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Conference

Smart Sustainable Cities 2025: Pioneering Novel Frontiers for Green Urban Living

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Smart Sustainable Cities 2025: Pioneering Novel Frontiers for Green Urban Living

Virtual Conference

5–7 March 2025

Conference Chairs

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Prof. Dr. Pierluigi Siano

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Welcome from the Chairs

Dear esteemed colleagues and conference attendees,

We are delighted to announce the Smart Sustainable Cities 2025 Conference, an event dedicated to pioneering novel frontiers for green urban living. As the Chairs of this conference, we are honored to host a diverse meeting of opinion leaders, researchers, industry experts, and policymakers around the globe.

The rapid evolution of cutting-edge technologies (artificial intelligence, networks, sensors, vehicles, metaverse...) presents unprecedented opportunities and challenges for urban environments. Our mission is to explore these frontiers, fostering innovative solutions that improve the sustainability, efficiency, and habitability of our cities. This conference serves as a platform for the exchange of front-line research, groundbreaking ideas, and practical insights that will shape the future of urban living.

Attendees will have the opportunity to engage with a rich program that includes five technical tracks covering the most relevant topics of Smart Sustainable Cities: Digital, Urban Operations, Mobility, Infrastructure, and Community. These tracks will include keynotes from renowned experts, panel discussions, and technical sessions.

The first conference's theme, 'Pioneering Novel Frontiers for Green Urban Living,' underscores the critical role of technology in addressing urban challenges and promoting sustainable development. By harnessing the power of smart technologies, we can create cities that are not only more resilient and inclusive but also more responsive to the needs of their inhabitants.

On behalf of the organizing committee, we wish you a productive and inspiring experience at the Smart Sustainable Cities 2025 Conference. Together, let us chart a course toward a brighter, more sustainable urban future.

Javier Prieto and Pierluigi Siano
Smart Sustainable Cities 2025 Chairs

Conference Chairs



Prof. Dr. Javier Prieto
BISITE Research Group, University of Salamanca,
Spain



Prof. Dr. Pierluigi Siano
Department of Management and Innovation
Systems, University of Salerno, Italy

Keynote Speakers



Prof. Dr. Francisco Luis Benítez
FIDESOL ICT Technological Center, Granada,
Andalusia, Spain



Mr. Alex Papacharalampous
AETHON Engineering, Athens, Greece

Invited Speakers



Prof. Dr. Martin de Jong
Erasmus Initiative 'Dynamics of Inclusive Prosperity',
Erasmus University, Rotterdam, The Netherlands



Prof. Dr. Ramón Sánchez Iborra
Department of Communications and Information
Engineering, University of Murcia, Spain



Prof. Dr. Tiago Pinto
University of Trás-os-Montes and Alto Douro,
Portugal



Prof. Dr. Marialaura Di Somma
Department of Industrial Engineering, University of
Naples Federico II, Italy



Dr. Zhen Chen
Department of Architecture, Faculty of Engineering,
University of Strathclyde, UK



Dr. Sergio Gambacorta
Enel X Global Retail, Rome, Italy



Dr. Miguel Pincheira
Fondazione Bruno Kessler, Italy



Prof. Dr. Bálint Molnár
Institute of Informatics Sciences/Department of
Information Systems, Faculty of Informatics, Eötvös
Loránd University (ELTE), Hungary



Dr. Albano Carrera González
Department of Computer Science and Automation,
University of Salamanca, Spain



Prof. Dr. Carlos M. Chang
Department of Civil and Environmental Engineering,
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Prof. Dr. Carlos Gershenson
School of Systems Science and Industrial
Engineering, Thomas J. Watson College of
Engineering and Applied Science, State University of
New York at Binghamton, USA

Abridged Program

Wednesday, 5 March 2025

9:00 – 17:45 CET (Check-In 8:30 CET)

Thursday, 6 March 2025

9:00 – 17:30 CET

Friday, 7 March 2025

9:00 – 12:45 CET

	Wednesday 5 March 2025	Thursday 6 March 2025	Friday 7 March 2025
Morning	Check-In Opening Ceremony	S4. Infrastructure (Part 2) & S2. Urban Operations (Part 1)	
	S1. Digital (Part 1)	S5. Community (Part 2) & S3. Mobility (Part 1)	
	Coffee Break	Coffee Break	Coffee Break
	S1. Digital (Part 2)	S2. Urban Operations (Part 2)	S3. Mobility (Part 2)
	Lunch Break	Lunch Break	Awards and Closing Ceremony
Afternoon	S1. Digital (Part 3)	S2. Urban Operations (Part 3)	Lunch & Networking Session
	Poster Session A	Poster Session B	
	Coffee Break	Coffee Break	
	S4. Infrastructure (Part 1)	S5. Community (Part 1)	

Conference Program



Smart Sustainable Cities 2025: Pioneering Novel Frontiers for Green Urban Living will be held online on 5–7 March 2025. Smart Sustainable Cities 2025 will bring together the international smart cities community to share and explore the latest advances in our field. The conference will cover a broad range of topics, from artificial intelligence to sustainability and technological applications. Attendees will have the opportunity to engage with a rich program that includes five technical tracks covering the most relevant topics of Smart Sustainable Cities: Digital, Urban Operations, Mobility, Infrastructure, and Community. Each session will be anchored by leading international speakers. We are also committed to showcasing the work of early-stage researchers, and the majority of the oral presentations will be selected from submitted abstracts. Crucially, the program will provide plenty of opportunities to casually network and mingle via poster and networking sessions.

Conference Platform

ClickMeeting

Information Desk

The virtual desk for information will be open from 8.30h on 5 March 2025. From this time you will be able to join the event, and can approach event staff through the meeting platform's chat function with any questions you might have.

Certificate of Attendance

Participants of the event will be able to download an electronic Certificate of Attendance by accessing their dashboards on Sciforum.net once the event is concluded. The certificates will be found under the "My Certificates" category.

MDPI, the Multidisciplinary Digital Publishing Institute, is a publisher of fully peer-reviewed, Open Access journals with a focus on robust and rapid editorial processes. Our aim is to ensure that high-quality research is verified and made available to the research community as quickly as possible. MDPI stands at the forefront of the Open Access movement, having launched its first online journal *Molecules* in 1996. Today, MDPI is a leader in Open Access, publishing more than 400 journals across all research disciplines and offering publishing-related initiatives to scholars:

- **Sciforum** - A platform for academic communication and collaboration where scholars can set up scientific conferences.
- **Preprints** - A multidisciplinary not-for-profit platform for rapid communication of research results before peer-review.
- **JAMS** - A complete manuscript submission system that incorporates all steps from initial submission to publication, including peer-review.
- **IOAP** - An Institutional Open Access Program that supports its members with access to MDPI's submission system, publication data and administrative processes relating to Article Processing Charge (APC) management.



Contact persons during the event



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Keynote Speaker

Mass Transit—Modern Solutions and Post-modern Problems

Alex Papacharalampous¹, Zoi Papacharalampous², Alexis Efraimidis²

¹ *AETHON Engineering, Athens, Greece*

² *TransiTool, Athens, Greece*

Mass Transportation is required to create data for passengers, not only as a business goal but also as a compliance target following different regulations of EU such as the MMTIS. The regulation stipulates the creation and operation of National Access Points in Europe acting as data locators. Yet, while the implementation of the regulation is being implemented in EU member states at different speeds, Mass Transit organisations are having many technical and business challenges to achieve good data publications to be used by passengers that meet the demands of the regulation. This has given rise to new issues resolving around data sharing, common use cases such as single ticketing, common usage of (digital) infrastructure and even the mechanism for creating and validating data standards. This talk will explore the as-is and to-be situations, the issues found in the market in an effort to provide holistic understanding of the issues and solutions to mitigate and absolve those post-modern problems.

Explorations and a framework of smart building and city integration systems

Dr. Ayse Glass¹, M.Arch. Juan Hernandez¹, Prof. Dr.-Ing. Jörg Rainer Noennig², Dipl.-Ing. Andreas Jorsch³, M.Sc. Anja Frost³, M.Sc. Laura Harnisch³

¹ *Chair of Digital City Science, HafenCity Universität Hamburg, Germany*

² *Professor für Digital City Science, HafenCity Universität Hamburg, Germany*

³ *EDGE, Hamburg, Germany*

Cities pursue sustainability goals for green urban living. The integration of smart building systems into smart city infrastructure offers a promising approach to enhance efficiency and sustainability. This research explores the synergy between potential smart operations on the EDGE ElbSide Hamburg and EDGE HafenCity Hamburg buildings as case studies. These buildings are designed to be active contributors to their urban environment. As cities must become more resilient and adaptive, smart building integration creates a potential framework for a scalable, data-driven approach to meet environmental targets and improve the quality of urban life. The collaboration between real estate smart solution management and university researchers allows us to gain a full overview from different expertises. Examining these buildings through the lenses of building design, facility management, and user interaction, we explore how smart systems can meet environmental targets, improve urban life quality, and advance sustainability goals.

By integrating Building Information Modeling (BIM), Internet of Things (IoT) infrastructure, and urban data systems, this study highlights how real-time data from smart buildings can optimize energy management, improve resource allocation, and contribute to sustainability goals. Key areas include adaptive lighting, indoor environmental quality, predictive maintenance, occupancy analytics, and energy conservation.

Our approach is based on the integration of real-time sensor data with multiple layers of syntactic component architecture, identifying resource use patterns and modeling adaptive responses. The research demonstrates a framework of quantifiable improvements in building performance and outlines a scalable model for similar urban applications. As a next step, research may proceed to explore AI-driven use cases and smart buildings not only serving their occupants but actively contributing to the smart city ecosystem by providing practical insights for policymakers, planners, and the future of smart city development.

Invited Speaker

Smart Campuses as Multidisciplinary Testbeds for Smart Cities: Opportunities and Success Stories

Ramón J. Sánchez Iborra¹

¹ *Department of Communications and Information Engineering, University of Murcia, Spain*

Smart campuses have emerged as pivotal platforms for testing and refining smart city technologies. This talk will explore the unique opportunities these environments offer for innovation, collaboration, and real-world application. By leveraging advanced IoT, AI, and data analytics, smart campuses can address urban challenges, enhance sustainability, and improve quality of life. Through different success stories in areas such as energy management, transportation, and public safety, insights into best practices and strategies for harnessing the potential of smart campuses to shape the future of smart cities will be discussed.

Invited Speaker

AgriClima: Evaluating Data Spaces with Pontus-X for Climate-Resilient Agriculture and Smart Cities

Miguel Pincheira¹

¹ *Fondazione Bruno Kessler, Italy*

Data spaces are federated ecosystems that enable secure, sovereign, and interoperable data exchange among multiple stakeholders. AgriClima is a collaborative initiative that leverages this approach, bringing together research institutions and private companies to share climate and agricultural data.

This talk will present the ongoing work of **AgriClima** in evaluating data space technologies to support climate-resilient agriculture. We will explore how the project's requirements guide the assessment of different implementations, including **Pontus-X**, a blockchain-based framework, as a potential solution for enabling trusted data exchange. Key challenges, such as architecture and interoperability, will be discussed, along with insights from the development of demonstrators showcasing real-world applications. Finally, we will examine how dataspaces from AgriClima can extend to **smart city scenarios**, where integrating environmental and infrastructure data can enhance urban resilience and sustainability.

Revolutionizing Waste Management: The Smart Autonomous Electronic Trash Bin Initiative

Claudia J. B. Abbas¹, Geovany Araujo Borges¹, Fabio Lucio Lopes de Mendonca¹, Francisco Lopes de Caldas Filho¹

¹ *University of Brasília, Department of Electrical Engineering*

The "Smart Autonomous Electronic Trash Bin" project aims to revolutionize waste management by integrating advanced technologies to enhance efficiency, sustainability, and recycling behaviors. Traditional waste collection methods face challenges such as inefficiencies in transportation, a lack of recycling incentives, and improper waste segregation. This project seeks to address these issues through an innovative electronic trash bin system.

