



2nd International conference

THE POWER OF TECHNOLOGY: SHAPING THE FUTURE OF ENGINEERING



23 DECEMBER 2025





WELCOME MESSAGE

It is a pleasure to welcome you to the Second Conference: The Power of Technology, an academic forum dedicated to exploring the transformative role of technology in shaping contemporary practices, research, and future directions.

Building on the success of the first edition, this second conference reflects our continued commitment to advancing scientific dialogue on how technological innovation influences knowledge production, professional practice, and societal development. Technology today is not merely a tool; it is a driving force that reshapes methodologies, redefines boundaries, and opens new horizons across disciplines.

This conference brings together researchers, academics, and professionals to critically examine emerging technologies, share applied research, and discuss their opportunities, challenges, and ethical implications. Through keynote lectures, technical sessions, and focused discussions, we aim to create a space for meaningful exchange that bridges theory and practice and encourages interdisciplinary collaboration.

We believe that such dialogue is essential to understanding the true power of technology and to guiding its responsible and impactful use in addressing current and future challenges.

I would like to extend my sincere appreciation to all speakers, contributors, and organizing team members whose efforts have made this conference possible. We also thank all participants for their engagement and valuable contributions.

Conference Chair

Prof. Zeinab Feisal



ABOUT THE ORGANIZING INSTITUTION

BENHA FACULTY OF ENGINEERING (BFE)

Established in 1988, the Faculty of Engineering at Benha University is a leading academic institution committed to excellence in engineering education, research, and community engagement. The Faculty offers diverse engineering programs that combine strong theoretical foundations with applied learning, while continuously updating curricula to align with technological advancement and international standards.

Through organizing scientific conferences and academic initiatives—such as The Power of Technology conference series—the Faculty seeks to promote knowledge exchange, foster innovation, and encourage meaningful dialogue on the evolving role of technology in engineering and related fields. The Faculty is proud to host the second edition of this conference, reaffirming its commitment to supporting scientific research and responsible technological development.



CONFERENCE OVERVIEW

Introduction

The Power of Technology Conference serves as an interdisciplinary academic platform that explores the transformative impact of technology on engineering education, research, and professional practice. The second edition of the conference builds upon the success of its inaugural event, bringing together scholars, researchers, and industry experts to discuss how emerging technologies are reshaping engineering disciplines and contributing to sustainable development.

The conference program integrates keynote lectures, technical sessions, workshops, and research presentations covering a wide range of engineering fields, including civil, architectural, electrical, mechanical engineering, and basic sciences. This structure encourages knowledge exchange, critical discussion, and interdisciplinary collaboration.

Objectives

The conference aims to:

- **Examine** the role of advanced technologies in shaping the future of engineering and scientific research.
- **Provide** a platform for researchers and professionals to present innovative studies and applied solutions.
- **Encourage** interdisciplinary dialogue between different engineering disciplines and related fields.
- **Bridge the gap** between academic research and practical applications in industry and society.
- **Support** young researchers and postgraduate students by offering opportunities for scientific presentation and discussion.

Relevance to the Sustainable Development Goals (SDGs) and Egypt Vision 2030

The Power of Technology Conference is closely aligned with the United Nations Sustainable Development Goals (SDGs), recognizing technology as a key enabler for sustainable development, economic growth, and social well-being.

The conference addresses the role of engineering and technological innovation in providing practical solutions to pressing global and national challenges.

The conference particularly contributes to:

- **SDG 4 (Quality Education)** by promoting advanced engineering education, research dissemination, and capacity building for students and young researchers.
- **SDG 7 (Affordable and Clean Energy)** through discussions on energy technologies, efficiency, and sustainable systems
- **SDG 9 (Industry, Innovation, and Infrastructure)** by highlighting innovation-driven engineering practices, smart infrastructure, and Industry 4.0 applications.
- **SDG 11 (Sustainable Cities and Communities)** Research related to urban development, smart cities, and resilient design.
- **SDG 12 (Responsible Consumption and Production)** Environmentally focused studies
- **SDG 13 (Climate Action)** promoting the use of advanced technologies and engineering innovation to address climate-related challenges. Through research presentations, technical sessions, and interdisciplinary discussions, the conference highlights solutions that support climate mitigation and adaptation, including energy-efficient systems, sustainable construction methods, smart infrastructure, and climate-resilient engineering practices.
- **SDG 17 (Partnerships for the Goals)** by fostering collaboration among academic institutions, research centers, and supporting companies.





Urban Innovation and Sustainability

Relevance to the Sustainable Development Goals (SDGs) and Egypt Vision 2030

At the national level, the conference aligns with Egypt Vision 2030, which emphasizes knowledge-based development, technological innovation, digital transformation, and sustainable growth. By fostering collaboration between academia, research institutions, and industry, the conference supports Egypt's strategic goals of enhancing scientific research, strengthening innovation ecosystems, and advancing sustainable engineering solutions that respond to national development priorities.

Through its focus on technology-driven research and interdisciplinary dialogue, the conference reinforces the role of engineering as a cornerstone for achieving sustainable development objectives and realizing Egypt's long-term vision for a resilient and competitive future.





INTRODUCTION

Technology has become a central force shaping contemporary societies and redefining the future of engineering. It no longer functions merely as a set of tools, but as a driving framework that influences research methodologies, design processes, professional practice, and decision-making. Advances in areas such as artificial intelligence, digital modeling, sustainable energy systems, and smart infrastructure continue to expand the scope and impact of engineering disciplines.

In this context, the **Power of Technology** Conference provides an academic and professional platform for exploring the transformative role of technology in shaping the future of engineering. The conference fosters scientific exchange and interdisciplinary dialogue on how emerging technologies are reshaping engineering practices and addressing complex global and local challenges.

The **second edition of the conference** builds on the success of its inaugural event, reflecting an ongoing commitment to advancing knowledge, encouraging innovation, and strengthening collaboration between academia, research institutions, and industry. As technological change accelerates, such dialogue becomes increasingly important in supporting sustainable development, digital transformation, and resilient engineering solutions.

