Computer Science for Green Technologies and Sustainable Development: Invited session Report at KES 2023

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Abstract

This report provides an overview of the Invited Session titled "Computer Science for Green Technologies and Sustainable Development", held during the 27th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems from September 6–8, 2023, in Athens, Greece. The session was co-chaired by Adam Sulich and Tomasz Zema, with additional organizational support from Letycja Sołoducho-Pelc. The session requirement was attendance by participants in person. The purpose of this report is to summarize the papers presented and the discussions that took place within the session. Therefore, this paper has a descriptive approach and does not attempt to combine the presented papers.

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Introduction

Green technological change and sustainability are urgent topics of practice, research, and theory that need to be addressed (Sulich & Zema, 2023). Therefore, this invited session titled "Computer Science for Green Technologies and Sustainable Development" invited both academics and practitioners who are involved in the development of green technologies as a pathway to sustainability to participate in this conference session. The session was co-chaired by Adam Sulich and Tomasz Zema, with additional organizational support from Letycja Sołoducho-Pelc. This group of scholars represented the Wroclaw University of Economics and Business. Tomasz Zema is a researcher interested in forecasting fuel sales (Zema i in., 2023) and the applied aspects of machine learning; he also has practical experience in business programming. Adam Sulich and Letycja Sołoducho-Pelc, on the other hand, represent management aspects, and their research focuses on sustainable development and the creation of green jobs (Sulich & Sołoducho-Pelc, 2022). This group of researchers participated in the KES conference for the third time, but it was their first occasion serving as chairs of the invited session titled "Computer Science for Green Technologies and Sustainable Development".

In this session, alongside the audience in the conference room, there were participants from various academic universities:

1. Łukasz Kozar from the Univeristy of Lodz in Poland, who is an expert in sustainable and green labor markets (Kozar, 2017);
2. Sudha Prathyusha Jakkaladiki, from the University of Hradec Kralove in the Czech Republic, is interested in the current advancements in fuzzy logic and machine learning;
3. Martin Schieck, Ingolf Roemer, and Sebastian Zurner from Leipzig University in Germany, who are interested in automation, computer science, and AI application in agriculture and business practice;
4. Maros Cavojsky from the Slovak University of Technology in Bratislava, Slovakia, is an expert in modeling, machine learning, and map trajectories (Cavojsky & Drozda, 2023);
5. Iwona Chomiak, Joanna Martusewicz, and Ewa Walaszczyk, from Wroclaw University of Economics and Business, are experts in computer science applications in decision-making models and sustainable management.

The session's objective was to foster a scientific exchange of ideas and facilitate discussions on the design of systems, particularly the Internet of Things, as well as programs and management tools that contribute to sustainability. A significant emphasis was placed on the dual roles of AI in sustainable development: the use of AI for sustainability and the sustainability of AI itself, including the reduction of carbon emissions and optimization of computing resources. Despite the increasing number of publications aimed at the Sustainable Development Goals, the intricate and often overlooked connections with AI warrant further investigation.

The urgency of green technological change and sustainability as critical areas of practice, research, and theory was a central theme. Academics and practitioners engaged in the development of green technologies as a pathway to sustainability were encouraged to participate. The session covered a broad spectrum of sustainability interpretations and approaches, with a special focus on AI. Topics of discussion included carbon emissions measurement, AI model training and tuning, smart cities, the Internet of Vehicles (IoV), sustainability impact assessments, sustainable policy, green management, and the economy; AI's role in these areas; sustainability and human rights; sustainable AI in the energy sector; and the value of sustainability in guiding AI development.

Summary of the presentations

This session explored the diverse meanings of sustainability and brings together a wide range of approaches to this problem in the context of AI especially, but not exclusively. Interested researchers were invited to address any of the following topics (not exclusive):

- carbon emissions measurement, training and tuning AI models,
- smart cities and the Internet of Vehicles (IoV),
- sustainability impact assessments,
- sustainable policy, green management,
- green jobs and a green economy,
- AI for green management, green economy, and sustainability
- sustainability and human rights,
- sustainable AI and energy sector,
- sustainability as a value to steer AI.

