College of Engineering
PhD in Engineering Systems Management (ESM)

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BArch, American University of Sharjah | MUP, American University of Sharjah

Dissertation: Pathways to Carbon Neutrality: A Decision Support Tool for Optimizing Carbon Sequestration of Desert Plants - A Sharjah Case Study

Supervisor: Dr. Adil Kahwosh Abid Tamimi

Abstract:

Urban carbon neutrality in desert climate cities requires a strategic approach to vegetation planning that prioritizes species not only by carbon sequestration potential but also by survival performance under harsh desert conditions. This dissertation develops an integrated AHP–TOPSIS–GIS–Goal Programming decision-support framework to identify, rank and optimally allocate desert-adapted plant species in Sharjah's urban landscape under spatial, ecological and budgetary constraints.

The study begins by defining evaluation criteria through literature review and institutional policy analysis, structured under biological, environmental and spatial management dimensions. An Analytic Hierarchy Process (AHP) survey was administered to derive expert-based priority weights, where resistance (23.43%), climate tolerance (13.17%), and age & lifespan (12.95%) emerged as the most influential determinants of species suitability. These weights were then integrated into a TOPSIS-based ranking of alternative species, where Tamarindus indica, Vachellia seyal, Ziziphus mauritiana and Nerium oleander ranked highest due to their longevity, canopy potential and high tolerance to salinity and drought.

Following the ranking stage, GIS-based carbon stock analysis using KhalifaSAT imagery and biomass estimation models quantified the current sequestration performance of existing urban vegetation, establishing a baseline for carbon offset potential across Sharjah's urban grid. The final phase formulates a Goal Programming optimization model that allocates the top-ranked species across designated planting zones while satisfying constraints related to available area, financial limits and species diversity thresholds to prevent ecological imbalance.

The resulting framework functions as a replicable decision-support tool, embedding expert judgment, quantitative ranking, spatial intelligence and optimization logic into a unified planning process. By aligning species selection with site-specific suitability and municipal constraints, this research provides a pathway for evidence-based urban greening planning to enhance Sharjah's contribution to carbon neutrality targets through optimized vegetation deployment in desert urban environments.

Inas Taisier Al Khatib

BS, Abu Dhabi University | MS, National University of Ireland

Dissertation: WELL-AI Platform: A SMART Blockchain Solution for Eliminating Bad Medical Debt

Supervisor: Dr. Malick Mody Ndiaye

Abstract:

Bad debt is unpaid medical costs that a hospital has attempted but been unable to collect. It is the term used to describe debt owed by patients who are not eligible for financial aid since hospitals are generally not allowed to pursue collections on invoices that qualify for charity treatment or financial assistance. When a patient's current income or resources are insufficient to cover their medical expenses, they may utilize credit cards, loans or mortgages to make the payments; work out a payment plan with hospitals and healthcare providers; or choose not to pay the bills at all. Debt may harm one's physical and emotional well-being, appear to prevent one from seeking care later on, and, as some have suggested, be a social determinant of health.

Connecting the healthcare sector with humanitarian initiatives to address medical debt represents a complex global challenge that calls for innovative solutions. Literature associated with survey results and insights from subject matter experts affirm a distinct need for a SMART (AI-driven) blockchain healthcare platform. This platform would enable secure, direct connections between beneficiaries and philanthropists, facilitating the safe exchange of patient medical data and bills while ensuring that beneficiary criteria align with philanthropist requirements.

Using a Decentralized Autonomous Organization (DAO) framework for this solution enables seamless integration of donation management, donor-beneficiary matching, and donor validation by utilizing decentralized governance and smart contract automation. The DAO establishes policies and criteria for these processes, allowing members to propose and vote on modifications, ensuring inclusivity and transparency. Smart contracts enforce the established rules by automating tasks such as fund distribution, executing matching algorithms and verifying donor credentials, all while preserving an immutable audit trail. This approach improves trust, efficiency and accountability across all platform operations.

