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Understanding green and digital transformation of universities in the context of Industry & Society 5.0

The recent COVID-19 pandemic has undoubtedly raised new questions regarding the future image of the innovation ecosystems, the relations between the main actors of innovation and the challenges they need to face in order to rapidly transform to new modes of operation related to digitalisation, digital transformation (DT) and to become resilient organisations. As we already indicated, this time of global crisis has also accelerated a world-wide debate on related wicked and complex problems and challenges called Sustainable Development Goals (initiated by the United Nations decades ago and proposed in 2015 as Agenda 2030), that gained their momentum. “Green” and “Digital” have become “big ideas” and leitmotifs of this debate (Carayannis and Morawska-Jancelewicz, 2022). Digitalization and greening of the economy are considered as twin concepts that promote sustainable development. New digital technologies including Artificial Intelligence (AI), Internet of Things (IoT), robotics, cloud computing, machine learning are used to collect, assess, analyse data related to sustainability and communicate those results to a wider public. They help to raise awareness and to advocate for more engagement from the society in solving complex problems through e.g. citizen science projects. They lead to better governance and more inclusive innovation processes. There are many challenges related to DT such as data security and transparency, or the carbon footprint of the ICT sector, but still there is a wide agreement on digital and green alignment and inter-relation. We believe that a future-oriented discussion is needed related to ongoing significant changes in the economy and society that will help to adapt or to better respond to undergoing substantial transformation with innovation as the driving force. The 2020 Agenda also expresses high expectations that innovation will play a central role in addressing (SDGs). We also agree with Khan et al. (2021, p. 2) that *the concept of sustainability in the digital transformation context, challenges traditional approaches to problem solving and demands more systemic ways of addressing change. This means that the current progression of sustainability and green economies requires a shift from homogenic systems of ‘doing things better’ towards holistic systems of ‘doing better things’.*

In this paper we will focus on two fundamental theoretical constructions that in our opinion play a crucial role in the process of green and digital transformations (twin transformations). That is the Quadruple/Quintuple Helix framework of innovation ecosystem (Carayannis et al., 2021a, p. 11; Carayannis, 2017; Carayannis, 2021d) that opens up a new perspective in understanding the modern process of innovation, that is open, non-linear, co-created, co-constructed and inclusive with civil society organisations and the environment as the active actors. The second vision is recently discussed concept of Society 5.0 and Industry 5.0 (Carayannis et al., 2021a, b, c; Carayannis & Morawska-Jancelewicz, 2021; Carayannis, 2021a, b, c, d; Carayannis, 2020b; Breque et al, 2021; Fukuyama, 2018) highlights the need to re-think existing working methods and approaches toward innovation and to focus them on developing human-oriented solutions and social innovation (Morawska-Jancelewicz 2021). Potočan et al. (2021, p. 799) argues that: *inclusion of technology, innovations and innovativeness in sustainability enables improvement of organisations’ diffusion of available sustainable solutions, creation of infrastructure and capacities for sustainable operating and behaviour and supports advancement of priority sustainable areas of Society 5.0.* Society and Industry 5.0 both reflect fundamental shifts of societies and economies toward a new paradigm to balance economic development with the resolution of social and environmental problems and to tackle challenges associated with human-machine

interactions and skills matching (Breque et al. 2021), and to focus more on the creation of social well-being, the impact on the quality of life and co-creation of knowledge as part of public–private partnerships (Morawska-Jancelewicz 2021 p. 3). It also stresses that *even the most advanced technology should not be above humanity* (Sułkowski et al. 2021). Our aim is to concentrate on new value creation in society and economy through innovations focused on the provision of products and services adopted for diverse individual needs. In this framework, *Society 5.0 recognizes innovations, especially social innovations, and innovativeness of all stakeholders in society as necessary preconditions for development of information society into human-centered society based on socially responsible society composed of individuals and their organizations* (Potočan et al. 2021, p. 808).