The proposed solution includes a smart trash bin that utilizes artificial intelligence (AI) to identify and categorize solid waste, ensuring effective recycling and disposal. The bin also compacts waste to maximize storage efficiency and rewards users with tokens via blockchain technology for responsible waste disposal, thereby promoting recycling and proper waste management.

Key features of the project include the real-time monitoring of waste volume using IoT technologies, optimal collection route generation in Google maps applications to reduce operational costs and environmental impact, and the comprehensive tracking of the waste management process from collection to recycling.

The project is creating a circular economy that incentivizes recycling by involving commercial partners in the ecosystem. Ultimately, the goal is to reduce the environmental impact of solid waste; improve the efficiency of waste storage, collection, and transportation services; and foster a more intelligent and eco-friendly waste management system.

The "Smart Electronic Trash Bin Initiative" not only aims to revolutionize waste management through advanced technologies but also serves as a vital social program designed to protect and incentivize the livelihoods of waste collectors. This approach not only elevates the role of waste collectors within the community but also fosters a sense of dignity and recognition for their essential work.

Edge AIoT-based monitoring and optimization system to improve efficiency in photovoltaic generation systems

Juan Manuel Núñez Velasco¹, Sebastian López Florez¹, Fernando De la Prieta¹, Javier Prieto¹

¹ *BISITE Research Group, University of Salamanca, Edificio Multiusos I+D+I, Calle Espejo 2, 37007, Salamanca, Spain*

This paper presents an intelligent monitoring system for solar panels based on Edge AIoT, designed to optimize energy generation, analyze the impact of environmental variables on solar production, and facilitate implementation in areas with low or no connectivity through a local management system. The architecture integrates IoT devices that capture data on irradiation, temperature, humidity, and wind with generative artificial intelligence algorithms executed at the Edge, eliminating cloud dependency and enabling real-time processing. The platform coordinates data and optimizes autonomous decision making at each node through learning models and predictive analytics, anticipating panel performance and detecting faults or anomalies for timely maintenance interventions. Additionally, genetic algorithms help to identify the optimal operating ranges for the panels, dynamically adjusting to environmental conditions and maximizing energy efficiency. By operating at the Edge, the system ensures low latency and efficient bandwidth use, promoting decentralized and sustainable energy management. This solution enables continuous, real-time monitoring, maximizing the performance of photovoltaic systems and providing a detailed understanding of the effect of weather conditions on energy efficiency, contributing to the resilient and intelligent management of renewable sources in areas without constant connectivity.

Using a Local Digital Twin to build a Positive Energy District in Aarhus

Pavel Kogut¹

¹ *Researcher*

Even though no city has yet reached climate neutrality, that holy grail of energy transition is pushing local stakeholders to test innovative concepts and tools to "get there" by 2030. LDT4PED is a new approach pioneered by Aarhus to bring the power of Local Digital Twins (LDT) and Positive Energy Districts (PED) to bear on net-zero ambitions. What does it mean?

PEDs produce more energy than they consume by tapping into local renewable sources, be they solar, wind, or geothermal. The prosumer model allows citizens and businesses to play a key role in achieving this surplus. They can return excess energy to the grid from their EVs or storage batteries, or trade green electricity as part of an energy community.

LDT is more than the 3D visual of a city. The version created for Aarhus has public-facing tools that local residents/companies can use to assess solar potential of their rooftop - is it worth installing photovoltaic panels or not? For policy makers, LDT offers a virtual sandbox to test measures across energy, transport, and the built environment that yield optimal results for PED development and reaching net zero emissions.

LDT4PED is being created for the Brabrand district of Aarhus. The solution boasts an initial LDT prototype which will be further refined with input from a growing PED community, which includes the municipality, utility company (Kredsløb), consultancy firm (DEKRA), environmental non-profit (NRGI), and the energy community (Sol over Brabrand). The long-term plan is to extend the Brabrand PED to other parts of Aarhus, and to offer the mature LDT solution to other cities in Europe that want to embark on an ambitious district transformation that is green, digital, and just.

The ongoing LDT4PED work in Brabrand is carried out as part of the BIPED project.

Smart Water IoT Monitoring System for Domestic Consumption Optimization Using Edge AI

Jorge Herrera Santos^{1,2}, Sergio Márquez Sánchez^{1,2,3}, Pablo Chamoso Santos^{1,2,3}

¹ *BISITE Research Group*

² *University of Salamanca*

³ *AIR Institute*

Efficient water management is essential for sustainable smart city development, addressing critical challenges such as resource scarcity, infrastructure inefficiencies, and environmental sustainability. This paper presents a Smart Water IoT Monitoring System designed for domestic use, integrating advanced sensing technologies to monitor critical parameters such as pressure, temperature, water quality, and consumption. The system utilizes LoRa-based wireless connectivity and Edge AI processing to deliver real-time insights and optimize water usage without requiring cloud-based services or mobile applications.

The hardware of the device has been specifically designed to house a multisensor module, ensuring precise measurement of pipeline conditions and water characteristics. Edge AI technology processes data locally, allowing for immediate detection of anomalies such as leaks, irregular consumption patterns, or deviations in water quality. This localized processing ensures minimal latency, enhanced privacy, and energy-efficient operation. The system communicates wirelessly with a central server or home automation system for data logging and visualization, making it adaptable to diverse smart home environments.

Experimental evaluations in controlled residential setups demonstrate the system's ability to identify patterns of water usage and detect potential issues in real time. The modular design and LoRa connectivity ensure flexible deployment across various household configurations, supporting seamless integration into existing infrastructure.

This Smart Water IoT Monitoring System represents a significant step forward in promoting sustainable water consumption and improving the resilience of domestic water systems. Its innovative use of Edge AI and IoT technologies offers a scalable, efficient, and cost-effective solution for monitoring and managing water resources. Future work will explore the incorporation of additional environmental parameters, further refinement of AI algorithms, and application in broader urban and industrial contexts to contribute to the global goals of water conservation and sustainable urban living.

Invited Speaker

Enterprise Architecture for Smart Cities: Considering Distributed Ledger, Information Technology including AI

Bálint Molnár¹

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A Smart City can be understood as an advanced information system that integrates the latest technologies into its organizational or enterprise architecture. Digital transformation, often viewed as a buzzword, represents a significant shift towards informatization through information technology (IT). In this context, a Smart City serves as a comprehensive Information System, leveraging recent technologies that propel a new phase of digital advancement. Key components include Cloud Computing, Robotic Process Automation (RPA), Natural Language Processing (NLP), and The Distributed Ledger alongside the methods and algorithms underpinned by Artificial Intelligence.

The Enterprise Architecture serves as a framework to understand the complexities of business processes both practically and theoretically and provides guidance for operationalization and governance in accordance with compliance. The Zachman ontology, the TOGAF, and Archimate methodologies can support the planning, analysis, design, and development of the systems.

Two areas can embrace the majority of issues that should be handled by recent technologies the supply chain/logistics and Finance/Fintech in the governance of Smart Cities, naturally with interacting and overlapping activities.

One of the enabling technologies is the blockchain both for Fintech and supply chain.

Blockchain technology is increasingly recognized for its potential to enhance supply chain management through the use of smart contracts. These contracts automate processes and build trust among participants, effectively tackling challenges related to data verification and privacy. Integrating blockchain and smart contracts into supply chains offers significant opportunities to improve efficiency and trust, paving the way for future advancements.

The development of digital platforms and ecosystems is regarded as a key aspect of digital transformation. These tools enable organizations to systematically address various tasks related to the transport and delivery of goods, all within a unified risk management strategy. Additionally, they contribute to creating supply chains aimed at smart city

initiatives. By utilizing information system modules dedicated to identifying, assessing, and monitoring risks, the integration of all technological and logistical processes is facilitated. This approach paves the way for smarter, faster, and more secure supply chains.

Enterprise and Information System Architecture can be the foundation for integrated supply chains that are enabled by smart technologies such as Big Data, blockchain, Internet of Things, Cloud Services, Mobile Applications, Artificial Intelligence, RFID, 3D Printing, Industry 4.0 (Robotics).

The fintech solutions offer automation for financial activities. The public administration of smart cities should consider which financial areas should be automated. The areas to consider include accounts payable, accounts receivable, and account reconciliation.

In conclusion, we outline an Enterprise Architecture based approach for integrating and reconciling the various business and IT processes to achieve business process improvement, and possible, to make the improvement measurable through Key Performance Indicator.

Do smart cities help drive economic growth in Latin American countries?

María Verónica Alderete¹

¹ *IIESS, CONICET-UNS; Department of Economics, UNS*

While in recent years numerous publications have focused on smart cities, there has been little research on the relationship between the presence of smart cities and their contribution to increasing or decreasing the level of product or income in the countries. In this paper there is interest on the effect that the development of smart cities has on the economic growth of the Latin American countries. This paper uses freely accessible data for the period 2020–2023 for Latin American countries, combined with city-level data. For this purpose, a sample of 27 cities from 16 countries is used, for which the Cities in Motion Index is published. A multilevel regression model is estimated, with three levels: time, city and country. While ICT access and use are country-level variables, the ranking of smart cities is a city-level variable; and it is assumed to be an indicator of the level of ICT appropriation, the third level of the digital divide. Results indicate that ICT appropriation at the city level, along with connectivity (ICT access and use) at the country level, significantly explain economic growth in the region during the period.

Predicting Urban Heat Islands With Uncertainty Estimation Using a Community Sensor Network and Machine Learning

Tom Narock¹, Anna Kulikova¹, Sakib Hussein¹, Marcellus Mwangi¹, Abdul Siam¹

¹ *Department of Computer and Data Science, Goucher College, Baltimore, MD, USA*

Urban Heat Islands (UHIs) are areas in cities that experience higher temperatures than surrounding areas due to construction features such as buildings, roads, and a general lack of vegetation. UHIs pose a threat to public health while also increasing energy usage. The Baltimore Social-Environmental Collaborative (BSEC) is co-designing climate solutions through a collaboration between communities and researchers. Our study demonstrates how the BSEC community sensor network can be paired with advances in machine learning to provide near real-time predictions of UHIs with uncertainty estimates. While prior research has investigated the use of neural networks in public health assessment, those efforts did not include uncertainty quantification. We demonstrate how uncertainty quantification can be incorporated into UHI prediction in Baltimore, Maryland. We use Landsat spacecraft measurements of land surface temperature from summer 2023 and show how our machine learning approach compares to these ground-truth values. Moreover, the capturing of different types of uncertainty can be informative for future smart city planning as it helps determine the location of future sensors. This information can empower city planners and residents to proactively address the risks associated with UHIs, potentially reducing heat-related illnesses.

Invited Speaker

Planning and operating Integrated Local Energy Communities for a successful energy transition

Marialaura Di Somma¹

¹ *Department of Industrial Engineering, University of Naples Federico II*

Sector coupling, through the integrated use of different energy carriers, both at the supply side (e.g., by converting (surplus) electricity into other forms, such as hydrogen), and at the demand side, (e.g. by using residual heat from power generation processes for district heating), is represented as a key for reaching the ambitious climate neutrality by 2050. The main benefit associated to sector coupling is related to the increase of flexibility of the energy system through the coordinated management and operation of different sectors and the exploitation of interplay of multiple energy carriers and related technologies. On the other hand, the ongoing transition from traditional centralized energy systems to decentralized schemes brings new opportunities for distributed energy resources integration, and for the evolution in the role of final users from passive consumers to active users also through energy communities. Combining sector coupling at the local level with energy communities, leads to the innovative concept of Integrated Local Energy Community (ILEC), that represents an effective way of managing available energy resources at local level by also fostering consumers engagement and empowerment. The aim of this presentation is to conceptualize the ILECs with analysis of key features, enabling technologies, actors, business models and key issues for their implementation. Innovative approaches for the coordinated planning and operation of ILECs, with integrated flexibility identification and employment will be also discussed, along with the definition of guidelines and recommendations for optimal implementation of ILECs.