The conference brings together academics, researchers, professionals, and postgraduate students from diverse engineering disciplines, including civil, architectural, electrical, and mechanical engineering, as well as basic sciences. Through keynote lectures, technical sessions, workshops, and research presentations, participants engage with cutting-edge research and practical applications that bridge theory and practice.

A **central theme** of the conference is the **responsible use of technology** in supporting sustainable development and societal progress. Engineering innovation must balance efficiency, resilience, and environmental considerations while responding to national and global development priorities. By promoting technology-driven research and applied solutions, the conference highlights the role of engineering in shaping a sustainable and forward-looking future.

Furthermore, the conference emphasizes the importance of partnerships between academic institutions, research centers, and industry. Such collaboration enhances knowledge exchange, supports technology transfer, and strengthens innovation ecosystems capable of delivering long-term impact.

Through dialogue, collaboration, and critical engagement, the **Power of Technology Conference** aims to contribute to the development of an engineering culture that is responsive to rapid technological change and equipped to address the challenges of the future.

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PROGRAM

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CONFERENCE AT A GLANCE

09:00 – 10:00 | Registration

Participant registration and welcome, providing an opportunity for early networking and orientation.

10:00 – 10:30 | Opening Session

Official opening of the conference, including welcome addresses by university leadership and conference officials, outlining the conference objectives and its focus on the transformative power of technology in engineering.

10:20 – 10:30 | Institutional Presentation

Short video presentation introducing the Faculty of Engineering – Benha University, highlighting its academic mission, research activities, and technological initiatives.

10:30 – 11:30 | First Technical Session (Keynote Lecture)

A keynote lecture addressing national and strategic perspectives on technology-driven innovation and sustainable engineering practices.

11:30 – 11:50 | Break

11:50 – 13:30 | Second Technical Session (Invited Lectures)

A series of invited lectures focusing on emerging technologies, including artificial intelligence, digital twin applications, environmental and sustainable engineering, and advanced technological solutions.

13:30 – 14:30 | Honoring Ceremony

A special session dedicated to recognizing distinguished contributions

11:30 – 11:50 | Break

15:00 – 17:00 | Parallel Research Sessions and Workshops

Parallel sessions held across multiple halls, covering a wide range of engineering disciplines.

The conference concludes with informal networking and exchange among participants, speakers, and partners, reinforcing collaboration between academia, research institutions, and industry.

2nd International Conference
THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING

OPENING SESSION

Opening Session:

The opening session marked the official launch of the conference and featured a series of keynote addresses delivered by senior academic leaders. The session began with the opening address by the Conference Chair and Dean of the Faculty of Engineering, **prof. Zeinab Feisal** who highlighted the vision of the conference and emphasized the pivotal role of technology in advancing engineering education, scientific research, and sustainable development.

This was followed by a speech from the Conference Rapporteur prof. Ashraf Yahia and Vice Dean of post graduate studies, who outlined the conference objectives, program structure, and the importance of interdisciplinary collaboration in addressing contemporary technological challenges.

The opening session also included an address by **prof. Gehan Abdel Hadi**, the University Vice President, who emphasized the university's commitment to supporting scientific research, innovation, and strategic academic initiatives that align with national development priorities.



The session concluded with an honoring ceremony recognizing former Deans of the Faculty of Engineering, in appreciation of their distinguished leadership and contributions to the development of the Faculty and the advancement of engineering education.

2nd International Conference
THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING



KEYNOTE SPEAKERS

The Power of Technology Conference features a distinguished group of keynote speakers who are leaders in engineering, architecture, artificial intelligence, and sustainable development. Their lectures offer valuable insights into the role of technology and innovation in addressing contemporary challenges and shaping future professional and academic practices.

2nd International Conference
**THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING**

KEYNOTE SPEAKERS



Prof. Dr. Abdel-Khalek El-kady
Assistant Minister of Housing for
Technical Affairs



Prof. Dr. A. J. Han Vinck
Professor of Digital
Communications, University of
Duisburg-Essen, Germany, and
Former President of the IEEE
Information Theory Society



Prof. Dr. A. J. Han Vinck
Professor of Architecture and
Sustainable Urban Environment
and Founder of the Center for
Urban Environment Governance
and Sustainability at the Military
Technical College.



Assoc. Prof. Dr. Shinsuke Mori
Associate Professor, Department
of Chemical Science and
Technology, Institute of Science
Tokyo



Dr. Amr Al-Awamry
Associate Professor, Benha
University | CEO, BBI, chair in IEEE
SIGHT.



Prof. Dr. Ibrahim Madany
Professor of Environmental
Architecture and CEO of GAT.

LECTURE ON

“National Strategy in Urban Innovation and Sustainable Urban Planning”

Prof. Dr. Abdel-Khalek El-kady

Overview of the Lecture

This lecture provides an in-depth exploration of the national strategy for urban innovation and sustainable urban planning, emphasizing the transformative role of technology in shaping the future of cities. Prof. Dr. Abdel-Khalek El-Kady addresses the growing challenges faced by urban environments, including rapid population growth, climate change impacts, resource scarcity, infrastructure stress, and the need for resilient and inclusive urban systems. The lecture highlights how technological advancement has become a central driver in modern urban planning practices. It discusses the integration of smart technologies,



digital platforms, and data-driven tools to support evidence-based decision-making and improve urban efficiency. Key areas of focus include sustainable land-use planning, smart infrastructure systems, climate-responsive urban design, energy efficiency, and optimized resource management.

Prof. Dr. El-Kady emphasizes the importance of innovation in achieving sustainable urban development by linking planning strategies with national policies and long-term development visions. The lecture demonstrates how urban innovation can enhance economic competitiveness, improve environmental performance, and elevate quality of life, while ensuring social equity and accessibility within urban communities.

The session also addresses the alignment between national urban strategies and global sustainability frameworks, particularly the United Nations Sustainable Development Goals, with a focus on climate action and sustainable cities. It underlines the role of interdisciplinary collaboration among engineers, urban planners, architects, policymakers, and technology experts in translating strategic visions into practical, implementable solutions.

