re-view of existing research on designing personalized gamification interfaces. In the field of asset management, personalized gamification may make eco-drive pro-grams or even improve training programs to be more effective and engaging.
63	131	**Digital Transformation in Higher Education with Support from Large Language Models: A Multiple Perspective Approach to Teaching Engineering Courses** This study evaluates the efficacy of ChatGPT as an AI teaching and learn-ing support tool in an introductory integrated circuit systems course at a higher ed-ucation institution in an Asian country. Various question types were completed, and ChatGPT's responses were assessed to gain valuable insights for further investiga-tion.

No	Paper No.	Abstract
		The objective is to assess ChatGPT's ability to provide insights, personalized support, and interactive learning experiences in engineering education. The study includes the evaluation and reflection of different stakeholders: students, lecturers, and engineers. The findings of this study shed light on the benefits and limitations of ChatGPT as an AI tool, paving the way for innovative learning approaches in technical disciplines. Furthermore, the study contributes to our understanding of how digital transformation is likely to unfold in the education sector. Keywords: ChatGPT, Generative AI, Digital transformation, engineering educa-tion, tutorial design, peer-assisted learning, AI-assisted learning, integrated circuit education.
64	132	**Increasing Asset Management Capabilities of Local Authorities in Sri Lanka** Infrastructure planning, management and budgeting, including establishing and managing of infrastructure inventory has been quite a challenge in local authorities of Sri Lanka and one can see a lot of gaps, duplication, and wastage of already limited resources in the provision of services to the community. A robust Asset Management System has been the longstanding need for the Local Authorities to efficiently plan and manage the local infrastructure. But their capacity in this regard is much wanting and there has been a need for both (i) establishing an efficient and user-friendly system and (ii) building the capacities to operate and manage the system. Government of Sri Lanka has been making a concerted effort to improve asset management practices. One such successful effort was securing the support of RMIT University for digital transformation of the asset management practice in Sri Lanka enabling capacity building not only in optimized management of infrastructure assets but also enabling digital transformation of the practice. A pilot project to develop the system and build capacities in asset management of local authorities has just been completed. The Government plans to expand the capabilities of other local authorities based on this experience. The paper presents the current scenario of Asset Management in Local Authorities of Sri Lanka and efforts of the Ministry in-charge of Local Government in increasing the capacities of Local Governments in establishing and working on sustainable inventory and asset management systems, through an Asian Development Bank funded project. The paper will present the current practice, identification of the best appropriate level of

No	Paper No.	Abstract
		digital capability for the authorities and design and implementation of the software platform in seven local authorities as a pilot. The training program deployed and the benefits of the project as observed by the governing authorities will also be presented.
65	133	**Explore an optimized trade-off for retrofitting measures in office buildings.** Abstract: Buildings account for over one-third of global energy consumption and emissions. Reduction in building energy consumption is feasible by implementing active and passive retrofitting strategies. However, the rise of high-performance buildings poses a unique challenge to understanding retrofit measures and their relative efficiency adopted in the existing buildings. Conventional analysis of energy audits is insufficient to have an in-depth insight into improved efficiency measures. This study addresses this issue with a holistic approach to diagnosing faults by installing an energy monitoring system. An energy savings model has been performed per AS/NZS 3598:2000 standard to represent building energy use in the operational phase. The critical path method (CPM) is defined based on retrofitting strategies' installation cost and annual savings. Installation of a new chiller, variable speed drive (VSD) pump and fan coils are identified as the potential energy efficiency measures for retrofitting. Financial indicators of retrofitting variables facilitate estimating and identifying energy savings, informing the decision-making process during retrofitting. Furthermore, the study also addresses the associated risks with the installation process to the development of best practices in retrofitting the existing building.
66	135	**Managing Highway Pavement Skid Saves Lives** Skid resistance is a critical pavement surface characteristic associated with road user safety, especially during wet weather conditions. There is an inverse correlation between roadway friction levels and the number of wet weather crashes: as skid resistance decreases, the number of wet weather crashes increases. However, skid remains a cumbersome characteristic to measure at a network level due to the inefficiencies of the measuring equipment. These limitations have created the need for an alternative method capable of predicting pavement friction continuously using readily available information, such as pavement texture. This study

No	Paper No.	Abstract
		evaluated thirty highway pavement sections in the state of Texas that cover a vast range of pavement surfaces, textures, and friction levels. The data were used to create machine learning models that use pavement texture to accurately predict surface information and friction. The model estimates skid in terms of grip number (GN) on the major types of flexible pavements present in Central Texas with an accuracy in the order of 80%. The innovative way in which machine learning algorithms are used in this study has the potential to allow highway agencies to obtain full network coverage of reliable estimates for friction.
67	136	**Indus TANTRA: An Indigenous, Modular, Scalable Platform for Industry 4.0 Implementation** Industry 4.0 protocols involve integration of physical systems with cyber technology for enhanced productivity and quality assurance. They provide the bridge between Operational Technology (OT) and Information Technology (IT). Operational Technology (OT), concerned with Physical Processes, involves Control Systems like PLC, DCS, SCADA etc., Hardened PCs and Servers, Industrial Networks, Sensors (temperature, pressure etc.), Cameras, Scanners, Embedded Systems (robots, analylzers), etc. Information Technology (IT) is concerned with Computing operations, Business Applications, Data Analysis, Storage Systems, and other hard and soft elements for managing information. Several hardware and software constraints, limit OT and IT integration. In this paper we describe implementation of Industry 4.0 protocols for a manufacturing unit. This is achieved through development of an indigenous platform, christened IndusTANTRA, which is modular and scalable and attempts to provide an end-to-end solution to Monitor, Manage and Control capabilities for CNC/Robotic Machines; possesses flexibility to incorporate Manual Machines monitoring using indigenously built add-on hardware, and capabilities for RFID enabled material tracking, Human Machine Interfacing, Indigenous Scheduling and ERP integration, and AI/ML powered Custom Analytics.