Vulnerability Assessment of Urban Flooding in Emergent Cities: A case of Bhubaneswar city

Anisa Azharunnisa¹, Sudha Panda², Rakesh Ranjan Thakur³

¹ *Research Scholar, School of Architecture and Planning, Kalinga Institute of Industrial Technology*

² *School of Architecture and Planning, Kalinga Institute of Industrial Technology*

³ *Odisha State Disaster Management Authority*

Urban flooding has become a significant challenge in Bhubaneswar, the capital city of Odisha, India, due to rapid urbanization and the resultant increase in impermeable surfaces, directly impacting the achievement of SDG 11's targets for resilient and sustainable development. While previous studies have examined urban flooding in established metropolitan areas, this research uniquely focuses on emergent cities like Bhubaneswar, where urbanization patterns and vulnerabilities are still evolving. The aim of this study is to assess the flood vulnerability areas by overlaying historical maps of the study area and uncovering changes in land use patterns, infrastructure development, and hydrological conditions that may have contributed to increased vulnerability to flooding. To address this concern, factors contributing to flood occurrence such as slope, elevation, land use/land cover, drainage density, rainfall, and soil types were assessed and data gathered to identify flood vulnerability areas using a multi-criteria evaluation method within the Geographic Information System (GIS).

In order to develop an integrated framework that connects historical urban development patterns with current flood vulnerabilities, a pairwise technique for ultimate weighting overlay analysis was used to calculate an allowance of inundation produced factor. The impacts on very-high-, high-, moderate-, low- and very-low-vulnerability regions were developed using GIS tools. By identifying the most vulnerable areas, this study equips policymakers to foster resilience planning and sustainable urban development, enabling Bhubaneswar to better withstand and adapt to flood risks.

Invited Speaker

Building Smart and Sustainable Cities: Energy Efficiency, Decarbonization, and Platformization Leveraging Data and Digital Technologies

Sergio Gambacorta¹

¹ ENEL-X, Business to Government Innovation – Smart City

The global urban population has grown exponentially since the industrial revolution, with urban centers attracting large numbers of workers and families seeking opportunities. Currently, more than half of the world's population resides in cities, a figure projected to reach two-thirds by 2050. Rapid urban development has exacerbated environmental issues related to unsustainable transport, housing, waste, energy, and land use management. Today, cities consume 75% of natural resources, generate 70% of global emissions, and produce 50% of total waste.

Achieving Net Zero Carbon goals necessitates a sustainable transition of our cities, a priority identified by the United Nations. Advanced digital technologies—including Artificial Intelligence, IoT architectures, and Big Data analysis—can address these challenges when tailored to specific use cases, focusing on environmental, economic, and social benefits.

This presentation introduces six real-world cases of urban innovation, developed by the Enel X Smart City and B2G Innovation unit in collaboration with startups and SMEs. Three of these cases aim to improve public lighting infrastructures, which play a key role in city energy efficiency and safety, while the other three empower public administration with data-driven decision-making to enable sustainable urban development. These solutions, validated within the innovation funnel and now part of the Enel B2G service portfolio, are grouped into two main areas:

Digital Transformation to Boost Efficiency and Safety in Public Lighting:

- **AI Satellite Lighting Census:** To increase efficiency and safety in public lighting census tasks by leveraging satellite imagery analysis and machine learning algorithms.
- **Lighting Category Automation:** To enhance public lighting design efficiency and minimize error margins and risks through an AI tool that standardizes and automates the design operations of entry and project lighting categories, based on open data and advanced models.
- **Adaptive Lighting:** To improve energy efficiency in public lighting and enhance street safety simultaneously by leveraging IoT remote control systems and computer vision software or radar technologies.

Data-Driven Decisions to Empower Sustainable Urban Development:

- **Open Data Program 4 Smart and Sustainable Cities:** To support data-driven sustainable urban development by leveraging open data analysis. The program offers Italian public administrations a preliminary assessment of three key urban sustainability pillars through innovative indicators: the *Circular City Index* for circular economy, the *15 Minute City Index* for urban proximity planning, and the *CO2 City Index* for decarbonization estimates.
- **Solar Cadaster for Public Buildings and Lands:** To promote renewable adoption by estimating the photovoltaic potential of buildings and public lands (> 1ha) across Italy using open data through a custom-developed solution.
- **Public Transport Electrification Simulator:** To assess the benefits of public electric mobility in terms of environmental impact and economic sustainability

Data-driven Urban Vulnerability Assessment in Smart Cities

João Carlos N. Bittencourt^{1,2}, Daniel G. Costa³, Paulo Portugal³

¹ *Federal University of Recôncavo da Bahia*

² *PDEEC, Faculty of Engineering, University of Porto*

³ *SYSTEC-ARISE, Faculty of Engineering, University of Porto*

Emergency management systems increasingly rely on data-driven solutions to enhance urban safety and resilience. However, their efficacy depends on a sophisticated understanding of the spatiotemporal dynamics inherent to urban environments. The aim of this presentation is to introduce a data-driven clustering-based method for assessing urban vulnerability by integrating Points of Temporal Influence (PoTIs)—such as educational institutions, healthcare facilities, commercial hubs, tourist attractions, and transportation nodes—that significantly impact urban dynamics. Incorporating these PoTIs enhances the granularity and accuracy of vulnerability assessments.

Our analytical model considers that areas with higher population flow densities are more susceptible to urban emergencies and aims to optimise urban safety planning. To quantify vulnerability, we employ an inversely weighted distance computation across urban zones. By dynamically identifying clusters of PoTIs within specific time windows, our method provides a detailed, context-aware understanding of urban vulnerability. This information can be applied to develop applications aimed at improving sustainability, safety, and responsiveness in urban planning. For example, emergency services can proactively use these assessments to monitor areas requiring heightened attention or policy adjustments. Furthermore, these insights can inform long-term urban planning to develop more sustainable and resilient cities.

We validate our approach through experimental results that reveal varying levels of vulnerability across different urban zones. Furthermore, our data-driven approach, which is based on OpenStreetMaps datasets, allows the method to be extended to every urban area worldwide. The model's flexibility also enables fine-tuning to different targets and PoTI classes. These findings are significant for planning data-driven smart city systems responsive to the distinctive spatiotemporal characteristics of urban environments. The proposed method represents a substantial advancement in urban vulnerability assessment, offering valuable insights for policymakers and urban planners seeking to enhance emergency management and urban resilience.

Revitalizing Heritage: Challenges and Opportunities for Sustainable Development in Old Cities

Hussaen A. H. Kahachi^{1,2}, Mufeed Ehsan¹, Maria Abreu²

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Old cities are living repositories of cultural heritage and collective memory, characterized by their historical significance, enduring urban fabric, and inter-generational continuity. However, integrating sustainable urban development within these contexts presents a unique set of challenges. Preservation efforts often conflict with modernization needs, resulting in regulatory hurdles, financial constraints, and environmental vulnerabilities. Conversely, old cities offer distinct opportunities for innovation through community engagement, adaptive reuse, and sustainable tourism.

This research explores the dynamics of sustainable development in old cities through in-depth interviews with experts, including urban planners, policymakers, and conservationists. By analyzing their insights, the study examines key tensions between heritage preservation and sustainability, focusing on themes such as policy constraints, technological innovation, and stakeholder collaboration. The findings reveal critical strategies for addressing these challenges, including flexible policy frameworks, inclusive decision-making, and context-sensitive technological adaptations.

Through expert-driven perspectives, this study highlights the potential for old cities to serve as dynamic models of sustainable urban development that balance preservation with progress. The research aims to contribute to the academic discourse on sustainable heritage management while providing practical recommendations for urban planners and policymakers. By aligning sustainability objectives with cultural preservation, old cities can evolve into resilient, vibrant communities that honor their historical legacies while meeting the demands of the modern world.

Waste to Opportunity: Decentralizing Waste Management Systems in Urban Areas through Social Enterprise Models

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Waste management is a major challenge that urban settings are facing. In many South Asian urban settlements, waste-pickers are critical actors who collect plastics, papers, PET bottles, and glass bottles. The unrecognized role of the waste-picker's job is visible in both formal governmental and informal self-employed collection systems. The formalized employment of waste-pickers gives a sense of job security, but for the informal waste-pickers, the fear of eviction remains. This article will look into the involvement of informal waste-pickers in Ahmedabad's existing waste management system. Additionally, it will analyze how a waste management-based social enterprise can support decentralized and socially inclusive models based on case studies from other cities. We highlight the potential for empowerment inherent in the social enterprise framework to transform a community into entrepreneurs and to seed enterprise through upskilling. The co-design model we propose requires deep conversation and partnership with the waste-picker community. With an analytical model for a social enterprise centered around waste-based alternative livelihoods through partnership with private and public organizations, we highlight the importance of community-based organizations in transformative design. Recognizing the systems of social stratification that undermine waste segregation at the source, we argue for incorporating waste-pickers into city-wide formalized waste management. These models offer greater inclusion as well as social and environmental sustainability in comparison to the centralized systems that are coming into vogue.

Transforming Gabtoli: A Model for Multimodal Transit in Rapidly Growing Cities

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This research explores transforming Dhaka's Gabtoli area into a model multimodal transit hub to establish a scalable framework for urban infrastructure in rapidly growing cities. The project focuses on redesigning Gabtoli's layout to integrate existing transport networks and a newly built underground metro service, aiming to address urban congestion, enhance intermodal connectivity, and reduce reliance on peripheral relocation.

Once a fringe bus hub, Gabtoli has become centrally located in Dhaka, where its limited capacity and outdated infrastructure now hinder the city's transport network. Rapid urban growth in Dhaka has shifted land use patterns, with hubs like Gabtoli struggling to meet the city's escalating transportation demands, leading to congestion and inefficiencies. This research proposes a modular, scalable design to reposition Gabtoli as a central, efficient transit node that aligns with current and future infrastructure needs.

Combining an architectural framework, computational simulation, and data-driven solutions, this research develops a comprehensive design approach for optimizing Gabtoli's spatial and operational layout. Site analysis, case studies of successful multimodal hubs, and advanced simulation tools inform the study's design framework. Simio software is employed for detailed vehicle simulations, assessing circulation patterns, traffic density, and infrastructure utilization to resolve bottlenecks. Pedestrian simulation tools also refine the layout for improved user experience, while modular design principles guide adaptability to future demands.

The proposed design emphasizes seamless connectivity across transport modes, incorporating dedicated pedestrian and cycling pathways, energy-efficient systems, and green infrastructure. A mixed-use development model integrates commercial spaces and community amenities, creating a vibrant urban space supporting commuters and residents.

This research presents a sustainable model for transportation infrastructure adaptable to Dhaka's dynamic urban landscape through its modular, flexible design. This solution enhances Gabtoli's capacity and inclusivity and provides a replicable framework for multimodal hubs in rapidly urbanizing cities, supporting improved quality of life in Dhaka.

Aging Buildings to Net-Zero Buildings: Retrofitting Parametric Intelligence for Smart Cities

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The critical requirement for climate change mitigation has attracted great attention to the transition towards sustainable and energy-efficient cities. One major difficulty in this transition is that existing building infrastructure is often based on obsolete technologies and inefficient energy consumption patterns. Integrating AI-driven parametric retrofitting technology for green buildings represents a transformative approach to optimize energy distribution, predict demand, and respond to real-time data fluctuations and overall performance of existing structures promoting Net-zero emission for green cities. This research aims to explore a robust framework of remodeling based on AI Simulation and Optimization to improve the flexibility, responsiveness, and efficiency of smart-grid infrastructures in urban settings. This parametric intelligence helps in accessing optimal adaptive strategies based on AI-based predictive modeling, data-driven insights and computational design suited to different building characteristics, climatic conditions, and grid interactions. The methodology includes prototype of theoretical framework to reinforce energy efficiency, environmental performance, and urban sustainability within the realm of the retrofitting process. By combining technical resilience, highlighting possible applications, limitations, and future perspectives the proposed paper concludes to promote a scalable model for Urban planners, architects, and policymakers to design optimal solutions for building retrofit to achieve better energy efficiency and comfort, that can transform aged buildings to green buildings eventually to lead to more sustainable and efficient cities that can effectively address modern energy challenges.