Concluding the lecture, Prof. Dr. Abdel-Khalek El-Kady stresses the need for adaptive planning approaches that embrace innovation, resilience, and sustainability as core principles. The lecture reinforces the idea that technology-enabled urban planning is essential for building future-ready cities capable of responding to evolving environmental, social, and economic challenges.

LECTURE ON

“Digital Twin Technology Applications in Egyptian Urbanism”

Prof. Dr. Mohammed Fahmy

Overview of the Lecture

This keynote lecture examines a range of advanced concepts related to urban management, governance, and sustainable heritage revitalization through the application of Digital Twin technologies. These applications represent some of the most recent and impactful developments in architectural and urban engineering sciences. The lecture adopts an applied research approach, systematically addressing key research questions and presenting selected international and Egyptian case studies to demonstrate practical implementation.



From this perspective, the keynote clarifies the concept of Urban Digital Twins as a critical emerging dimension that complements sustainable urban design, particularly for residential neighborhoods within the framework of Egypt's fifth-generation cities. Digital Twins are presented not only as technological tools, but also as strategic enablers for smart, sustainable urban governance.

The lecture outlines two main implementation tracks. The first focuses on the generation of Digital Twins for both new and existing cities as a foundation for smart urban management, governance, and continuous updating of urban plans. This approach relies on geo-referenced Building Information Modeling (BIM) at the neighborhood and city scale. In existing urban contexts, Digital Twins are developed using advanced surveying techniques, including aerial and terrestrial surveys and laser scanning, which can be translated into BIM and Heritage BIM (HBIM) models.

The second track addresses urban design dimensions rooted in courtyard urbanism and the regulation of urban compactness. It promotes housing models that respond to local climatic conditions and utilize local materials, aiming to achieve a strong urban identity while meeting environmental and economic sustainability standards.

In addition, the keynote highlights the role of Digital Twins as a vital tool for cultural tourism development in historic urban areas. Digital Twins support the documentation of historical layers, buildings, and tangible heritage fabrics, while also enabling the creation of immersive Virtual Reality (VR) and Augmented Reality (AR) experiences for tourism and education. This approach supports a balanced relationship between cultural tourism investment and the conservation and revitalization of architectural and urban heritage.

Overall, the lecture demonstrates how Digital Twin technologies can contribute to sustainable urban development, heritage conservation, and smart governance, in alignment with Egypt's Sustainable Development Vision 2030.

LECTURE ON

Shaping the Future: Cutting-Edge Directions in AI

Dr. Amr Al-Awamry

Overview of the Lecture

This keynote lecture presents a comprehensive overview of the transformative shifts currently reshaping the field of Artificial Intelligence, marking a transition from reactive generative systems to active, embodied, and scientifically integrated intelligent agents. The lecture frames this moment as a historical phase transition, moving beyond “Generative AI oracles” toward autonomous systems capable of reasoning, decision-making, and action in both digital and physical environments.

The keynote explores six major forces driving this transformation. It begins with the agentic revolution, highlighting the shift from fast,

pattern-based “System 1” processing to deliberative “System 2” reasoning enabled by advanced test-time computation and multi-agent workflows. These architectures distribute complex tasks across specialized agents, significantly improving reliability, scalability, and problem-solving performance.

The lecture then examines architectural innovation in AI models, addressing the computational limitations of traditional Transformer architectures. Emerging alternatives such as Selective State Space Models (SSMs) and hybrid architectures offer linear scaling, enabling efficient processing of long sequences and expanding AI’s applicability across complex data domains.

A key focus is placed on sustainable intelligence, emphasizing breakthroughs in 1-bit large language models and neuromorphic computing. These innovations dramatically reduce energy consumption and memory requirements, enabling AI deployment on edge devices and supporting environmentally responsible technological growth.

The keynote further highlights the rise of Embodied AI, particularly humanoid robotics, where Vision-Language-Action models allow machines to learn through observation, simulation, and natural language instruction. This shift enables adaptive physical systems capable of operating in real-world environments with increasing autonomy.

In the realm of scientific discovery, the lecture showcases how generative AI is revolutionizing biology and materials science by designing novel genetic systems and predicting millions of new materials, accelerating innovation through autonomous research loops.

Finally, the lecture addresses the geopolitics of AI, outlining the emergence of fragmented global regulatory ecosystems and the concept of “Sovereign AI.” It underscores the challenge of navigating divergent governance models while maintaining innovation, ethical responsibility, and global competitiveness.



LECTURE ON

“Environmental Architecture: Between Reality and Aspiration”

Prof. Dr. Ibrahim Madany

Overview of the Lecture

In this keynote, **Prof. Dr. Ibrahim Madany** explores how environmental principles can be effectively translated from conceptual frameworks into practical, measurable, and economically viable design solutions.

The lecture discusses the current realities shaping environmental architecture, including climate change, energy consumption, resource efficiency, and rapid urban development. It highlights the challenges faced by architects and planners in balancing environmental performance, functional requirements, economic constraints, and cultural context.



A key focus of the lecture is the role of technology and innovation in bridging the gap between aspiration and implementation. Prof. Dr. Madany emphasizes the integration of passive design strategies, energy-efficient systems, sustainable materials, and performance-based design tools to enhance environmental quality and building efficiency. The lecture also addresses the importance of environmental simulation, digital design technologies, and lifecycle assessment in supporting informed architectural decision-making.

The session further explores how environmental architecture contributes to resilient and healthy built environments by improving thermal comfort, indoor environmental quality, and resource optimization. Case-based insights illustrate how context-sensitive design approaches can achieve sustainability goals while maintaining architectural identity and social relevance.

The lecture concludes by underscoring the need for an integrated, multidisciplinary approach to environmental architecture one that aligns academic knowledge, professional practice, and technological advancement to create sustainable, realistic, and future-oriented built environments.

