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DIGITALIZATION IN ENGINEERING AND ECONOMICS AS A DRIVER OF INNOVATION AND GLOBAL CHALLENGES

The rapid advancement of digital technologies has become a defining feature of contemporary engineering and economic processes. In the context of European integration, digitalization acts as a powerful catalyst for innovation while simultaneously generating complex global challenges that require interdisciplinary solutions.

The paper aims to explore the role of innovative digital technologies in engineering and economics and to analyze the major global challenges they pose to modern society.

First, it is important to clarify the concept of digitalization and how it differs from related terms. Digitalization refers to the adoption and integration of digital technologies into business models, processes, and value chains, fundamentally transforming how organizations operate and deliver value (Brennen & Kreiss, 2016). Unlike simple digitization (the conversion of analog data to digital form), digitalization involves broader organizational and cultural changes. In engineering, it manifests through digital

twins, additive manufacturing, Internet of Things (IoT), and artificial intelligence-driven design. In economics, it appears in FinTech, blockchain-based transactions, big data analytics, and algorithmic decision-making systems.

Second, the specifics of digitalization within engineering and economics deserve closer examination. This process closely overlaps with the Fourth Industrial Revolution (Industry 4.0), which emphasizes connectivity, automation, real-time data exchange, and cyber-physical systems. The core features include high productivity, resource efficiency, and data-driven innovation. The persuasive function of digitalization is evident in its ability to accelerate economic growth, optimize production cycles, reduce costs, and promote sustainable development. Consequently, digital transformation is realized across socio-economic and technological spheres. Its primary purpose is to solve production and market problems, shape stakeholder attitudes toward innovation, raise awareness of sustainable practices, and promote progressive economic models. The outcomes target a broad range of actors: businesses, governments, and society, rather than narrow professional groups (Parviainen et al., 2017).

Finally, several distinctive features and technologies characterize digitalization in engineering and economics and often serve as both drivers of progress and sources of global challenges:

1) necessity of interdisciplinary integration between engineering expertise and economic analysis;

2) widespread use of cutting-edge tools such as IoT, blockchain, artificial intelligence, and cloud computing;

3) intensive application of big data analytics for strategic planning and risk assessment;

4) deployment of simulation software, digital platforms, and virtual reality technologies;

5) growing emphasis on cybersecurity protocols, ethical AI frameworks, and sustainable technological solutions;

6) implementation of flexible management models that allow enterprises to quickly adapt to market fluctuations, foster cross-border partnerships, and systematically mitigate operational risks (Schwab, 2017).

Thus, innovative digital technologies are indispensable for efficiency, competitiveness, and sustainability in engineering and economics. However, they also create serious global-scale problems: the rise of cyber-physical attacks, the deepening gap between digitally advanced and lagging regions, the displacement of traditional jobs by automation, the lack of transparency in AI-based economic decisions, and the growing energy consumption of IT infrastructure. Addressing these issues requires not only technical solutions but also international legal frameworks, inclusive education, and cross-cultural cooperation. Further research should focus on mitigating these risks while embedding digital tools into the European scientific and educational space with respect for cultural diversity.

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