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DEEP TECH AS A SOLUTION TO GLOBAL CHALLENGES IN THE CONCEPT OF INDUSTRY 5.0

Recent trends include digital transformation, automation, and robotics in manufacturing and management processes, shifts in consumer behavior values (sustainable consumption and environmental awareness), the environmental impact of production, and enhancing system resilience to external risks, among others. Accordingly, in line with the concept of Industry 4.0, national economies are

undergoing digital transformation, while Industry 5.0 concept represents a green transition, an improvement in the resilience of value chains and ecosystems to new disruptions.

Unlike the concept of Industry 4.0, which is technology-centric, Industry 5.0 concept is centered around a human-centric approach to the use of technology. Therefore, the pressing issues in contemporary societal development include global challenges related to human capital development, the enhancement of intellectual resources, and the social and environmental responsibility of businesses. The primary focus of business process development is to increase the ability to rapidly respond to crisis factors and situations, fostering flexibility and adaptability within systems. In this context, the use of 'deep technologies' becomes essential for achieving resilience in business organizations. These deep technologies represent innovations stemming from profound research. Their implementation requires significant intellectual and economic capital. However, the use of these technologies must be strategically oriented, and in the future, Deep Tech solutions should become scalable and transparent solutions. Particularly noteworthy are Deep Tech solutions within the context of Ukraine's innovative economic recovery and the establishment of a competitive industry in the post-war period.

Deep Tech solutions represent a reimagining of fundamental capabilities that address real and significant societal and economic challenges. The primary goal of Deep Tech technologies is to enhance the quality of life for the population by creating innovative solutions and products. Deep Tech is characterized by scientific and technological novelty. Innovations that support Deep Tech include cloud computing, additive manufacturing, genome editing, voice services, microsatellites, wireless power, artificial intelligence, machine learning, and robotics [1]. It is undeniably Deep Tech that plays a key role in realizing the fundamental concepts of Industry 5.0.

Industry 5.0 is the contemporary phase of industrial development that complements the concept of Industry 4.0. It places particular emphasis on the interaction between people and technology. Today, social and environmental issues requiring a more humane and rational use of resources and technology in production and consumption are highly relevant. Additionally, ethics and boundaries in the use of artificial intelligence are pressing concerns. The primary goals of the Fifth Industrial Revolution relate to three spheres: economic, social, and environmental, as illustrated in Figure 1. Achieving these goals can be facilitated by strengthening the connections between the government, businesses, and science, which are integral elements of the Deep Tech ecosystem.

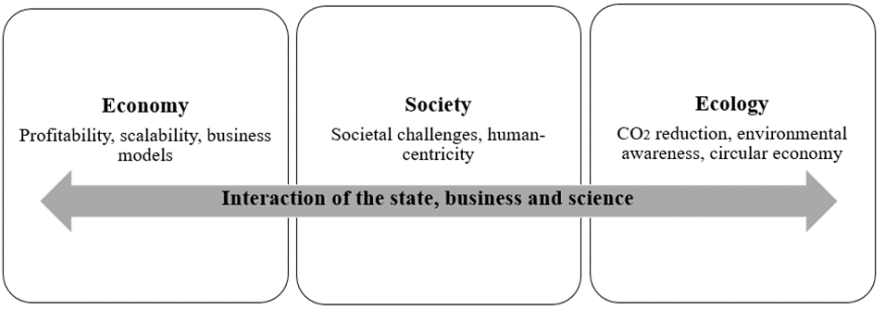

Figure 1 – Goals of Industry 5.0 and their achievement vector. Source: adapted by the author [2].

As Deep Tech solutions exist at the intersection of various disciplines, modern engineers, researchers, and scientists from diverse fields can develop Deep Tech projects aimed at optimizing production, rationalizing resource use, creating alternative energy sources, advancing medical and societal well-being, and fostering a favorable environment for human-technology collaboration.

However, the main obstacles to the widespread adoption of Deep Tech in various sectors include their high scientific complexity, cost, and the absence of a robust research and development system as well as government support. Currently, most deep technological innovations are in the stages of scientific ideas or research. To commercialize them and make Deep Tech projects more appealing to investors, it is essential to establish a high-quality and versatile product development model. This model will facilitate scientific research in deep technologies that can be suitable for market integration.

For Ukraine, challenges in the development of Deep Tech include an imperfect legislative framework for regulating intellectual property, copyrights, patents, and inventions, as well as a nearly absent state financial support system. Consequently, contemporary Ukrainian researchers may not be inclined to work on deep technologies, while domestic businesses and private stakeholders may find more benefit in acquiring foreign technologies, often several technological levels below the achievements of local scientists.

Therefore, to address global development challenges envisioned in the concept of Industry 5.0 through the implementation of Deep Tech projects in Ukraine, it is essential to establish a strong interconnected relationship among science, business, and the government to meet each other's needs. Additionally, there is a need to develop a robust research and development system, which can be realized through the creation of technology parks, technopolises, business incubators, experimental laboratories, and more. These measures will enable the

involvement of Ukraine's domestic scientific and creative talent in working on deep technologies and utilizing them to address global issues on a national and global scale during the post-war recovery of Ukraine's economy.

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