LECTURE ON

Coding and Information Theory **ONLINE**

Prof. Dr. A. J. Han Vinck

Overview of the Lecture

This keynote lecture presents a comprehensive overview of coding and information theory as fundamental pillars of modern digital communication, data storage, and intelligent systems. The lecture traces the historical origins of the field through the pioneering work of Claude Shannon, whose groundbreaking theories established the mathematical foundation for reliable communication and initiated the digital revolution. Shannon's contributions are presented not only as a historical milestone, but as enduring principles that continue to shape contemporary technologies.



The lecture explains the core concepts of information theory, including data representation, compression, error detection and correction, and channel capacity. These concepts form the basis for transmitting information efficiently and reliably over noisy communication channels. Prof. Dr. Han Vinck emphasizes how coding techniques enable the correction of errors introduced during transmission and storage, making modern digital systems—from mobile communications to cloud storage—both robust and efficient.

A significant portion of the lecture is devoted to modern challenges in coding theory, driven by the rapid growth of data volumes, increasing transmission speeds, and the demand for higher reliability and security. The talk addresses the role of advanced coding schemes in emerging technologies such as high-speed wireless networks, data centers, distributed storage systems, and intelligent communication infrastructures. It highlights how theoretical advances are continuously translated into practical engineering solutions.

The lecture also discusses the expanding relationship between information theory and artificial intelligence, illustrating how information-theoretic principles contribute to learning efficiency, data representation, and decision-making in intelligent systems. This interdisciplinary perspective reinforces the relevance of coding theory beyond traditional communications engineering.

Concluding the lecture, Prof. Dr. Han Vinck underscores the lasting impact of information theory as a cornerstone of technological innovation. The talk emphasizes the importance of continued research and education in coding and information theory to support the development of future communication systems and intelligent technologies, reinforcing their critical role in shaping the digital world.

LECTURE ON

Energy Storage via CO₂ Conversion and N₂ Fixation Using SOEC–Plasma Hybrid Reaction Systems **ONLINE**

Prof. Dr. A. J. Han Vinck

Overview of the Lecture

This keynote lecture presents an advanced and innovative approach to energy storage and sustainable energy systems through the conversion of carbon dioxide (CO₂) and nitrogen (N₂) using Solid Oxide Electrolysis Cell (SOEC)–Plasma hybrid reaction systems. The lecture addresses critical global challenges related to climate change, carbon emissions reduction, and the efficient storage of renewable energy. Prof. Shinsuke Mori explains how surplus renewable electricity can be stored in the form of chemical energy by converting CO₂ and N₂ into value-added fuels and chemicals.



The SOEC–Plasma hybrid system combines the high efficiency of solid oxide electrolysis with the high reactivity of plasma processes, enabling chemical reactions that are otherwise difficult to achieve under conventional conditions. This hybrid approach enhances reaction kinetics, improves energy efficiency, and expands the range of achievable conversion pathways.

The lecture highlights the role of SOEC technology in high-temperature electrochemical conversion, particularly for CO₂ electrolysis, where carbon dioxide is transformed into carbon monoxide and other useful intermediates. When integrated with plasma-assisted reactions, the system enables effective nitrogen fixation, offering sustainable alternatives to traditional energy-intensive industrial processes. This creates new opportunities for producing synthetic fuels, fertilizers, and chemical feedstocks with a significantly reduced carbon footprint.

Special emphasis is placed on the potential of SOEC–Plasma hybrid systems as a long-term energy storage solution, supporting the integration of intermittent renewable energy sources such as solar and wind power. By converting excess electrical energy into stable chemical products, these systems contribute to energy security, grid stability, and the transition toward a low-carbon economy.

The lecture concludes by discussing future research directions, technological challenges, and scalability considerations for SOEC–Plasma hybrid systems. Prof. Mori emphasizes their strategic importance in advancing sustainable energy technologies, circular carbon utilization, and climate mitigation efforts, positioning them as a promising pathway toward next-generation energy storage and carbon-neutral industrial systems.



2nd International Conference
THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING

RESEARCH SESSIONS

Parallel research sessions provide a platform for researchers and postgraduate students to present their work in: Civil Engineering, Architectural Engineering, Electrical Engineering, Mechanical Engineering and Basic Sciences
These sessions encouraged scientific discussion, feedback, and interdisciplinary exchange.

Parallel sessions were organized across multiple halls, allowing participants to engage with diverse research topics simultaneously. Each session was chaired by experienced academics to ensure high-quality discussion and effective knowledge sharing.

Following, The conference research abstracts present a diverse collection of research contributions that highlight the transformative role of technology in shaping the future of engineering. They address emerging innovations across artificial intelligence, sustainable energy, environmental architecture, digital urbanism, and advanced communication systems, showcasing interdisciplinary approaches that bridge theory, research, and real-world applications in support of sustainable development.

2nd International Conference
THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING

Mechanical Engineering

A Comprehensive Analysis of the Influence of FDM Process Parameter Optimization on Surface Roughness

Tarek Ahmed Elattar

ABSTRACT:

The capacity to create complicated shapes, design freedom, and cost-effectiveness have made fused deposition modeling (FDM) one of the most popular additive manufacturing (AM) processes. But the low surface quality of printed parts is one of the biggest obstacles preventing technology from being used in practical ways. This literature review provides a comprehensive analysis of studies investigating the influence of FDM process parameters on surface roughness. We seek out at how important process variables, such as build orientation, raster angle, extrusion temperature, layer thickness, and print speed, affect surface texture and roughness values. A variety of optimization techniques used to reduce surface imperfections are also examined in the paper, including Taguchi techniques, Response Surface Methodology (RSM), Design of Experiments (DOE), and machine learning-based approaches. The topic also emphasizes how surface quality can be improved by varying the type of material, post-processing techniques, and hybrid production procedures. The results highlight how surface quality is greatly enhanced by multi-parameter optimization and sophisticated predictive modeling, which enhances mechanical performance and dimensional accuracy. To achieve superior surface quality in components made using FDM, this review attempts to compile existing knowledge, pinpoint research gaps, and offer future approaches.

