Chapter 13
Computational Intelligence for Green Cloud Computing and Digital Waste Management

Sana Dahmani
Independent Researcher, Germany

ABSTRACT

The intersection of environmental protection, Sustainable Development Goals, and the role of information technology (IT) is to foster it. Artificial intelligence addresses environmental challenges, offering solutions such as emissions reduction, cost savings, legal compliance, HR attraction, optimized investments, and waste management. The "three Rs" of green IT emphasize sustainable hardware management through reuse, refurbishment, and recycling. Green IT aligns with broad sustainability and ESG standards and is fostered with innovative AI solutions to integrate and optimize AI-based green computing algorithms which address environmental impacts and data utilization strategies, optimizing energy consumption, and mitigating digital waste and carbon footprint. The conclusion advocates increased use of AI-built technologies for the adoption of renewable energy sources, energy-efficient hardware, hardware optimization, and exploration of external cloud solutions for a more sustainable future.

I. INTRODUCTION

Digital transformation acts as a stimulus for sustainability through the promotion of innovation, enhancement of resource efficiency and enablement of eco-conscious decision-making. Integrating artificial intelligence (AI) and machine learning (ML) facilitates data analysis for the purpose of identifing inefficiencies and optimizing resource deployment, and reducing energy consumption within buildings, factories, and transportation. Digital platforms support circular economy principles through the minimization of waste through product reuse and sharing. Blockchain enhances supply chain transparency for ethical sourcing, a better ebergy efficiency and the development of smart cities (Parmentola et al., 2021). Digital tools empower individuals to make environmentally conscious choices and suypport organiza-

DOI: 10.4018/979-8-3693-1552-1.ch013

tions to provide optimal sustainable solutions. Smart grid technologies optimize energy distribution and integrate renewable sources, thus, reducing dependancy on fossil fuels. Precision agriculture, enabled by sensors and AI, minimizes resource use through the real-time environmental monitoring which also provides crucial data for informed decision-making, and smart city initiatives optimize urban planning for reduced environmental footprints. To sum up, digital transformation contributes to sustainable development, harmonizing technological advancement with environmental stewardship.

According to (UNDP, 2023), digital transformation hastens sustainable and inclusive development. To harness the immense hidden and identified potential of digital technologies for development while ensuring inclusivity and sustainability, a conscious endeavor must be prepared to guide technology development and national digital transformation. The United Nations Development Programme (UNDP) advocates for an inclusive digital transformation which addresses the needs of the most vulnerable groups, covering the destitute, women, and people with disabilities. The core goal is to prevent the exacerbation of existing inequalities and empower underrepresented groups, fostering meaningful participation and gender equality. Furthermore, the emphasis is on safeguarding individuals from the adverse effects of digital technologies and promoting the use of responsible, rights-based, and open digital technology. Drawing on over a decade of experience in supporting developing countries with digital transformation, the UNDP has responded to the accelerated digitalization prompted by the COVID-19 pandemic. Employing a whole-of-society, inclusive, and rights-based approach, the UNDP advises countries on digital strategies, governance frameworks, and the implementation of digital public infrastructure. Insights gained from country-level digital interventions highlight three key ways in which digital transformation propels sustainable and inclusive development: enabling economic development, building resilience, and facilitating climate adaptation. In the contemporary technological landscape, IT/OT integration and digital transformation are pivotal paradigms that converge Information Technology (IT) and Operational Technology (OT). Historically functioning in isolation, IT and OT integration aims to dismantle silos, fostering connectivity to enhance communication, streamline processes, and unlock the full potential of data and technologies. Digital transformation involves leveraging various technologies to reshape business processes, organizational structures, and customer experiences, achieving efficiency, innovation, and growth. Key sub-topics include data-driven decision-making, customer experience transformation, process automation, business model innovation, digital culture and leadership, cybersecurity, digital talent development, and the integration of emerging technologies. These interconnected elements collectively shape organizations' trajectory in the ongoing digital transformation journey. Digital transformation and cloud computing, influential forces in today's business landscape, involve leveraging digital technologies to fundamentally alter business operations and provide value to customers. Cloud computing, delivering various computing services over the Internet on a pay-as-you-go basis, enhances agility, innovation, and scalability, reduces costs, improves collaboration, and offers robust security measures. This integration fosters an improved customer experience by providing global accessibility to data and applications. Various strategies including cloud-first, hybrid cloud, multi-cloud, and cloud-native, can be adopted based on specific business needs and goals. The implementation of digital transformation and cloud computing involves assessing the current IT infrastructure, developing a cloud strategy, selecting a well-fitting provider, migrating IT infrastructure to the cloud, and managing the cloud environment to ensure security, reliability, and scalability. While the process is complex, successfully embracing these transformations, appoints businesses for future success (Andhra Pradesh Grama Sachivalayam, 2019). The concept of the "Green Cloud" encapsulates the prospective environmental benefits offered by cloud computing, a paradigm that migrates IT services to the internet. Anticipated benefits include a notable 38%