Developing Resource-efficient Nitrogen Removal Systems for Urban Wastewaters

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Wastewater treatment plants are required to manage an increasingly complex influent profile that includes high levels of nitrogen—a major contributor to eutrophication and harmful algal blooms in receiving water bodies. The global nitrogen discharge from wastewater sources is projected to nearly double from 6.4 Tg-N per year in 2000 to 12–15.5 Tg-N per year by 2050, creating an urgent need for improved nitrogen removal solutions. The conventional nitrification–denitrification (N/D) process remains the most widely used approach for nitrogen removal; however, its reliance on extensive aeration and external organic carbon sources has rendered it both costly and energy-intensive. Alternative processes that provide for resource-efficient operations must be developed to address the challenges associated with conventional nitrogen removal processes.

This study investigates the optimization of nitrogen removal in wastewater treatment through a comparative analysis of conventional nitrification–denitrification (N/D) and partial nitritation–anammox (PN/A) processes integrated with anaerobic digestion (AD). Using Bio-Win 6.0 simulations, the research examined system performances across various operational conditions, including temperature ranges (15–35°C), dissolved oxygen levels (0.1–2.0 mg/L), and total Kjeldahl nitrogen concentrations (40–1000 mg/L). The results demonstrated that the PN/A-AD system achieved superior nitrogen removal efficiency (up to 97.5% at 100 mg/L TKN) compared to conventional N/D processes, particularly in treating high-strength nitrogen wastewater. The PN/A system maintained 54.3% removal efficiency even at 1000 mg/L TKN, while requiring less energy and producing significantly less sludge (0.57 kg/kg versus 8.07 kg/kg nitrogen removed). Temperature significantly influenced system performance, with optimal conditions observed at 35°C and DO levels between 1 and 1.5 mg/L. Sensitivity analysis revealed system stability across multiple operational parameters, suggesting robust performance in real-world applications. This research provides valuable insights for designing and optimizing nitrogen removal processes in wastewater treatment plants, particularly for facilities targeting energy efficiency and reduced operational cost.

Invited Speaker

How Artificial Intelligence is Leveraging the Future of Urban Green Mobility

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As cities worldwide strive for sustainability, artificial intelligence (AI) is playing a transformative role in shaping urban green mobility. AI-driven solutions are optimizing transportation networks, reducing emissions, and enhancing commuter experiences through intelligent traffic management, predictive analytics, and autonomous mobility systems. This work explores the key ways AI is contributing to advancing eco-friendly urban transportation. AI-powered traffic control systems dynamically adjust signals to reduce congestion and minimize idling, cutting down emissions. Machine learning models predict demand for public transport, allowing for real-time route optimization and better resource allocation. AI also supports the integration of micro-mobility solutions—such as e-scooters and bike-sharing—by analyzing usage patterns and suggesting infrastructure improvements. Additionally, autonomous electric vehicles (EVs) are revolutionizing city mobility. AI enables efficient fleet management for shared EVs, ensuring availability while minimizing environmental impact. Connected vehicle technologies further enhance safety and energy efficiency by facilitating vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. This work addresses relevant challenges, such as data privacy, algorithmic bias, and the need for inclusive AI-driven mobility solutions that benefit all urban residents. By leveraging AI responsibly, cities can create smarter, cleaner, and more efficient transportation ecosystems. Ultimately, AI is not just a tool for optimization but a catalyst for a greener, more sustainable urban future.

Transit-Oriented Development in Dhaka: Enhancing Urban Mobility and Infrastructure at Kazipara Metro Station

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Introducing the Mass Rapid Transit (MRT) system in Dhaka has been a pivotal advancement in the city's transportation landscape to mitigate traffic congestion and enhance urban mobility. This study centers on the Kazipara Metro Station, a 500-meter radius encompassing approximately 2,400 buildings and limited open spaces, posing challenges for new development. The primary goal is to design an urban development strategy that aligns with Transit-Oriented Development (TOD) principles, making the area more vibrant and accessible while addressing the dense urban context. Key research questions include "How can urban facilities be enhanced to promote vibrancy and accessibility within the existing spatial constraints?", "What minimal changes can improve development efficiency and reduce carbon emissions?", and "How can economic benefits be maximized through strategic, low-impact redevelopment?"

A thorough analysis was conducted, evaluating road conditions, accessibility, building density, and structural heights to pinpoint areas suitable for redevelopment. Low-rise buildings (1-3 stories) were identified as key sites for targeted interventions, allowing for efficient space utilization with minimal environmental disruption. The proposed design strategy introduces new amenities, such as a furniture factory and mall, centralized shopping facilities, health centers, public gathering spaces, a fresh produce market, bus stops, affordable housing, water bodies, playgrounds, and parks. To enhance connectivity and vibrancy, an integrated network of elevated walkways and strategically placed urban landmarks and signage are included to improve accessibility and pedestrian movement.

This study highlights the fact that thoughtful, context-sensitive redevelopment can significantly improve urban infrastructure and the quality of life in densely populated areas. By focusing on minimal yet impactful changes, the proposed solutions aim to create a more vibrant and accessible urban environment, preserving the area's unique character while integrating essential modern amenities. This approach demonstrates that efficient, low-impact urban development can revitalize high-density areas without extensive land acquisition or disruptive construction practices.

Smartphone Sensing for Road Anomaly Detection in Bicycle Transportation

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Bicycle transport is increasingly recognized as a sustainable urban mobility solution, with many cities investing in cycling infrastructure. Effective infrastructure design requires assessing road conditions, especially for irregularities like speed bumps. This study presents a methodology for detecting road anomalies using unsupervised machine learning. Data were collected using an iPhone 13 and the G-Field Recorder app, yielding 267 samples of z-axis acceleration signals over a 300-meter University of the Philippines—Los Banos campus road segment with five rubber speed bumps. Data preprocessing involved digital reorientation, high-pass filtering, and stationarity testing. A sliding window approach was applied to extract time-domain features such as descriptive statistics, moving average, and autocorrelation. Anomaly detection using K-Means (KM) and Isolation Forest (IF) algorithms revealed IF as marginally superior, achieving a weighted F1 score of 0.98 compared to KM's 0.97. IF effectively identified anomalies, while KM (k=2) showed consistent detection with minimal false negatives and positives, indicating robustness. Notably, KM has the potential to detect multiple types of anomalies by increasing the number of clusters, which could improve its versatility in varied road conditions. These findings validate the methodology's utility in identifying road irregularities, supporting the development of bicycle-friendly infrastructure for sustainable urban transport.

Assessing the future energy demand of Greece's transportation sector

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The terrestrial transportation sector, including passengers, buses, and trains, is becoming an increasingly complex field in terms of decarbonization, requiring science-driven, data-based solutions to address its energy and emissions challenges effectively. Greece exemplifies these challenges, as its transportation sector has been slow in transitioning towards decarbonization, despite the country's commitments. Factors such as dependence on conventional fuels, infrastructure inefficiencies, and policy gaps exacerbate the situation, highlighting the urgent need for comprehensive modeling and assessment tools. This research presents a detailed assessment of Greece's transportation sector, focusing on energy demand and associated greenhouse gas (GHG) emissions, per use and per fuel type. Leveraging the Low-Emission-Analysis Platform (LEAP) model, we analyze the sector's fuel mix across various uses at a national scale, marking, to the best of our knowledge, the first such effort for Greece. The model is tested under Shared Socioeconomic Pathways (SSPs) scenarios: SSP1 (sustainability-focused), SSP2 (moderate progress), and SSP5 (fossil-fueled development), projected to 2050. Our findings reveal critical insights into how different decarbonization pathways could reshape Greece's transportation sector. The key outcomes discussed include variations in energy consumption, emission trajectories, and the feasibility of achieving national and EU decarbonization targets under diverse socio-economic conditions. This work aims to support policymakers in designing robust, forward-looking transportation strategies aligned with sustainability objectives.

Commuters' Perception of Travel Impedances and Management Strategies in Makurdi Metropolis amidst Fuel Price Increase

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The recent hike in fuel price due to a deregulation policy enacted by the federal government of Nigeria has significantly influenced travel behaviour across the country. This study investigated commuters' perception of travel impedances in Makurdi metropolis amidst the fuel price increase. Objectives of the study include to determine the demographic characteristics of commuters in Makurdi metropolis, ascertain the before-and-after travel behaviour using a K-Means clustering technique, and model and optimize the travel utility of commuters in Makurdi metropolis using a genetic algorithm technique. Online questionnaires were administered to 400 respondents from an estimated human population of 433,700. Descriptive statistics, the K-Means technique, and regression modelling and genetic algorithm techniques were used for data analysis. Findings of the survey revealed that male (55.50%), adolescent (36.80%), adult (43.90%) and single persons (67.10%) travel more frequently. Also, students (33.50%), employees (41.30%), A-Level (29.00%) holders and first-degree (51.60%) graduates travel the most. A total of 63.20% of respondents travel daily, out of which 81.90% use private cars. The common modes of transport used by commuters are commercial bikes (56.10%), buses (36.80%) and private cars (24.50%). Trips for work/business (64.50%), social/leisure (50.30%) and school/study (38.70%) recorded the highest percentages of trip purposes. There was no significant change in maximum travel demand for the before (43.90%) and after (42.60%) cases, with a 40.00% travel cost increase. About 40.60% and 10.30% of the respondents' mode choices shifted from bike to bus, and bike to tricycle (Keke), respectively, due to increased generalized travel cost. Some commuters adopted new travel strategies as follows (which are presented in order of decreasing priority): walking then catching a bus, using a bicycle or tricycle (45.40%), reduced rate of travel (26.00%), walking for short distances (10.40%) and suspending most travel activities (6.50%) to minimize the present impact of travel challenges.

Mobility

Keynote Speaker

Francisco Luis Benítez

Designing a new concept of Smart Cities based on Digital Twins

Invited Speaker

An Infrastructure Management Humanistic Approach for Smart Cities Development, Evolution, and Sustainability

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In the coming decades, the continuous migration to urban areas will intensify the demand for infrastructure that meets economic, environmental, and social needs. The strong connection between civil urban infrastructure and smart cities stems from their shared objective of enhancing public services. However, traditional approaches to smart city development often lack a holistic, integrated vision for infrastructure management. This keynote introduces a humanistic infrastructure management approach, integrating a smart city conceptual model with an educational perspective. Employing a mixed research methodology that combines quantitative and qualitative techniques, the study applies inductive-deductive tools to develop a comprehensive infrastructure management framework. The proposed framework is structured around five key dimensions: (1) environmental, (2) financial-economic, (3) political-governance, (4) social-people, and (5) technological. Case studies demonstrate the practical application of this model. The findings emphasize the significance of a multidimensional approach to infrastructure management, fostering inclusivity and improving the quality of life by preserving and enhancing civil infrastructure systems.

Invited Speaker

Cybernetic Cities: Designing and controlling adaptive and robust urban systems

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Cities are changing constantly. All urban systems face different conditions from day to day. Even when averaged regularities can be found, urban systems will be more efficient if they can adapt to changes at the same temporal scales at which these occur. Still, the functionality of urban systems must be robust to changes, either caused by adaptation or by other factors. Technology can assist humans in designing and regulating this adaptation and robustness. To achieve this, we propose a description of cities as cybernetic systems. We identify three main components: information, algorithms, and agents, which we illustrate with current and future examples. The implications of cybernetic cities are manifold, with direct impacts on mobility, sustainability, resilience, governance, and society. Still, the potential of a cybernetic perspective on cities will not depend so much on technology as on how we use it.