Multi-Criteria Decision Making (MCDM) in Non-Traditional Machining (NTM): A Review

Ibrahim Ahmed Elshafey

ABSTRACT:

The manufacturing industry is increasingly adopting non-traditional machining (NTM) processes to meet the challenges posed by advanced engineering materials, intricate geometries, and tight dimensional tolerances. Despite their advantages, selecting and optimizing NTM processes is complex due to the presence of multiple, often conflicting, performance criteria such as material removal rate, surface integrity, tool wear, cost, and environmental impact, as well as numerous controllable process parameters. Multi-criteria decision-making (MCDM) techniques offer systematic and quantitative frameworks to evaluate, compare, and optimize such processes under competing objectives. This review provides a comprehensive examination of recent developments in the application of MCDM approaches to NTM, outlining the major evaluation criteria, widely used decision-making methods, and their applications across various industrial domains. Additionally, it highlights how MCDM contributes to process selection and parametric optimization when combined with mathematical modeling, statistical methods, or artificial intelligence tools. The paper concludes by identifying research gaps and suggesting promising future directions for sustainable and intelligent NTM process optimization.

2nd International Conference
**THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING**

Mechanical Engineering

**Process Capability Assessment in Friction Stir Welding: A
Data-Driven and AI-Integrated Perspective**

Ibrahim Sabry

ABSTRACT:

Friction Stir Welding (FSW) has emerged as a vital manufacturing process for producing lightweight and high-integrity structures in aerospace, automotive, and transportation industries, where consistent weld quality is paramount. Conventional process capability indices such as C_p and C_{pk} rely on assumptions of normality and stationarity, which are often invalid in FSW due to its complex nonlinear thermo-mechanical behaviour and multiple correlated quality characteristics. This review integrates recent developments in data-driven and artificial intelligence (AI) methodologies that improve process capability evaluation in FSW through sensor fusion, predictive analytics, and digital twin technologies. By synthesizing research published between 2018 and 2025, it highlights innovative techniques for real-time capability estimation, management of non-normal data distributions, and multivariate quality optimization. The paper concludes by outlining a research roadmap focused on five key directions: development of robust capability indices, creation of open-access datasets, advancement of hybrid digital twins, implementation of explainable SPC frameworks, and adoption of adaptive learning approaches to build intelligent, Industry 4.0-ready capability systems for FSW.

2nd International Conference
**THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING**

Mechanical Engineering

Integrating MCDM Approaches into Modern Quality Control: A Review of Methods, Challenges, and Industry 4.0 Synergies

Tarek Ahmed Elattar

ABSTRACT:

This comprehensive review investigates more than 120 scholarly publications published between 2018 and 2025 to explore how multi-criteria decision-making (MCDM) techniques contribute to advancing quality control (QC) and quality management across manufacturing and service sectors. The study identifies that, although significant methodological and technological progress has been achieved, the implementation of MCDM in QC applications remains fragmented and inconsistent. Key challenges include dealing with uncertainty in decision parameters, maintaining the stability of weighting schemes, and ensuring real-time model validation in dynamic industrial environments. The review provides a detailed classification of classical and hybrid MCDM approaches such as AHP, TOPSIS, VIKOR, DEMATEL, and their fuzzy, grey, or machine-learning-enhanced versions and discusses their effectiveness in areas such as supplier selection, process optimization, inspection scheduling, performance evaluation, and risk assessment. Furthermore, the paper critically examines the convergence of MCDM with Industry 4.0 and 5.0 technologies, including the Internet of Things (IoT), cyber-physical systems, big data analytics, and artificial intelligence. This integration is shown to enable adaptive, data-driven, and intelligent quality decision systems. Finally, the review proposes a taxonomy of MCDM–QC interconnections, identifies unresolved research gaps, and outlines five key strategic directions for developing explainable, sustainable, resilient, and human-centric quality systems for future smart manufacturing environments.

2nd International Conference
THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING

Mechanical Engineering

Continuum Robots – Design Principles, Modeling Approaches, and Hybrid Actuation Advances: A review

Abdelmaged Elsayed

ABSTRACT:

Continuum robots represent a transformative direction in modern robotics, characterized by continuously deformable structures that enable smooth, multidirectional bending and motion without discrete joints. Unlike conventional rigid-link manipulators, these robots can navigate and operate effectively in confined, cluttered, and dynamic environments. Inspired by biological structures such as octopus arms, elephant trunks, and snakes, continuum manipulators exhibit inherent compliance, adaptability, and dexterity, making them ideal for tasks requiring delicate interaction. This paper presents a comprehensive literature review of continuum robot technology, encompassing their historical development, structural classifications, actuation principles, modeling methodologies, and control strategies. Particular attention is given to hybrid continuum architectures that combine pneumatic artificial muscles (PAMs) with tendon-driven mechanisms to balance precision and flexibility. Various modeling frameworks—including constant-curvature, variable-curvature, and Cosserat rod theories—are examined and compared. Advanced control schemes addressing nonlinearities and dynamic uncertainties are also discussed. The review concludes by outlining current research challenges and future directions in continuum robot design, sensing integration, and intelligent control development. Open research directions include achieving unified modeling frameworks, real-time sensing-based control, and robust learning-driven approaches to enhance autonomy and adaptability in unstructured environments.

A Framework to Enhance Green Factories by Applying Lean Production Concepts -A review

Ibrahim Ahmed Elshafey

ABSTRACT:

This research discusses the integration of Lean Manufacturing (LM) and Green Manufacturing (GM) as a cohesive strategy for enhancing operational efficiency and environmental sustainability. The review, informed by recent empirical studies, illustrates that fundamental Lean tools—such as 5S, SMED, Kaizen, Root Cause Analysis, Value Stream Mapping, and Just-in-Time—consistently diminish non-value-added activities, augment workflow stability, and enhance productivity across various industrial sectors. These operational improvements directly result in environmental advantages, including reduced energy use, diminished CO₂ emissions, lowered water usage, and minimal material waste. While Lean Manufacturing (LM) and Green Manufacturing (GM) share core tenets of waste reduction, the literature highlights various discrepancies, including the environmental impact of frequent changeovers, heightened logistical emissions from Just-In-Time (JIT) systems, and the embodied energy associated with the duplication of Single-Minute Exchange of Die (SMED) tools. The paper tackles these difficulties by presenting a cohesive Lean–Green paradigm, emphasizing Industry 4.0 technologies as essential facilitators of real-time monitoring, predictive maintenance, and resource-efficient optimization. A pragmatic roadmap is offered to assist small and medium-sized organizations (SMEs) in the cost-effective implementation of Lean–Green practices. The synthesis highlights the strategic importance of Lean–Green integration and provides prospective research avenues for quantifying environmental consequences and evaluating digitally enabled sustainability enhancements.