The chairs of this session were open to new topics of the scientific discussion proposed by the KES 2023 participants. However, the publications that were selected for presentation in this session underwent a rigorous double-blind review process. In this invited session, there were seven scientific papers presented as below:

Łukasz Kozar presented his scientific presentation about the paper titled “Self-employment and Sustainable Development: Using ICT Solutions for Greening Economic Activity”. This paper examines the impact of information and communication technologies (ICT) on promoting environmentally conscious self-employment within the framework of sustainable economic development (Kozar & Oleksiak, 2022). The research scrutinizes 603 applications for grant aid to start businesses in the Łódź region of Poland, with the goal of pinpointing primary sectors where ICT is leveraged for eco-friendly self-employment and assessing whether ICT can spur the creation of such opportunities. The findings reveal that ICT is a key component in nearly three-quarters of the green self-employment proposals, with digital communication, online presence, and e-commerce being the predominant uses. The qualitative assessment indicates that ICT is not only pivotal for initiating green self-employment ventures but also enhances their ecological sustainability by diminishing carbon emissions and optimizing the use of resources. The paper highlights the transformative role of ICT in the green evolution of the economy and calls for more in-depth studies on the synergy between green self-employment and technological advancements.

The paper "Modelling and Use of Adaptive Control Using Petri Nets" by Kristian Fodor, Zoltán Balogh, Ján Francisti, Martin Drozda, and Maros Cavojsky delves into the critical role of modeling in the application of control theory, especially at higher levels where the verbal articulation of control objects is essential. Maros Cavojsky presented this paper. This paper addresses the challenge of ambiguity in verbal descriptions by proposing the use of Petri nets (PN) to model and control components within an intelligent home environment. The study focuses on creating a model for temperature regulation, a pressing concern given rising energy consumption and costs. It demonstrates the transfer of the model to the Simulink environment using IF THEN rules, evaluating its performance with the goal of optimizing energy usage and reducing costs in households. The paper emphasizes the potential of Petri nets in smart home applications, aiming to enhance energy efficiency and cost-effectiveness through adaptive control techniques.

The article "Creating good practice in effective sustainability management by

implementing the EFQM model" by Iwona Chomiak-Orsa and Joanna Martusewicz investigates the development of good practices in sustainability management through the implementation of the EFQM (European Foundation for Quality Management) model in organizations. The authors conducted a systematic literature review complemented by qualitative empirical research, including case studies, interviews with managers, and focus groups, to verify the potential of the EFQM model in enhancing sustainability management. The research aimed to align the EFQM model with the sustainable development goals set by the UN for 2030, assess the sustainability benefits of the model, and define experiences that could be considered good practices. The study found that while the EFQM model is a significant tool for improving environmental and sustainability initiatives, the relationship between quality management and sustainability is complex and not always directly positive (Martusewicz i in., 2022). However, the EFQM model, particularly its 2020 version, is strongly grounded in sustainable development issues, making it a viable framework for organizations aiming to integrate sustainability into their operations and strategies (Lewoc i in., 2015).

The paper by Martin Schieck, Ingolf Roemer, Anika Oertel and Bogdan Franczyk titled "Evaluating the Economic and Sustainability Impacts of Drones in Viticulture using BPMN-based Simulation" explores the economic and sustainability impacts of drone technology in viticulture, marking a pioneering study in this domain (Franczyk i in., 2020). It evaluates the potential of drones as an automated solution to enhance viticultural business processes, contrasting them with traditional methods such as backpack and trailed sprayers. By employing Business Process Model and Notation (BPMN) for simulation, the research assesses the integration of sustainability indicators into business operations. The results indicate that drone automation can significantly contribute to the sustainability and efficiency of agricultural practices. This methodological approach, supported by literature and expert insights, suggests that drones not only improve the economic aspects of viticulture but also align with sustainable agricultural advancements.

The paper "Sustainable Development of AI applications in Agriculture: A Review" by Sebastian Zürner, Lukas Peter Deutschländer, Martin Schieck, and Bogdan Franczyk provides a comprehensive analysis of the role of AI in promoting sustainable agriculture. It highlights the urgent need to increase food production sustainably in the face of challenges such as climate change, land degradation, and biodiversity loss. Through systematic literature reviews, the study identifies and examines AI applications that can enhance agricultural efficiency and sustainability (Franczyk i in., 2020). A significant contribution of this work is the Data-Model-Purpose (DMP) matrix, which categorizes AI applications in agriculture based on data sources, algorithms, and their purposes. The paper underscores the importance of AI in achieving sustainable intensification in agriculture, which is crucial for meeting the increasing global food demand while minimizing environmental impacts. The authors' findings suggest that AI-driven smart farming and precision agriculture can significantly contribute to the sustainability goals of modern agriculture (Zema i in., 2022).