Estimating Electrical Energy Generation in Urban Spaces Using Piezoelectric Materials: Insights from a Qualitative Study

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Urban public spaces such as sidewalks, walkways, and walking streets play crucial roles in creating vibrant and dynamic cities, as they support daily activities including walking, social interaction, and shopping. Besides enabling people to move from one place to another, these spaces are also social spaces with an important role in sustaining cities. The simple act of walking generates kinetic energy that can be converted into electrical energy. Energy harvesting through vibration has emerged as a sustainable means through which captured energy can be repurposed to reduce greenhouse gas emissions by alleviating global warming and conserving resources. Therefore, this study aims to estimate the amount of electricity generated by applying piezoelectric materials in the selected urban spaces. An observational study was conducted in the Babolrood area of Babolsar (Mazandaran Province, Iran) to quantify pedestrian movement and activity patterns over a year. The research adopts a mixed-methods approach, beginning with a qualitative stage that involved unobtrusive, non-participant observation to analyse users' behaviours. In the subsequent quantitative stage, the study calculated potential electricity generation using four piezoelectric tiles covering a total area of four square meters.

The findings indicate that energy harvested from these piezoelectric materials could significantly reduce street lighting electricity consumption, enabling the illumination of approximately 125 LEDs and 36 high-pressure sodium lamps. This reduction in energy demand could lower greenhouse gas emissions and support the broader goal of sustainable energy production and consumption.

Invited Speaker

Smart Cities: Policies, Digital Twins, and Project Management

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This presentation focuses on three issues relating to smart cities. The three issues highlighted in this presentation include Smart City Related Policies and Implementation, Digital Twins for Smart Cities, and Smart City Project Management. This presentation explores topics relating to the three issues in the context of smart city development and operation and discusses examples in related areas to support further research and practices in related areas.

Evaluating the Cooling Effects of Urban Parks to Mitigate Urban Heat Islands in Bhubaneswar, India: Insights for Tropical Mid-Sized Cities

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The accelerated growth of mid-sized tropical cities like Bhubaneswar is accompanied by the Urban Heat Island (UHI) effect, which increases energy demands and health risks for the urban populace. The natural cooling solutions of urban green spaces (UGSs) help mitigate UHI effects by creating localized green cooling islands (GCIs). However, the GCI concept in tropical environments such as Bhubaneswar remains largely unexplored, particularly in relation to the effects of the characteristics of urban parks and the land cover around them on cooling extent and intensity. This study evaluates urban parks' cooling potential by analysing the land surface temperature (LST) derived from Landsat and Google Earth high-resolution images for the city by applying buffer analysis. The park characteristics with the surrounding temperatures were correlated to find out the cooling areas and temperature associated by sampling 15 parks. The GCI effects are defined by three parameters, namely, cooling intensity (CI), cooling distance (CD), and cooling area (CA). These parameters were assessed against urban park characteristics by developing statistical models.

The results show that the size, perimeter, and shape complexity of urban parks influence its cooling and were negatively correlated with the park LST. There is stronger cooling where park shapes were larger and complex in nature. They also offered localized cooling effects that extend from 300 m to 450 m beyond their boundaries, with an average temperature reduction of 2°C to 4°C compared to adjacent non-green urban areas. Increasing the NDVI of the parks, as well as in the neighbouring land area, while decreasing impervious surfaces widens the cooling scope of urban parks. Thus, by quantifying the cooling impacts of UGSs, the results provide an evidence-based recommendation for the designing of future parks along with the improved usage of green infrastructure to mitigate UHIs in tropical mid-sized cities.

Smart House: An Innovative and Green Design of a Single-Storey Residence in Dasmariñas City, Philippines

Leiron Mark S. De Guzman¹

¹ *National University*

This research addresses the challenge of integrating green technology into residential architecture while documenting the process. Architects often struggle to balance client desires with project necessities. Clients like sustainable approaches but are afflicted with initial investment and application cost burdens. This paper aims to establish project documentation as a norm for architects in academia, focusing on applying green technology to single-story residences. The study offers insights into project viability, innovative solutions for traditional homes, and relevant green regulations. It documents a case study that implements rainwater collection, solar panels, and softwater technology to guide designers and clients in implementing design strategies within budgetary constraints. Furthermore, this study underwent a test run with basic EDGE simulation and an initial assessment to verify the green initiative of the project. The project also addresses the United Nations Sustainable Development Goals—Goal 11: Sustainable Cities and Communities, and the researchers aim to develop innovative housing designs and achievable green solutions for better sustainable housing in our current cities.

Vegetation Dynamics in Antananarivo Throughout the 21st Century

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Given the dynamics caused by anthropogenic factors, understanding the dynamics of urban vegetation is essential to ascertain what guidelines to implement in city planning to promote green infrastructure. In the case of Antananarivo, only land-use maps from 2017 and 2022 by Dupuy et al. are available for vegetation analysis. Hence, the aim of this research is to understand the vegetation dynamics of the urban municipality of Antananarivo (CUA) during the 21st century. This research used the machine learning algorithm Continuous Change Detection and Classification (CCDC), using the NDVI vegetation index as the main variable employed. On 620 Landsat images from 2000 to 2023, predicted NDVI values were obtained per pixel. A LASSO regression was performed on these predicted values to obtain the break dates, slope, magnitude, and amplitude over 5-year intervals. The model's results show that the vegetation density has remained stable in the CUA. This is due to the fact that demographic pressure was mainly concentrated in the communes surrounding the CUA, and that the forests within the CUA are either state-owned or owned by companies, thus having a secure existence. Nevertheless, woodland covered only 890 ha of the 92 km² of the CUA. Seasonal variability was more important than long-term variability. Seasonal variability was concentrated mainly in crop-growing areas. Abrupt changes in vegetation occurred mainly in rice fields in Antananarivo. However, vegetation dynamics did not vary with altitude.

Invited Speaker

The importance of data in city development

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Vast amounts of diverse data are being collected, which can be categorised into two main types. On the one hand, environmental monitoring data such as meteorology, energy generation, and agriculture. On the other hand, human centred data, including energy consumption, indoor/outdoor pollution, and vehicle movement.

Although these variables could be considered independently, establishing connections between them is essential for achieving greater sustainability and improved performance. Identifying these relationships enables cities to optimise the use of resources and, therefore, reduce costs.

Artificial intelligence plays a decisive role in this process by analysing large datasets and identifying patterns that inform targeted actions. AI-driven insights allow for the development of specialised tools designed to enhance key variables, such as optimising energy consumption, promoting sustainable and homogenous agricultural production through the responsible use of natural resources, and regulating pollution by enhancing traffic flow. Additionally, by monitoring individuals' behaviour and activity, potential emergency situations for society can be predicted. For example, tracking the sale of flu medications in pharmacies allows the healthcare system to anticipate and prepare for seasonal outbreaks of illness before they peak.

In this context, following a thorough analysis of the current landscape, scenarios will be proposed that pave the way for both cities and rural areas to move towards a healthier, more sustainable, and efficient future.

Cross-Sectional Industrialization Factors' Contribution to Heatwave Risk Classification

Kevin Geng¹, Sajeew Magesh¹

¹ *Independent Researcher*

The intensifying frequency and severity of heatwaves, driven by climate change, pose significant threats to human health, agriculture, and ecosystems, especially in industrialized regions. Traditional studies on heatwave risk often focus on meteorological variables while neglecting the influence of industrialization and urbanization. This paper addresses this gap by employing advanced machine learning models, specifically a Multi-Layered Perceptron, (MLP), a Support Vector Machine (SVM) and Logistic Regression (LR), to analyze the relationship between industrialization factors and heatwave risk across California's diverse census tracts. Using data from the National Risk Index (NRI) and the Smart Location Database (SLD), we found that the MLP model, which achieved a cross-validation accuracy of 94.81%, outperformed the SVM and LR models in capturing the impact of industrial metrics such as employment density, land use, and proximity to transit on heatwave vulnerability. Our results reveal the significant role industrialization plays in exacerbating heatwave risk, particularly in urban areas affected by the Urban Heat Island effect. These findings suggest that integrating industrialization factors into heatwave risk assessments is essential for protecting vulnerable communities and guiding more effective urban planning.

Seoul's Smart City Evolution: Citizen-Centric Approaches and Global Leadership

Sofia Shwayri¹

¹ *Tulane University*

This paper explores the evolution of the smart city model, initially envisioned by global Information and Technology corporations and embraced by governments to enhance public services and governance. Criticisms of the original top-down, technology-driven approach highlighted the neglect of citizens' needs and urban diversity, leading to a shift towards a bottom-up model. Encouraged by the growth of both academic and non-academic discourses emphasizing the importance of homegrown initiatives and partnerships that foster citizen participation and innovation, governments embraced this transformation. This has sparked a dual race among cities to become the first truly smart city and, consequently, to assume global leadership in this field.

The study recognizes the smart city as a global phenomenon, characterized by both global and local attributes, with homegrown ideas and solutions circulating across different geographical and cultural settings. While this enables a more nuanced understanding of the development of many smart cities, it fails to explain how local strategies affect global discourse and the rise of global leadership. This leads to the following question: how do cities employ citizen-centric strategies and technological innovation to enhance their global branding as leaders in smart city development?

Seoul, South Korea, characterized by world renown e-governance strategies and advanced technologies, has been at the forefront of advancing the smart city vision both locally and globally for several decades, making it a unique case. This paper focuses on Seoul, investigating how the city leverages its advanced technology infrastructure and citizen engagement to drive its smart city transformation. By analyzing the roles of Seoul Innovation Bureau and Social Digital Foundation, the study seeks to understand how Seoul has branded itself as a global leader in smart city development. The goal of this research is to highlight the importance of local developments in contributing to the global phenomenon of smart cities.

Community

Invited Speaker

Martin de Jong

TBA

Decision Making for Future Cities: A Review of Factors, Stakeholders, Phases, and Mechanisms for Sustainable Development

Hussaen A. H. Kahachi^{1,2}, Maria Abreu², Mufeed Ehsan¹

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Cities continue to grapple with significant challenges in achieving sustainability despite increasing global awareness. At the midpoint of the UN's 2015 Sustainable Development Goals, only 12–15% of the targets are expected to be accomplished. This shortfall is often linked to the need to rethink urban planning processes, particularly decision making. Similarly to the evolution of urban planning from traditional rational approaches to more experimental methodologies, decision-making frameworks have also shifted—from linear, narrowly focused strategies to iterative approaches that envision comprehensive, inclusive scenarios.

This study addresses a critical gap in the literature by examining decisionmaking within the context of future cities' theories, such as Smart City, Resilient City, Sustainable City, Compact City, Intelligent City, Digital City, and Livable City. It identifies the key frameworks, factors, and stakeholders involved in decision making for future cities. Employing a combination of literature reviews and expert interviews, this research organizes the identified mechanisms into the five stages of urban planning decision making. It further explores the potential integration of these mechanisms to support sustainable urban development.

The findings offer valuable insights for embedding decision making practices from future cities' paradigms into contemporary urban planning, advancing the pursuit of sustainable urban development.

Understanding the role of Built Up density in creating Urban Heat Islands: A Decadal study of Bhubaneswar City

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A common consequence of rapid and uncontrollable urbanization is urban heat islands (UHIs), which describe a higher land surface temperature (LST) in cities than their surrounding areas. Along with the local warming, land conversion is a key factor in LST rise in urban bodies. Studies have revealed that the most important factors affecting LST are increasing population density, built-up areas, and vegetation changes. This study assesses Landsat 8 thermal bands for LST changes and remote sensing data for land use changes over 10 years from 2014 to 2024 and tries to find the decadal changes in built up density, NDBI (normalized difference vegetation index), and NDVI (normalized difference vegetation index) for the city core, planned area, and peri-urban area. Finally, it tries to find a correlation between LST changes and built up density, NDVI, and NDBI. The paper also tries to find the built up conversion rate with respect to the population growth rate to calculate the Land Conversion Rate–Population Growth Rate (LCRPGR) of the three areas of city core, planned area, and peri-urban area. Green areas like forests, agricultural land, and blue areas reduce LST rise, and built up and open spaces increase LST rise. By studying the land conversion rate versus the population growth rate, this study aims to recommend a proper land conversion rate to check LST increases.