2nd International Conference
THE POWER OF TECHNOLOGY:
SHAPING THE FUTURE OF ENGINEERING

Mechanical Engineering

Multi-Objective Ablution System Design Analysis

Roubi Abdelsattar

ABSTRACT:

Ablution (wudu) is an Islamic ritual performed by Muslims several times a day, and it consumes a large amount of pure water. It is necessary to offer comfortable and healthy ablution facilities for the user that help rationalize water consumption. After investigating the criteria for optimum ablution system design, the major design objectives are found: Ablution Validity, Safety, Hygiene, Ergonomics, Water Saving and Economy. A system design is proposed to meet all these objectives, and it is compared to six other existing designs. The system consists of two adjacent basins, one upper for washing the face and hands, and the other lower one for washing the feet. The user sits in front of them on a rotatable seat. The system includes two pedal operated faucets, upper faucet opens by pressing inward two pedals located on the inside sides of user knees. The lower faucet opens by two pedals on both basin sides. Kepner-Tregoe matrix is used to prioritize the seven alternatives based on eight objectives: Avoid slipping or falling, Avoid touching faucets, Avoid touching surfaces, Avoid the body strain, Achieve aesthetic appearance, Help in water saving, Economy, and Minimizing water splash. The proposed design has the highest performance when compared to the other designs.

**The Industrial Applications of Artificial Bee Colony Algorithm:
Definition, Equations, Advantages, Disadvantages, and
Applications**

Hala Saeed

ABSTRACT:

The Artificial Bee Colony (ABC) algorithm is a swarm intelligence-based optimization technique inspired by the cooperative foraging behavior of honeybee colonies. This paper presents a structured overview of the ABC algorithm, including its mathematical model, operational phases, and governing equations for employed, onlooker, and scout bees. The algorithm's strengths—such as simplicity, flexibility, and effective global exploration—are analyzed alongside known limitations, including slow convergence and sensitivity to control parameters. Furthermore, the study reviews prominent industrial applications of ABC in areas such as production planning, energy optimization, machine learning, and wireless sensor networks. Current research trends, hybrid approaches, and potential enhancements are also discussed to improve the algorithm's performance in large-scale industrial optimization problems.

A Comparative Study of Salsa20 and ChaCha20 Stream Cipher Algorithms for Image Encryption

Eyman Esam

ABSTRACT:

Stream ciphers are widely used for securing multimedia data due to their high speed and low computational overhead. This paper presents a comparative analysis of the Salsa20 and ChaCha20 stream cipher algorithms in the context of image encryption. Both algorithms are based on the Add-Rotate-XOR (ARX) design paradigm and are recognized for their strong security and efficient software implementation. The study examines their internal structures, round functions, security margins, and performance characteristics. In addition, their suitability for military image transmission and storage is discussed. The analysis shows that while Salsa20 provides architectural simplicity and proven security, ChaCha20 offers improved performance and a higher diffusion rate, which explains its adoption in modern security standards such as TLS 1.3.

Review on physical modeling of scouring downstream compound weirs

Mohamed A. Zidan

ABSTRACT:

Scour downstream compound weirs is not well understood effect in the channels. Scour is a natural phenomenon that occurs when currents and waves remove sediments and submerged drags from a structure's base. When weirs are involved, the turbulence that results from the flow state shifting from supercritical to subcritical downstream the weirs affect the channel's downstream reach. The purpose of this study is to provide an extensive review of the factors influencing local scour downstream compound weirs. Consequently, a thorough review of the experimental studies and their corresponding outcomes documented in the literature is conducted. The analysis is separated into two primary sections. The dimensional analysis, the key parametric factors affecting scouring were presented in this paper. Channel and weir dimensions, flow conditions, stilling basin and sediment characteristics significantly affect scouring. The findings of this review are highlighting key influencing factors compound weirs outlet scouring

there needs to be more experimental research that focuses on hydraulic parameters related to the scouring process downstream compound weirs, such as the shape of compound weirs, sediment, headwater depth, tailwater depth and Froude number.

Evaluation of Seismic Separation Distance of the ECP Using Nonlinear Time History Analysis

Mohamed Ahmed Abd El-Aziz

ABSTRACT:

Seismic pounding between adjacent buildings remains one of the most critical sources of damage in densely constructed urban areas. Many codes, including the Egyptian Code for Loads (ECP-201), rely on simplified displacement-based formulas that may not fully capture the complex dynamic interaction between neighboring structures. This study evaluates the adequacy of seismic separation distances prescribed by ECP-201 by benchmarking them against detailed nonlinear time history analysis (NLTHA). Three reinforced concrete moment-resisting frame buildings—5, 8, and 11 stories—were modeled in CSI ETABS using realistic material nonlinearities, geometric nonlinearity, and bidirectional seismic excitation. Three horizontal ground motion records were selected and amplitude-scaled to ensure spectral compatibility. The NLTHA results revealed that the required separation distances were consistently larger than those calculated using ECP-201, with some cases showing underestimation exceeding 100%. The findings indicate that actual seismic demand is strongly influenced by dynamic interaction and characteristics of the applied ground motions. The results highlight the limitations of the simplified code expressions and emphasize the need for refined or supplementary procedures, especially for mid-rise RC buildings in dense urban environments.