Wadhah Saif Alzahmi

BS, Higher Colleges of Technology – Sharjah Women's College | MS, Mohammed Bin Rashid School of Government

Dissertation: Digital Spare Parts Ecosystem: A Strategic Approach to Industrial Advancement
Supervisor: Dr. Abdulrahim Shamayleh

Abstract:

Spare parts are essential for maintaining the smooth operations of industrial processes. However, traditional stock-based management methods are becoming less effective due to unpredictable demand, complex global supply chains and shorter product lifecycles. These challenges often result in higher costs, inefficiencies, and increased risks of downtime and obsolescence. Emerging digital technologies, including additive manufacturing (AM), digital twins and blockchain, have the potential to transform Spare Parts Management (SPM) by making it more flexible, data-driven and on-demand. At the center of this transformation lies the concept of Digital Spare Parts (DSP). Despite growing interest, the literature on DSP remains fragmented, marked by conceptual inconsistency, sectoral silos and methodological narrowness that limit coherence and large-scale applicability. This research aims to address this gap by developing and validating a DSP Ecosystem model that views DSP adoption not as a matter of adopting one technology, but as a transformation of the entire ecosystem.

Using a mixed-methods design, the study began by refining and validating the ecosystem enablers through expert interviews and then use Structural Equation Modeling (SEM) to map their interdependencies. The results show that DSP adoption depends less on individual technologies and more on the systemic alignment of different dimensions. The study also conducted a gap analysis, an urgency–feasibility assessment and an impact–effort matrix, which informed the design of strategic actions at both the organizational and national levels. The outcome of all of the analysis resulted in the development of the Decision Support Tool (DST), which organizations can use to assess their readiness for DSP adoption.

This research contributes to both theory and practice. It presents the first empirically grounded ecosystem assessment for DSP adoption and delivers a practical DST that enables policymakers and firms to assess their readiness for DSP adoption. Ultimately, this study advances the conversation on DSP, moving it from promise to practice and positioning it as a cornerstone of industrial resilience, competitiveness and sustainability in the digital age.

Noorhan Ahmed Hany Assal

BS, American University of Sharjah | MEngMgmt, University of Wollongong in Dubai

Dissertation: Urbanization and Coastal Water Quality: An Integrated Assessment
Supervisor: Dr. Fatin Samara

Abstract:

Urbanization has profound impacts on coastal water quality, altering hydrological processes, increasing pollutant loads and influencing ecological balance. This study examines the urbanization-driven changes in water quality at Khalid Khor in Sharjah, UAE, aiming to assess historical trends, identify key influencing factors and propose mitigation strategies. By integrating water quality assessments, GIS-based land-use change analysis, statistical modeling and expert opinions, this research develops a comprehensive understanding of how urban expansion affects the water quality of this critical coastal system.

The study begins by reviewing the broader implications of urbanization on water quality, identifying key research gaps and formulating research questions to guide the investigation. Historical water quality data, including physical, chemical and biological parameters, are analyzed to track changes over time. Statistical tools such as Pearson correlation and the Kruskal-Walli's test are employed to assess the significance of observed variations, while GIS-based land-use change analysis helps establish links between urban development and water quality deterioration. A tailored Water Quality Index (WQI) is developed specifically for UAE coastal waters, incorporating expert input to ensure the index reflects regional environmental and hydrological conditions.

The role of urbanization factors, including land-use patterns, population growth, infrastructure development and runoff management, is examined in correlation with WQI trends. Predictive models are constructed to anticipate future changes in water quality, integrating environmental and economic parameters to provide a robust framework for decision-making. The study further explores the time lag between urban expansion and its impact on WQI, offering insights into the delayed effects of development on coastal water bodies. By examining rainfall, flood patterns and runoff contributions, this research highlights the compounding influence of climate change and extreme weather events on urban water quality dynamics.

A key outcome of this research is the formulation of best practices for mitigating the adverse effects of urbanization on water quality. These include improved stormwater management, stricter land-use policies, enhanced wastewater treatment and sustainable urban planning strategies. Recommendations are drawn from global best practices and tailored to the specific environmental context of Khalid Khor, ensuring their applicability in the UAE and other rapidly urbanizing coastal regions. The findings emphasize the importance of integrating water-sensitive urban design with policy interventions to minimize the long-term environmental consequences of urban expansion.

This research contributes to the growing body of knowledge on coastal water management by providing empirical evidence of urbanization's impact on water quality and proposing actionable mitigation strategies. The insights gained from this study serve as a valuable resource for urban planners, environmental policymakers and water resource managers seeking to balance development with ecological sustainability. By addressing urbanization's challenges through scientific assessment and strategic planning, this study paves the way for more resilient and environmentally sustainable coastal management practices.