A1. Enhancing Urban Identity Through Smart City Technologies: A case of medieval port city of Kochi

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The historic port city of Kochi is one amongst the first 20 cities chosen under Indian Smart Cities Mission for urban renewal and retrofitting. The cultural heritage of Kochi is thus left high and dry amidst the conservation and urbanization efforts. It's imperative to safeguard the city's unique cultural heritage as it significantly invigorates the smokeless industry of tourism. The paper aims to focus on enhancing the attributes of cultural heritage that render the city image with smart city technologies, thereby evolving into a state-of-the-art, yet culturally rooted destination with innovative smart technological solutions.

The recommendations focus on strategic, creative and tactical placemaking. The strategies advocates for the revitalization of public spaces with integrated digital platforms. Such strategies incorporate interventions like digital interactive kiosks, art events, smart event management systems and public art installations. The paper subsequently addresses on various issues including infrastructure limitations, cultural authenticity, sustainability concerns, funding constraints, regulatory challenges and privacy. It also reflects on equitable approaches to promote environmentally sustainable practices and inclusive community engagement.

The placemaking recommendations not only offers a new experience to the tourists but also safeguards the well-being of people, heritage, and environment. The implications of this study promise a roadmap for planners, policy makers and other prominent stakeholders to guide Kochi into a culturally enriched smart city.

A2. Sustainable Infrastructure: The Role of Green Data Centers in Smart Cities

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As urban digitalization intensifies, smart cities in Latin America increasingly rely on data centers to manage and process extensive volumes of information. However, this infrastructure demands significant levels of energy and water, resulting in substantial environmental impact. This article examines how transitioning to green data centers—characterized by improved energy efficiency and reduced carbon emissions—can support sustainable digital infrastructure within smart cities. The purpose of this study is to analyze sustainability and energy-efficiency strategies applied to data centers in Latin American cities, with a focus on their role in mitigating environmental impacts and fostering sustainable urban development. The central research question is, “Which technologies and sustainability practices most effectively reduce the environmental footprint of data centers in smart cities, and how can implementing green data centers contribute to the goals of urban sustainability and energy efficiency in Latin America?” This study employs a comparative analysis of case studies from Brazil, Chile, and Mexico, examining Brazil's investments in solar and wind energy for data centers, Chile's leadership in renewable energy integration within technological infrastructure, and Mexico's policies that incentivize sustainable practices. The findings highlight the efficacy of practices for green data centers, including the adoption of solar and wind energy, passive cooling systems, and heat reuse technologies, while acknowledging challenges such as high initial costs and the scarcity of supportive policies. Green data centers are crucial for the sustainable development of smart cities across Latin America, advancing both energy efficiency and climate justice. However, their expansion requires targeted public policies and specific incentives.

A3. CREST—Climate-Resilient Coastal Urban Infrastructures Through Digital Twinning

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Climate change has a profound impact on urban life. Severe events like floods, droughts, and storms significantly affect cities' essential services, infrastructure, housing, livelihoods, and public health.

AugmentCity has developed an innovative approach to operate Digital Twins of cities, allowing for data analysis and “what-if” scenario simulations through an interactive, immersive visualization tool. This tool is accessible to policymakers, researchers, companies, and citizens.

The CREST initiative, co-funded by JPI Urban Europe and led by a consortium of nine partners from France, Poland, and Norway, tested this Digital Twin technology in three European urban areas. Its goal was to support resilient urban infrastructure adaptation to climate change, fostering capacity-building and collective decision-making within cities. This pioneering initiative used Augmented Reality (AR) and co-creation methods to empower the selected urban areas to address climate change challenges. Vulnerable areas received tools to create collaborative platforms that support environmental decision-making and innovative policies for robust, resilient climate responses.

After nearly three years, the project's outcomes reveal valuable, cross-cutting insights to guide researchers, businesses, citizens, civil society, and public authorities in more effective decision-making. These lessons enable the improved adaptation of urban infrastructure to climate change impacts, especially in coastal areas.

Among the project's highlights, CREST showcases how Digital Twins can engage citizens in urban planning and disaster preparedness. Key aspects include minimizing controversy, enhancing communication between citizens and professionals through a shared digital platform, and visualizing scenarios to illustrate the potential outcomes of various changes. This approach helps citizens understand necessary disaster-response actions and gain public support for essential city planning measures, such as those addressing sea level rise and flooding.

A4. Redefining Education Zoning for Equitable Access and Mobility in the Surabaya Metropolitan Area

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The current education policy in Indonesia, as regulated by the Ministry of Education, seeks to ensure equal access to public education but has revealed significant limitations, particularly in a non-urban setting. The ineffectiveness stems from its lack of consideration for inter-region access to competitive educational facilities, which results in unequal opportunities for students in certain regions. Additionally, the zoning does not align well with the goal of achieving efficient mobility across neighboring areas, as it remains constrained by administrative boundaries. This study aims to develop a more inclusive and accessible education zoning model for basic public education, spanning elementary through high school levels, within the Surabaya Metropolitan Area. By creating zones that consider cross-boundary access and educational competitiveness, this study seeks to promote a balanced distribution of educational resources and facilitate efficient mobility within this region. To accomplish these objectives, the research employs methods such as travel-time-based zones, accessibility and competitiveness indices, as well as modified effective density and compactness indices. Key variables include the availability of public transport options (Suroboyo Bus, Trans Semanggi, Surabaya Regional Railway, and Trans Jatim), the spatial distribution of public schools, and population density. This approach enables the formulation of zoning that integrates accessibility, equality, and smart mobility. Preliminary results reveal a hierarchy in access to educational facilities, with Surabaya at the top due to its abundance, while surrounding areas often face inadequate educational infrastructure. The proposed zoning model, which ignores administrative limitations, allows for inter-city access to schools, supported by comprehensive public transport routes. Zoning patterns differ by educational level, with high school zones showing more inter-city travel potential due to the consideration of national school rankings, aiming to provide students with access to the best nearby educational facilities. This model thereby enhances both educational accessibility and competitiveness within the Surabaya Metropolitan Area.

A5. Urban Activity and Children: Strategies to Promote Mobility

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This study proposes a reflection on the design and management of urban environments near public transport stops, specifically the stops of Line 4 of the tram in Valencia, to promote pedestrian and cycling mobility. The research is based on the hypothesis that urban activities aimed at children and families can encourage public transport usage and foster sustainable mobility. Through a social responsibility approach and inclusive design, this work emphasizes the importance of creating accessible and safe environments, oriented towards early education in sustainable mobility. The proposal addresses specific criteria for the tram reference nodes, prioritizing pedestrian streets, green areas, and essential services to foster social interaction and public transport usage. Ultimately, this model seeks to strengthen community ties and promote urban management that contributes to social cohesion and environmental sustainability, offering an innovative perspective for the design of inclusive and accessible cities for all residents. Using tram stops as reference nodes, a series of criteria affecting streets, facilities, and services, among others, are developed, creating an environment rich in activities where pedestrian streets, green spaces, and services dominate, thereby encouraging interaction between road users and the use of public transport.

A6. Place-making and city boosterism with metro rail – a case of impacts on quality and image of Indian metro cities

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Transport acts as an agent in constructing places, shaping cities, and developing the region. A city's image and quality may improve due to metro rail transit, which may also aid in overall development initiatives like socioeconomic development and the creation of livable and sustainable communities. The role of place-making of metro rail is examined in this article through an analysis of its tangible and substantive implications for enhancing the quality and image of the city. It presents a critical literature review of published and unpublished sources on metro rail. It also includes the qualitative impact of physical transformations in the city on various parameters such as appearance, landscape, green spaces, cleanliness, cultural identity, sense of pride, modernity, social inclusion or exclusion, environmental quality, ease of accessibility, and physical changes. It was found that positive impacts were more than negative impacts; however, it differed not only with geographical area but also with time. Through integrated transportation and urban planning initiatives, some of the cities are purposefully targeted to maximize impacts. The sociocultural approach to study is taken to focus on the interlinkages between transit infrastructure development and city boosterism along with place-making.

A7. The Relevance of the Internet of Things in the functioning of Smart Cities— Opportunities and challenges for an interconnected future

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This article examines the role of the Internet of Things (IoT) as a critical resource in formulating and implementing public policies for smart cities. Through a literature review of the past decade, drawing on articles published in reputable, highly cited journals, it explores the relationship between smart cities and Information and Communication Technologies (ICT). The study aims to understand how these technologies can be sustainably leveraged to enhance citizens' quality of life. In addition to the direct role played by IoT, its adoption by civil society has also gained increasing importance within the context of public policies and in addressing various daily community challenges. Furthermore, this study analyzes the evolution of the four most recent four Smart City Rankings (2021–2024), developed by the Institute for Management Development, to identify trends and best practices. As a conclusion, the article proposes strategies to foster sustainability in smart cities and discusses key future challenges, targeting both academic research and policymakers as well as practitioners responsible for the implementation of public policies.

A8. From Smart City Goals to Edge City Realities: Challenges and Opportunities for Guwahati's Urban Development

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This study examines the smart city developments in Guwahati, revealing significant overlaps with “edge city” characteristics as described by Garreau (1991). Though chosen for India's Smart City Mission, which promotes technology-driven governance, improved infrastructure, and sustainability, Guwahati's growth reflects features common in edge cities: reliance on car-based transit, traffic congestion, poor waste management, unplanned commercial zones, and limited focus on environmental and social equity (Bhattacharjee, 2023).

To investigate this dynamic, the study analyzes public perceptions of Guwahati's smart city efforts, focusing on ecological sustainability, infrastructure resilience, and socio-economic equity. Findings reveal significant environmental concerns as urban expansion encroaches on ecologically sensitive areas like the Ramsar site, Deepor Beel, endangering wildlife and community health (Baruah, 2020). Additionally, wildlife corridors critical for species like elephants complicate urban planning, highlighting the need for targeted protections to balance biodiversity with development.

Public feedback on issues like pollution, congestion, and insufficient green spaces indicates a disconnect from the smart city mission's vision for a livable, tech-driven urban environment. Untreated sewage and unmanaged waste pose serious health risks (Akhtar, 2021). Flash floods, combined with wetland encroachment, continue to place significant stress on Guwahati's infrastructure, which struggles to meet the demands of its growing population (Akhtar, 2017). These challenges reveal a potential mismatch between the city's smart city designation and its on-ground realities, as evidenced by Guwahati's persistent infrastructural inefficiencies and ecological strain.

The study underscores the need for adaptable smart city strategies that align with SDG 11, which advocates for resilient, sustainable urban spaces. The study highlights the importance of community-centered approaches that genuinely address local ecological and social challenges, providing valuable insights for urban policy and planning in similar contexts.