Enhancing Mechanical Performance and Durability of Rigid Pavements Using Fly Ash and Basalt Fiber: Experimental and Numerical Assessment

Mohamed Ahmed Abd El-Aziz

ABSTRACT:

Sustainable and high-performance rigid pavements require innovative material strategies that enhance structural efficiency, service life, and economic feasibility. Against this approach, current study investigates the combined effect of fly ash (FA) and basalt fiber (BF) on the performance of rigid pavement slabs under dual wheel loading. Twenty concrete mixes were prepared, including a control and nineteen with varying FA and BF proportions. Compressive strength tests were conducted on 28-day cubes. Choosing the highest eight mixes to next stage. Eight beams (100x100x500mm) tested for flexural strength while eight slabs (1000 × 1000 × 100 mm) were tested over a subgrade characterized by a measured modulus of subgrade reaction. Each slab was subjected to dual wheel loading to evaluate first crack load, ultimate load, and load-deflection characteristics. Finite Element Modelling FEM was developed in ABAQUS using identical material properties, geometry, and subgrade conditions, enabling simulation of load-deflection behaviour, first crack load, and ultimate load. Comparative analysis between experimental and theoretical results allowed thorough assessment of mechanical performance. Across all experimental and theoretical evaluations, mix of 5% FA and 0.2% BF consistently outperformed the control mix in compressive and flexural strength, slab cracking resistance, load-deflection response. The Portland Cement Association PCA design method by fatigue analysis showed that adding 5% (FA) and 0.2% (BF) significantly improved and extended pavement life. The optimized mix increased allowable load repetitions, confirming enhanced long-term performance. Overall, integrating FA and BF proved effective in improving the strength, durability, and sustainability of rigid pavements under repeated traffic loading.

Finite Element Parametric Analysis of Torsional Behavior in Fibrous Reinforced Concrete Corbels

Osama Mohamed Anwar

ABSTRACT:

This study investigates the structural behavior of fibrous reinforced concrete (FRC) corbels subjected to eccentric vertical loading and varying reinforcement configurations. A nonlinear finite element model was developed using ANSYS and validated against previously tested specimens, demonstrating strong agreement with experimental observations. After validation, a comprehensive parametric study was conducted to examine the influence of key variables, including concrete compressive strength, load eccentricity, stirrup characteristics, and main reinforcement diameter. The results indicate that concrete strength, eccentricity, and vertical stirrup diameter are the most influential parameters governing torsional resistance. Increasing these parameters consistently enhanced torsional capacity, while their reduction led to noticeable performance losses. The findings provide useful insights for optimizing the design of FRC corbels under combined shear and torsional actions. The findings provide useful insights for optimizing the design of FRC corbels under combined shear and torsional actions, offering guidance on enhancing their structural performance, improving safety, and achieving more efficient material utilization in practical engineering applications, while also contributing to the development of more accurate predictive models for engineering design.

Adaptive Architecture in the Face of Climate Change: Towards a Resilient and Future-Oriented Design Approach

Aya Mohamed Shaheen

ABSTRACT:

Climate change increasingly threatens the built environment, demanding innovative and resilient architectural strategies. This study examines adaptive architecture as a design approach capable of addressing climatic challenges while promoting sustainability and resource efficiency. A three-phase methodology is applied: (1) a theoretical review of adaptive concepts and global resilience strategies, (2) analysis of case studies demonstrating applications of adaptive design to climate-related issues, and (3) development of a proposed framework integrating theory and practice. The research identifies key design principles, tools, and strategies that allow buildings to modify functions, performance, and forms in response to environmental changes. The findings offer architects, planners, and policymakers practical guidelines to shift from rigid conventional designs to flexible, climate-responsive, and future-oriented solutions. Special focus is given to the Egyptian and broader Arab context, aiming to foster sustainable, resilient, and adaptive architectural development in regions highly vulnerable to climate change impacts, providing a model for responsive and forward-looking design approaches.

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Architecture

Modular Construction as a Tool for Achieving Smart Buildings in Egypt

Esraa Aidy

ABSTRACT:

Egypt's construction sector faces significant and growing challenges due to reliance on traditional building methods, which are often inefficient, generate large amounts of material waste, and cause environmental degradation through frequent demolition and reconstruction. Modular construction offers an innovative and practical solution that can improve building efficiency, reduce waste, shorten construction time, and provide greater design flexibility to meet the evolving economic, social, and environmental demands. This study aims to explore the potential role of modular construction in promoting smart and sustainable building practices in Egypt by examining the possibilities for localizing technology, utilizing sustainable local materials, and enhancing labor productivity and project management. A comprehensive review of international case studies highlights both the benefits and challenges of modular construction, including cost-effectiveness, adaptability, environmental performance, and social acceptance. The findings indicate that the adoption of modular construction can significantly contribute to integrated urban development, support Egypt's transition towards smart and sustainable cities, encourage innovation in the construction sector, and provide long-term economic and environmental advantages. The study ultimately emphasizes that embracing modular construction is a key step toward building a more resilient, efficient, and sustainable construction industry in Egypt.

Visual Identity in the Era of AI Technologies - Case Study of Benha City

Sameir Mohamed Hammad

ABSTRACT:

The research paper investigates the hypothesis of the ability Artificial Intelligence tools generate urban interventions that are stylistically coherent with local heritage to assist Architects forming a Visual Identity guideline. Throughout a theoretical study and comparative analytical case study, the research validates the ability of AI tools to simulate human outcomes due to analyzing the Visual Identity guideline for Qaliobia assigned by Benha University team accomplished in 2024 with that created by GOOGLE Gemini (Nano Banana) as a tool of AI. The findings demonstrate the capability of AI tools to contribute to creating guidelines of Visual Id. in local areas based on Architectural prompting data. Visual Id. elements that are generated by AI tools show a high-quality, accurate and reflect the traditions and local heritage of the city can be directly utilized to reduce effort and time that encourage Architects to utilize in achieving design process for Visual Id. guideline.