The paper "Study of Uncertainty and Inaccuracies of the Income for Inequality Paradox through Fuzzy Logic for Sustainable Development" by Sudha Prathyusha Jakkaladiki and Martina Janečková explores the application of fuzzy logic to quantify the uncertainty and inaccuracy in income disparities, particularly focusing on the gender income inequality in the European Union. The study aims to address the Sustainable Development Goal of reduced inequality (SDG: Goal 10) by examining the differences in earnings between male and female workers based on their educational attainment. Using data from the Organization for Economic Cooperation and Development Statistics, the authors apply fuzzy logic to measure the degree of uncertainty and inaccuracy in the income inequality paradox (Jakkaladiki i in., 2023). The paper emphasizes the importance of understanding and quantifying these disparities to inform policymakers and contribute to sustainable development efforts.

The study "Key decision factors in the shared economy decision-making model" by Michał Nadolny, Maja Leszczyńska and Ewa Walaszczyk investigates the determinants that shape consumer-contributors' choices within the shared economy, characterized by peer-to-peer exchange facilitated through digital platforms. Drawing from a comprehensive survey of 1,620 individuals actively engaged in both consuming and providing services or goods, the research pinpoints pivotal factors that guide their decision-making. These factors include preferences for sharing, the degree of trust in the platform and other users, the benefits they perceive, awareness of potential risks, and their readiness to participate in sharing (Markowska i in., 2022). The paper also examines the impact of personal income satisfaction on how these elements are valued by consumer-contributors. The findings emphasize the critical roles of trust and perceived advantages in navigating the shared economy, shedding light on the intricate behaviors and preferences of participants in this burgeoning economic paradigm.

There was a fruitful discussion and exchange of ideas following each presentation. The session concluded with the presentation of certificates and a commemorative photo of the session chairs with the presenter. Finally, a group photo of the participants of the invited session "Computer Science for Green Technologies and Sustainable Development" (Figure 1).

Figure. 1. Family photo of the session participants taken the Tomasz Zema.

Report summary

The presentation of papers during the "invited session" at the scientific conference served as a significant platform for the exchange of scholarly views among researchers concerned with the challenges of sustainable development and the practical application of knowledge in the field of computer science. Such interactions and discussions within an international community not only stimulate scientific progress but also foster the creation of new concepts and projects.

The conference venue, the Royal Olympic Hotel in Athens, added remarkable value to the event. Situated in the heart of the city, the hotel provided magnificent vistas of the Temple of Zeus, the National Garden, and the Acropolis. Athens, recognized as the cradle of democracy where ancient philosophers once disseminated their knowledge, undoubtedly contributed to the conference's unique ambiance. Furthermore, the city, rich in culture and art and known as the birthplace of the modern Olympic Games and the European Capital of Innovation in 2018, offered an excellent backdrop for international scientific exchange.

The conference featured an array of keynote speeches, oral and poster sessions, invited sessions, and workshops, focusing on the theory and applications of intelligent systems and related scientific fields. Such a structure undoubtedly fosters international collaboration.

All the papers presented were to be published in the conference proceedings in Elsevier's Procedia Computer Science journal, an open-access publication with the potential for indexing in databases such as ISI conferences, Engineering Index, and Scopus. The conference's status, rated 'B' in the CORE conference ranking system, and the awarding of 70 points by the Polish Ministry of Science and Higher Education attest to its high standing.

The conclusion of the conference also served as an occasion to announce the next edition of this prestigious event and the theme of the forthcoming "invited session" to be held in Seville. This highlights the continuity and significance of the conference for the academic community and its international dimension. 👁

Tomasz Zema – doktorant Szkoły Doktorskiej na Uniwersytecie Ekonomicznym we Wrocławiu. Jego zainteresowania naukowe koncentrują się wokół zagadnień łączących uczenie maszynowe i metody prognozowania ze zrównoważonym rozwojem. Pasjonat fotografii, przyrody i podróży.
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