A9. Landscaping Eco-Therapeutic Healing Garden Design for Mental Health Recovery at TB Hospital, Rajshahi

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Landscape is an essential element that has a significant relationship between the spatial characteristics of nature and the mental health of human beings. Healing and therapeutic landscape design solutions are appropriate for medical facilities and individuals with health disorders. Healthcare facilities had traditionally prioritized pathogen-centric healing and should establish a purposeful and structured restorative environment to facilitate holistic healing for individuals. Despite being one of the most important hubs for healthcare in North Bengal, hospitals in Rajshahi are ill-equipped to utilize their open areas. Recognizing the significant relationship between nature, mental health, and physical healing, this research aims to create a harmonious and restorative healing garden within the hospital premises to overcome the mental distress of the patients. The research methodology involves a thorough literature analysis of the therapeutic benefits of nature and eco-therapy. By integrating principles of landscape planning, and maintaining the elements of landscape, the study formulates a framework of design guidelines and principles for the creation of a healing garden. Involving stakeholder preferences for participatory planning, the healing garden design prioritizes accessibility, safety, and inclusivity. Features such as sensory gardens, labyrinth circles, meditation areas, noise-protective trees, canopy, fountain gardens, meandering paths, rain gardens, medicinal and aromatic herbs, yoga places, and other interactive installations are strategically incorporated to foster a sense of serenity, connection with nature, and promote physical activity. Implementation of the suggested healing garden at TB Hospital in Rajshahi is expected to provide a significant enhancement to conventional healthcare approaches. An effective and well-designed healing garden supports SDG 11 through multiculturalism and social life by building better facilities for patients and employees.

A10. Water and Sustainable Development: Connecting the Communities of Dhaka City and Canals

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Water plays a pivotal role in fostering sustainable urban development, particularly in rapidly growing cities like Dhaka. Dhaka's intricate network of canals historically served as natural drainage, transportation, and community interaction hubs. However, rapid urbanization, poor water management, and encroachment have led to severe degradation of these waterways, contributing to urban flooding, water pollution, and environmental health issues. This study explores the potential of Dhaka's canals as a foundation for sustainable urban water management, aiming to revitalize these networks and enhance community resilience. Through case studies and spatial assessments, we investigate the role of these canals in supporting local ecosystems and the livelihoods of vulnerable communities. Findings indicate that integrating canal rehabilitation with community-driven approaches can yield multifaceted benefits: reducing flood risks, improving water quality, and fostering green, accessible urban spaces. This research proposes a spatial framework encompassing canal restoration, sustainable drainage systems, and active public places, highlighting the importance of connecting water with local communities. Such an approach aligns with Sustainable Development Goals 6 (Clean Water and Sanitation) and 11 (Sustainable Cities and Communities), offering a replicable model for water-centered urban renewal in similar megacities.

A11. Combined use of morphometric analysis and Hydraulic modelling to support the building of flood resilient cities

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The building of flood-resilient cities requires an in-depth understanding of cities at the subcatchment or catchment level. Morphometric analysis is one method that can provide a detailed insight into the extent to which a subcatchment and, consequently, existing built environment within the subcatchment, is at risk of flood. Another tool is the hydraulic model, which can provide similar information in more detail. A combination of both methods has the potential to improve the development of built-up areas to make them more resilient to flood. The purpose of this study is to show that even when analyses are conducted for small, steep sub-catchments, a combination of both technologies can provide detailed insight into the vulnerability of specific sites to flood challenges. A high-spatial-resolution digital elevation model was used to study a built-up area at the catchment, subcatchment, and site levels. The morphometric analysis classified the subcatchments that make up the catchment at different levels of vulnerability to flood challenges. The hydraulic model was used to identify sites where the risk of flood was highest. A field survey was conducted with the community and with the technical staff of the concerned municipality to validate the findings. This study confirms that these two technologies provide great insight and that the flood risk level can be minimised significantly at these highly flood prone sites when drainage systems are well designed. By combining these two technologies prior to the development of a built-up area, mitigation measures can be made to minimise flood risk. This study recommends this analysis prior to the development of integrated built-up areas such as smart cities.

A12. Smart cities beyond technology: reimagining quality of life through citizen centric approaches

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The rise of the rate of urbanization in Sri Lanka has intensified urban challenges and as a solution, the administration has been forced to consider smart city (SC) initiatives. This presentation aims to explore how citizen-centric smart city initiatives improve quality of life while understanding the citizens' perception regarding such initiatives. The COVID-19 pandemic, social unrest within the context, and the economic recession have led to political instability and have reflected the downside of pure techno-centric solutions.

Exploring citizen's perceptions has revealed haphazard approaches are costly mistakes made at the expense of the trust of the primary stakeholders. The qualitative design with structured interviews established the prevalence of bleak urban atmosphere, failure to understand contextual culture, and community living has been detrimental to the progress of the smart city initiatives in Sri Lanka. Smart education, robust feedback mechanisms, and a sense of belonging will be the enablers to make smart cities effective while ensuring quality of life, which is essential for national development.

The presentation will fill literature gaps by providing rich insights regarding the priorities of citizens and expectations of the functionality of an adaptable smart city which is novel to the context of South Asia. This would enable policymakers and administrators to formulate a more responsive and engaging smart city framework for low-income nations. An efficient citizen-centric setup would be the steppingstone towards inclusive growth ultimately improving the quality of life in an urban ecosystem. This presentation would lead to comparative analysis in future within the South Asian context fostering citizen-centric approaches towards smart city initiatives.

A13. Integrating Smart Technology to Enhance Place Attachment on Pocket Parks of Dasmariñas City

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The transformation of leftover spaces in residential zones of Dasmariñas city into pocket parks represents a practical and sustainable urban intervention. Despite often appearing neglected, these parks still attract visitors hence, the study's objective is to explore why they keep on visiting the pocket parks regardless of its current condition, and the study focuses on the environmental, psychological, and social factors that made the community attached to the pocket parks.

The study areas are at the three pocket parks in Dasmariñas City, employing a convergent mixed-method process of direct and naturalistic observation, and a 5-point Likert scale survey of 75 adult respondents. The findings, analysed using an ANOVA test, revealed significant differences of place attachment among the three parks. Notably, factors such as a sense of pride, environmental quality, and community engagement received the highest ratings from respondents. Thus, the combined findings show the pocket parks play a significant role in fostering socialization and facilitating community-oriented activities, individuals from different age groups visit pocket parks for varied reasons, demonstrating that the community's use of these spaces is not necessarily dependent on their physical condition. Instead, the level of attachment formed is influenced by the activities for which the park is designed.

A14. Future Cities Defined: A Multidisciplinary Analysis of Their Definitions and Characteristics Across Diverse Fields

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The growing academic focus on future cities stems from the increasing complexity of urban challenges, including rapid urbanization, population growth, and social inequality. However, varying perspectives across disciplines have resulted in divergent interpretations of future cities and their defining features, leading to a disconnect between their theoretical frameworks and practical implementation. This study aims to bridge this gap by offering a unified, multidisciplinary definition of future cities and critically examining their conceptual and functional characteristics across fields such as philosophy, computer science, engineering, environmental science, management, economics, social science, health sciences, and architecture and planning.

Employing a hybrid systematic–narrative literature review, this research identified key themes and characteristics, which were then refined through a multidisciplinary expert focus group. The findings reveal significant variations in how different fields conceptualize future cities, particularly regarding their infrastructure, resource management, innovation, adaptability, technology, and sustainability. Nonetheless, common objectives emerge: future cities aim to address the well-being and equity of current and future populations. They emphasize the integration of technology, sustainable practices, community participation, responsible citizenship, and effective governance to ensure enduring and just urban development.

B1. Empowering citizen-centric smart cities: pathways to next-generation cities in emerging economies

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Smart Cities are pivotal to creating efficient, inclusive, and environmentally responsible urban spaces to enhance the quality of life. As technology advances at an explosive rate, emerging economies have initiated efforts to develop smart cities in response to urban challenges (mobility issues, pollution, income disparities, disruptions to community living) and to align with Sustainable Development Goal (SDG) 11: Sustainable Cities and Communities. The adoption of smart cities heavily relies on the acceptance and engagement of the citizens, who are the primary stakeholders of the smart city ecosystem.

This research aims to conceptualize the behavioral intention to adopt smart cities depending on the citizens' attitudes toward Smart city initiatives, which are shaped by the perceived usefulness and perceived ease of use. In an emerging economy, addressing the gaps of socio-economic and cultural dynamics unique to this context is crucial. Furthermore, understanding the interplay of cultural nuances and technology acceptance that triggers citizen engagement is equally important.

Insights into an emerging economy would enrich the theoretical and practical benefits of offering actionable citizen-centric strategies and customized context-sensitive approaches for sustainable urban development. Ultimately, this presentation advocates for inclusive growth through smart city transformations, laying the foundation for Society 5.0, which extends citizen-centric behavior by providing flexible innovative opportunities.

B2. Theories of Future Cities for a Sustainable Tomorrow: A Systematic Literature Review

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In recent decades, sustainability has emerged as a critical focus in academic research, driven by the urgent need to address climate change, biodiversity loss, and social inequities. Cities and local authorities are increasingly prioritizing the integration of sustainability into urban development strategies. However, progress towards the 2015 Sustainable Development Goals remains limited, with only 12-15% of targets expected to be achieved by the 2030 deadline. Scholars attribute this shortfall to the lack of a comprehensive framework for sustainable urban development.

This study explores the frameworks and mechanisms of established future cities' theories in advancing sustainability, with a specific focus on principles of sustainable urban development. Using a systematic review enhanced by natural language processing and the statistical analysis of over 27,500 SCOPUS documents, the research examines more than 40 future cities' theories from 1900 to 2023. These theories are evaluated based on criteria such as comprehensiveness, consistency, empirical support, and applicability to sustainability goals. The analysis highlights mature theories like Smart Cities, Resilient Cities, and Sustainable Cities as promising approaches to sustainable urban development, though they require further refinement. The findings provide actionable insights to advance both research and practice in achieving sustainable urban development in cities.

B3. The impact of Transit Nodes on Affordable Housing and Accessible Living in Preparation for Transit-Oriented Developments: The case of the University Belt District in Manila City

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Transit-Oriented Developments (TODs) are planned unit developments located around a designated transit hub, which may include bus, train, and intermodal stations. Research indicates that introducing an effective and efficient public transport system in an area significantly changes its development values, profiles, and fabric. However, these changes can be advantageous or detrimental to a city and its stakeholders in certain instances. Recently, the Philippines and other developing Southeast Asian nations embraced the concept of TOD along railways and their associated stations, prompting these countries to secure financing from institutions such as the Asian Development Bank (ADB), Japan International Cooperation Agency (JICA), and the World Bank (WB) to initiate the implementation of TODs in their metropolitan areas. Consequently, the emergence of this development resulted in uncontrolled and rapid urbanization, leading to various potentials and constraints within the involved cities. The University Belt, located in Manila City, the capital of the Philippines, is a dendritic development focused on academic activities. Within the district, two major transit nodes are present, which have led to notable changes, including an abnormal rise in urban population density, violations of urban development regulations, environmental degradation, and an escalation in the prices of essential commodities. This paper aims to delineate observable trends and transformations within the specified district through comparative cartography and data analysis, thereby providing clear insights into the district's rapid urbanization, which is attributed to transit nodes built in anticipation of a TOD within these districts. This research will identify trends to delineate the potential and constraints of urbanization, serving as a benchmark study for the city, the Philippines, and neighboring Southeast Asian countries experiencing similar phenomena.

B4. Pamayanan, A Proposed Urban Housing Study for a Mixed-Used Housing Community at Brgy. Sto. Nino, Paranaque City

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This research is an attempt to study possible land integration of lot properties in certain areas in Barangay (Residential Community) Sto. Nino, Paranaque City. Maximizing the allowed and possible zoning on its assigned land use, and proposing an urban renewal and revitalization in the area through a mixed-use housing community, could provide additional housing units for the community, proper housing design, sanitation, and building code compliant for human habitation. This is to be proposed on parcels of land distributed to several lot owners with low storey infrastructure that does not maximize the potential land use and floor area ratio allocation provided for potential additional housing units. The study is also geared toward local government to explore and make use of it for initial outputs, and this can be integrated into the city's master plan. Furthermore, this can be presented as a base plan for a possible financial linkage to project implementation from international grants if sustainable applications are considered.