The Impact of Converting Residential Buildings into Kindergartens on Stimulating the Child's Imaginative Abilities

Zeinab Atef Qasemy

ABSTRACT:

The architectural environment of kindergartens is a crucial factor in developing children's cognitive, social, and psychological skills. This study investigates the impact of converting existing residential buildings into kindergartens on the development of children's imaginative abilities in high-density urban contexts in Egypt, focusing on an increasing phenomenon driven by economic pressures that lead to unplanned conversions, which often neglect the architectural, psychological, and educational requirements of early childhood environments. The research adopts an inductive approach through a review of studies and theories related to kindergarten design standards and early childhood characteristics, alongside an applied approach through a case study of a residential building converted into a kindergarten, analyzing its design elements and comparing them with the theoretical standards. The study also follows a qualitative methodology, including semi-structured interviews with teachers and parents, field visits to collect architectural data, analysis of spatial distribution according to functional design criteria for kindergartens, and observation of children's interactions with the spaces at different times. The findings indicate that converting residential buildings into kindergartens without carefully planned architectural and educational interventions results in insufficient space, lack of spatial flexibility, weak sensory stimuli, and inadequate interactive tools, which limit opportunities for symbolic play and the development of imaginative abilities. The study emphasizes the importance of integrating well-considered architectural design with educational empowerment for teachers to ensure a spatial environment that fosters children's creative and imaginative growth.

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WORKSHOP

Think It, Model It, Code It: Mastering System Modeling and Verilog Realization

Prof. Ashraf Yahia and Dr. Haitham Azmy

Faculty of Engineering, Benha University

Microelectronics Department, Electronics Research Institute

This hands-on workshop guides participants through the complete journey of turning a concept into a fully validated digital design. Starting from an initial idea, attendees will learn how to develop a high-level system model, define and verify design parameters, and generate test vectors that ensure the design behaves as intended. The workshop then transitions into translating the validated model into synthesizable Verilog code, demonstrating how to align hardware implementation with the original system model by applying identical inputs and comparing outputs.

Through a practical case study a simple low-pass filter participants will see each stage of the process in action. From modeling the filter's behavior, to validating cutoff characteristics, to creating test vectors, and finally implementing the design in Verilog, the session offers a clear and structured methodology for moving from concept to hardware. This workshop is ideal for engineers, students, and hobbyists looking to develop a deeper understanding of model-based design and hardware implementation workflows.

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CLOSING CEREMONY

CLOSING SESSION AND HONORS

The conference concluded with a closing session that reflected on the key discussions, outcomes, and recommendations of the day. The session emphasized the importance of sustaining academic dialogue, strengthening collaboration, and building upon the insights generated throughout the conference to support future research and innovation.

As part of the closing activities, a recognition ceremony was held to honor distinguished contributors whose efforts played a significant role in the success of the conference. Certificates of appreciation were presented to keynote speakers, session chairs, and members of the organizing and scientific committees, in recognition of their valuable academic contributions and dedicated efforts.

The closing session reaffirmed the conference's commitment to promoting technology-driven engineering solutions, fostering partnerships between academia and industry, and supporting sustainable development goals. The conference concluded on a note of appreciation and optimism, highlighting the importance of continued collaboration and engagement in shaping the future of engineering.

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RECOMMENDATIONS

KEY CONFERENCE RECOMMENDATIONS

Based on the discussions, presentations, and interactive sessions of The Power of Technology – 2nd Conference, a set of key recommendations were identified to support the advancement of engineering education, research, and professional practice in the context of rapid technological development.

First, the conference emphasized the importance of **integrating emerging technologies**—such as artificial intelligence, digital twin systems, advanced modeling tools, and smart technologies—into engineering curricula and research agendas. This integration is essential to ensure that engineering graduates are equipped with the skills and competencies required to meet contemporary and future challenges.

Second, participants highlighted the need to **strengthen interdisciplinary research** and collaboration across engineering disciplines. Addressing complex challenges related to sustainability, urban development, energy, and digital transformation requires integrated approaches that transcend traditional disciplinary boundaries.

The conference also recommended enhancing **industry-academia partnerships** to bridge the gap between theoretical research and practical application. Strong collaboration with industrial partners and supporting companies can facilitate technology transfer, applied research, and innovation, contributing to national development priorities and supporting Sustainable Development Goal 17 (Partnerships for the Goals).

In addition, the conference stressed the importance of aligning engineering research and innovation with the **Sustainable Development Goals** (SDGs) and **Egypt Vision 2030**, particularly in areas related to clean energy, sustainable cities, responsible consumption and production, and climate action. Technology-driven solutions should be developed with a clear focus on environmental responsibility and social impact.

The conference further recommended providing greater support for **postgraduate students and early-career researchers** through training programs, workshops, and opportunities for research dissemination. Creating an enabling research environment is critical for fostering innovation and sustaining academic excellence.

Finally, the conference underscored the need for **continuous professional development** for academics and engineers, encouraging lifelong learning and ongoing engagement with technological advancements to ensure resilience and adaptability in an evolving engineering landscape.

These recommendations reflect the collective vision of the conference participants and serve as a roadmap for leveraging technology to shape a sustainable, innovative, and future-oriented engineering sector.

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Official Sponsor Message

The Organizing Committee of **The Power of Technology** – 2nd Conference is honored to express its sincere appreciation to **Global Appraisal Tech (GAT)** as the Official Sponsor of the conference.

This sponsorship reflects GAT's strong commitment to supporting technological innovation, scientific research, and knowledge exchange, as well as strengthening collaboration between academia and industry. Through this valued partnership, the conference was able to provide a high-quality academic platform that brought together researchers, professionals, and students to explore the transformative role of technology in engineering and sustainable development.

The Organizing Committee extends its gratitude to **Global Appraisal Tech (GAT)** for its generous support, which contributed significantly to the success of the conference and the achievement of its objectives. Such partnerships play a vital role in advancing applied research, fostering innovation, and supporting future-oriented engineering initiatives.



A large audience of people in a lecture hall, seated in rows, looking towards the front. The room has a high ceiling with a grid of lights.

THE POWER OF TECHNOLOGY
Shaping the Future of Engineering

Benha Faculty of Engineering – Benha University
23 December 2025

Thank you for your participation