Maram Wahed Helmy

BS, American University of Ras Al Khaimah | MS, American University of Sharjah

Dissertation: Dynamic Adaptive Video Streaming Over HTTP using Deep Learning Techniques
Supervisors: Dr. Mohamed S. Hassan, Dr. Usman Tariq, Dr. Mahmoud H. Ismail

Abstract:

Maintaining a high Quality of Experience (QoE) in adaptive video streaming remains a significant challenge in the presence of dynamic and heterogeneous network environments. Traditional Adaptive Bitrate (ABR) algorithms in Dynamic Adaptive Streaming over HTTP (DASH) often rely on basic throughput estimation methods that struggle

to adapt to rapid network fluctuations caused by mobility and handoff events. These limitations lead to frequent playback interruptions, abrupt quality changes and overall QoE degradation. This dissertation proposes a novel deep learning-based framework to enhance ABR decision-making by predicting future throughput with greater accuracy and responsiveness. A transformer-based throughput prediction model is developed to capture the complex temporal dependencies in network dynamics. The predicted throughput feeds into two novel intelligent modules: a mobility-aware throughput prediction system (MATH-P) that combines mobility classification with dynamic bandwidth forecasting, and a handoff-aware prediction engine (HATH-P) that anticipates transitions between access networks (e.g., 4G and 5G) to ensure seamless adaptation during handoff events. In addition, three novel ABR algorithms are introduced using deep reinforcement learning (DRL): a throughput-aware algorithm (THA-P) that directly incorporates predicted throughput into the decision process, a mobility-aware algorithm (MATH-P ABR) that adapts to user movement patterns, and a handoff-aware algorithm (HATH-P ABR) that optimizes decisions during access network transitions. These DRL-based agents are trained and evaluated in realistic mobility and network scenarios. Extensive experiments demonstrate that the proposed methods significantly outperform both heuristic and learning-based ABR algorithms across key QoE metrics, achieving higher bitrate utility, reduced rebuffering durations, smoother bitrate transitions and improved overall playback quality. The contributions of this work offer a robust and intelligent approach to ABR in mobile and heterogeneous environments, paving the way for next-generation adaptive streaming solutions.

Fatemeh Marzbani

BS, Shiraz University | MS, American University of Sharjah

Dissertation: Optimal Participation of Virtual Power Plants in Energy Markets

Supervisors: Dr. Ahmed Helmy Osman-Ahmed, Dr. Mohamed Said Abdou Hassan

Abstract:

The global transition toward cleaner energy systems has significantly accelerated the integration of renewable energy sources into modern power networks. This shift has driven the evolution from conventional power systems to smart grids. However, smart grids often lack the flexibility required to manage the variability and intermittency introduced by large-scale RES deployment. As a result, there is an increasing need for more advanced and adaptive energy management approaches. In this context, virtual power plants have emerged as a promising solution. By leveraging advanced communication and control technologies, virtual power plants enable the coordinated operation of distributed energy resources, thereby enhancing system flexibility, resilience and efficiency. Moreover, the growing participation of prosumers, the decentralization of energy generation and the evolution of electricity markets toward liberalized models have reinforced the necessity for robust and intelligent virtual power plants-based energy management frameworks.

This dissertation presents a hierarchical, data-driven decision-making framework for the optimal operation, coordination and market participation of virtual power plants. The proposed framework comprises three interconnected stages. In the first stage, a super learner-based ensemble model is developed to improve forecasting accuracy for key VPP parameters, including load, renewable generation and electricity prices. This predictive layer effectively addresses multi-source uncertainty and strengthens the reliability of operational planning. The second stage introduces a feature-driven deep K-means clustering technique for forming virtual power plants dynamically based on both topological and operational characteristics. In the third stage, a two-level optimization approach is implemented, which consists of system-level scheduling and electricity trading. Two trading mechanisms are explored: a cost-minimizing bilateral model and a bonus-based market-oriented mechanism that incentivizes inter-virtual power plants collaboration. The framework is evaluated through a detailed case study using a modified IEEE 33-bus distribution system and real-world hourly data. The results indicate substantial improvements in forecasting accuracy, operational cost savings, and enhanced coordination across virtual power plants. Additionally, the proposed trading strategies facilitate the use of surplus renewable energy, thereby reducing curtailment and minimizing grid imports. These outcomes contribute to both economic efficiency and emissions reduction. Overall, the findings demonstrate that the proposed framework is a practical and adaptable solution for intelligent energy management in decentralized and dynamic power systems.