The project also envisions addressing United Nations Sustainable Development Goals—Goal 3: Good Health and Well-Being. The research shows that having a habitable home is already a key indicator of well-being. Regarding Goal 11: Sustainable Cities and Communities, the researchers aim to develop sustainable housing design and achievable green solutions for our cities, and in terms of Goal 16: Peace, Justice, and Strong Institution, transparency in housing units is a good indicator for this goal, and having a formal, well monitored, and organized home will help local administration to monitor governance and impose local peace and order through sound community and urban renewal.

B5. Integrating Traffic Simulation into Urban Planning: A Case Study of Phoolbagan, Dibrugarh

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Urban cities are increasingly grappling with traffic congestion due to the surge in vehicle numbers, posing significant challenges for urban planning. To address these challenges effectively, traffic simulation has emerged as an essential tool. This study focuses on a critical three-way traffic intersection in Phoolbagan, Dibrugarh city, Assam, India, and evaluates current traffic conditions, including traffic intensity, vehicle delay, and queue formation, using the advanced traffic simulation software PTV Vissim. Over a period of 30 days, comprehensive data collection was conducted through detailed traffic observation sheets. A simulation model was subsequently developed to analyze current traffic dynamics. The core objective of this research was to assess the potential improvements in traffic parameters through the addition of a new road at the intersection under study. The results of the simulation demonstrated significant enhancements in traffic flow, reduced vehicle delays, and shorter queue lengths when the new road was incorporated into the model. These findings underscore the importance of data-driven simulation tools in urban traffic management and infrastructure development. This study provides crucial insights and practical recommendations for urban planners, aiding in informed decision-making for future urban development and traffic mitigation strategies. By illustrating the effectiveness of strategic road network expansion, this research highlights the value of simulation-based evaluations in anticipating the impacts of infrastructural changes on traffic conditions. The outcomes serve as a foundational guide for policymakers and urban planners aiming to create sustainable and efficient urban traffic systems.

B6. Use of remote sensing techniques for assessment of land use change as a tool for sustainable urban planning in Faisalabad (Pakistan)

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Urbanization encompasses several challenges for sustainable development, such as increased pressures on land resources and ecosystems. To address this problem, knowledge of land use change dynamics is considered a key factor for guiding efficient urban planning and management. This study, therefore, presents the application of free satellite imagery in the analysis of land-use change with time in Faisalabad, Pakistan, highlighting implications for sustainable urban planning. This study used remote sensing data obtained from the Landsat and Sentinel satellites to find the pattern of urban growth, quantify land-cover class change, and analyze its overall environmental impact. This study applied methods of supervised classification and NDVI analysis to quantify changes in land use with a special focus on the transformation because of urbanization in green spaces, agricultural lands, and water bodies. This study helps to reduce the trends of expansion to inform zoning regulations and stimulate practices for sustainable development. This research emphasizes how remote sensing could offer a data-driven tool for decision-making by urban planners to enhance environmental sustainability, create more resilient city centers, and do so without the need for further data capture from local departments.

B7. Green Infrastructure and Digital Technologies: A Path Towards Sustainability and Climate Resilience

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Green infrastructure is a vital strategy for achieving sustainability and climate resilience in smart cities, offering both ecological and social benefits. This article explores the role of green infrastructure in Latin American and Caribbean cities, highlighting its potential to mitigate the effects of climate change and improve urban quality of life. The purpose of this study is to assess the impact of green infrastructure on climate resilience in Latin American smart cities, with a particular focus on sustainability and quality of life. The guiding research question is: "How does green infrastructure contribute to climate resilience in smart cities, and what are the primary challenges and benefits of this approach in Latin America?" This study includes case analyses of Latin American cities that have implemented green infrastructure solutions, such as urban parks, green roofs, and ecological corridors, to address climate change. The solutions analyzed demonstrate improvements in air quality, reductions in flooding, and increased urban biodiversity, alongside social benefits. Investing in green infrastructure offers a viable and sustainable path for Latin American cities, fostering a greener and more resilient urban environment for their residents.

B8. Modular Recycling Hubs: Enhancing Urban Sustainability in Smart Cities—A Case from Dhaka

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Dhaka, one of the most densely populated cities in the country, faces significant challenges in urban waste management and sustainability. Old Dhaka houses diverse small-scale industries, including a vital recycling micro-industry that processes materials like metal, plastic, and paper. Modular recycling hubs offer a novel architectural solution to these challenges by creating adaptable spaces that improve waste management, enhance worker safety, and optimize resource efficiency through design and technology integration. This paper explores the impact of modular recycling hubs on urban sustainability in Dhaka, focusing on architectural innovations for social and environmental well-being.

A socio-survey of recycling sector workers reveals insights into their working conditions, safety concerns, and environmental needs, directly informing the hub's architectural design. The proposed solutions feature improved layouts incorporating ventilation, natural lighting, and safety features, creating safer, more efficient spaces. These design elements are further supported by recommendations for future IoT-based integrations to monitor air quality, equipment performance, and environmental safety, aligning with smart city goals.

The modular design minimizes urban transportation demands, reduces energy consumption, and allows for flexible deployment based on local waste generation and population density. Integrated green spaces within the hubs contribute to Sustainable Development Goal (SDG) 11 by promoting environmental well-being and social inclusion, while enhanced workspaces support SDG 8 through safer working conditions.

Modular recycling hubs embody smart city principles by merging eco-friendly, connected, and adaptable infrastructure. They contribute to environmental sustainability, social equity, and economic resilience by creating jobs, offering affordable recycled materials, and enhancing quality of life. Adopting modular recycling hubs could transform waste management practices, positioning Dhaka as a model for sustainable urban development nationwide.

B9. An Agent-Based Study of Greater Pedestrian-Level Interaction in Block-Based Housing

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Block-based housing developments offer multi-functional, community-oriented spaces that promote resident interaction and strengthen community ties. Unlike high-density, plot-based development, which can lead to isolation and stress, block layouts incorporate shared and green spaces that improve mental well-being and foster social relationships. These developments also support sustainable urban growth by enhancing walkability, reducing car dependency, and enabling eco-friendly practices such as energy-efficient designs and green infrastructure. However, criticisms of block-based housing include potential architectural monotony and social stigmatization, particularly in low-income areas, spurring calls for more aesthetic and socially inclusive designs.

This study quantitatively assesses pedestrian interaction in an urban block-based housing development, comparing it to a plot-based layout on the same parcel.

An agent-based simulation was used to analyze pedestrian flow in block-based and plot-based layouts. Demographics and interests were categorized as the following agents: Adult Males (grocery, hardware, pharmaceuticals), Adult Females (grocery, pharmaceuticals, social spaces), and Children/Young Adults (food, play, books). A simulated population of 100 agents, each with a 120° viewing angle, was implemented to create realistic visual perception and navigation.

The plot-based development restricted pedestrian flow to street-level and external pathways, limiting interaction. In contrast, the block-based design enhanced cross-circulation, frequent social interactions, and a higher utilization of community spaces, especially by women. This layout led to a more socially interactive, pedestrian-friendly environment.

The findings suggest that block-based designs can meet diverse demographic needs more effectively than plot-based layouts, creating livable, user-interactive spaces that enhance community engagement. Successful applications of quasi-block-based housing illustrate effective integration of commercial and residential uses, adaptability to changing density requirements, and better access to public spaces. This study's insights support the potential benefits of block-based designs for modern urban planning.

B10. Towards Sustainable Transit Hubs: Innovative Design Strategies

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Transit hubs have the potential to significantly enhance urban mobility by encouraging the use of public transport, multi-modality, walking, cycling, and shared mobility. Indeed, locating various modes of mobility in the same place would increase the visibility of the modes provided and the economic benefits. However, these hubs often suffer from a negative perception as malfunctioning, crowded, and unsafe spaces. This research explores the potential of innovative design strategies and placemaking to transform transit hubs into vibrant, welcoming, and attractive destinations. By integrating elements of architecture, landscape design, public art, and community engagement, transit hubs can be re-imagined as social and cultural hubs that enhance the overall quality of urban life. Furthermore, this research investigates the impact of design interventions on passenger experience and surrounding land use development.

Ultimately, this study aims to provide practical guidelines for creating transit hubs that can reduce traffic congestion, improve air quality, increase economic activity in the surrounding area, and harbor enjoyable places.

B11. Analysis of ISO 37122 Transport Indicators: A Brazilian Case Study

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The accelerated and disorderly urbanization process of urban centers has resulted in several environmental impacts, compromising public health and hindering the development of cities. In this context, the measurement of urban indicators can be an important ally in the process of urban management and planning. By understanding these indicators, it is possible to acquire subsidies to help develop more effective strategies for each area. In this regard, the objective of this article was to analyze the transportation indicators of ISO 37122—Sustainable cities and communities—Indicators for smart cities, in the context of the city of Passo Fundo, in Rio Grande do Sul, Brazil. In addition, we aimed to investigate the level of development of the city in relation to these indicators, determining those that lack investment by public management, and which initiatives the city has implemented or plans to implement that are aimed at improving the indicators analyzed. For the research methodology, initially, a bibliographical review was carried out on the themes of urban indicators, Smart Cities, and ISO 37122. Soon after, data collection was carried out in relation to the transport indicators of ISO 37122 and the city of Passo Fundo in RS. From the results, it was possible to verify that, despite having satisfactory indices, the city of Passo Fundo lacks improvements in some indicators, such as the system indicator for monitoring the availability of public parking spaces in real time, and the presence indicator of public transport lines equipped with Internet connectivity for users. Furthermore, it was possible to observe the importance of data management with regard to urban indicators, which are important tools for the planning and development of cities, aiding in more decisive decision-making in directing public policies and investments by urban management.

B12. Empowering Smart Cities: A Citizen-Centric Framework through a 5 Dimensional Approach

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With the inception of smart cities, citizen participation in project prioritization has advanced significantly, transitioning from nascent technological applications to today's top-notch technology incorporating learning and social innovation. Despite the presence of numerous frameworks regarding the decision making process in smart city projects, a substantial gap remains in incorporating citizen participation. This presentation describes a mixed-method research approach by using both qualitative and quantitative data in order to address the gap. The research contribution is the development of a comprehensive framework incorporating citizen participation into smart city planning, guided by the 5 Dimensional humanistic approach model. This model for smart cities includes 5 dimensions: (1) Environmental, (2) financial-economic, (3) political-governance, (4) social-people, and (5) technological. By incorporating this humanistic approach model our framework will contribute to well-informed decisions by fostering an inclusive better quality of life due to the participation of citizens and local authorities. The framework integrates ISO standards and 5-Dimension model, focusing on human-centric approach of infrastructure management of smart cities.

B13. Building Resilient Communities: Flood Risk and Vulnerability Analysis in a Smart Sustainable City Framework

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Flooding is a significant challenge to urban resilience, especially in the context of smart sustainable cities, where environmental, social, and economic factors must be carefully integrated. This study focuses on modeling and simulating flooding scenarios in Tampa, Florida, leveraging high-resolution LiDAR data to construct a Digital Elevation Model (DEM) and compute flow accumulation across the study area. By simulating flooding caused by sea level rise and storm events—both exacerbated by the increasing threat of climate change—we identify at-risk areas and assess the potential impacts on them.

To quantify these impacts, we analyze the economic and social consequences of flooding. Financial losses are estimated using current property valuation data, offering insight into potential costs to property owners and the broader economy. Social vulnerability, assessed through census survey data, highlights how vulnerable groups—such as low-income families, individuals with disabilities, and those facing language barriers—are disproportionately affected by flooding events.

This work contributes to the advancement of smart cities by integrating geospatial technologies, climate risk assessment, and social equity considerations into urban planning and decision-making. The insights gained can guide Tampa and other cities in creating targeted mitigation strategies, prioritizing resources, and fostering community resilience. By addressing both the economic and social dimensions of flood risk, this study helps to build a more sustainable, inclusive, and adaptive urban environment, ensuring the well-being of all community members in the face of growing climate challenges.