This paper however does not refer to potential ethical and safety risks and challenges related to digital transformation as this is not the aim of our study. But we should acknowledge after Ghobakhloo (2020, p. 16) that is referring to World Economic Forum Global Risks Report that *digitization has the capacity to increase income levels and enhance the quality of life for all people, however, it cannot be ignored that billions of people still do not have the necessary access to clean drinking water, electricity, or safe sanitation, welfare systems long-developed during the second industrial revolution*. It can then lead to further disparities and disadvantages related to e.g. job polarisation, technology accessibility, massive costs between well and less developed countries. But this is also one of the reasons why we aim to encourage academics, leaders, public and private entities to work together in the proposed framework of human-centric innovation ecosystems to ensure that the achievements and possibilities related to new technologies are fairly and equally distributed and used for the benefit of humans and our planet.

Artificial Intelligence is a concept dating back to 1950s and Alan Turing works, and as a term coined by John McCarthy, a computer scientist or related to IBM's Deep Blue defeating Gary Kasparov in the mid-1990's. However the recent two decades brought novel break-throughs and developments that have already changed our world and the way we live, we consume, we create etc. There are different approaches to defining AI. In this paper we will use AI for describing a wide range of technologies associated with fourth industrial revolution, as proposed by Procter, Glover and Jones (2020, p. 5):

[AI is] an umbrella term to cover a set of complementary techniques that have developed from statistics, computer science and cognitive psychology. While recognising distinctions between specific technologies and terms (e.g., artificial intelligence vs. machine learning, machine learning vs. deep learning), it is useful to see these technologies as a group, when considering how to support development and use of them.

We agree with Correia & Reyes, 2020 that AI could be seen as a potential game-changer for productivity and sustainability and achieving this depends on having in place the right complementary skills, infrastructure, and management culture. In this article we aim to focus on opportunities arising from AI and digital and green transitions and reflect on new considerations and approaches that are more balanced, sustainability oriented and human-centric. We therefore concentrate on theoretical views and considerations related to the present/future concept of Industry 5.0 and Society 5.0 and their potential to generate new values to economy, society and the natural environment and to build new system of innovation that promotes in a systematic way open, social, digital, technical innovations for the benefit of people (Carayannis & Morawska-Jancelewicz, 2022). In this work we refer to Quadruple/Quintuple Helix Models of Innovations (Q2HM) and the key role of universities as drivers of knowledge and the anchors of innovation and leaders of change (Goddard, Hazelkorn, Kempton, Vallance 2016). We also claim after Maasen Andreadakis, Gulbrandsen & Stensaker (2019, p. 8-11) that universities' social responsibility should be incorporated in universities' strategic framework related to all universities'

missions (that is education, research innovation and public engagement) with the aim to contribute more directly and effectively into the society and economy and to create wider impact.

In this article we also refer to the concept of Mazzucato (2018) that calls for mission-oriented innovation, social innovation that is cross-disciplinary, cross-sectoral and cross-actor innovation with the important role of citizens as active participants of the innovation process. Research and innovation missions should thus aim to improve society's welfare. We agree that *openness and collaboration are not a nice complement, but rather a critical factor for success* (Mazzucato 2018, p. 5). This approach calls for a transformative innovations focused on achieving sustainability priorities and goals and for inspiring visions which provide long-term directionality and challenging, yet doable missions that formulate more specific targets (which enable accountability) and are accompanied by financial instruments (that enable concrete action (Mazzucato, 2018, p. 7). And transformation twin and system transitions can only happen when those new types of innovation will be really embedded in business, user, civil society and policy environments (Geels, 2020, p. 7).

We claim that novel types of innovation that is: (digital) social innovation (DSI), human-centric innovation, transformative innovation or habitat innovation, can play a significant role in supporting green and digital transition of universities since they lead to transformative change (Guide to Social Innovation 2013). They reflect the attempt to balance economic growth, quality of life and protection of our planet (Deguchi et al., 2018a). We also agree with Potočan et al. (2021, p. 800) that *Society 5.0 established innovations and innovativeness as necessary preconditions and leading accelerators for solving sustainability problems in society*. Our theoretical considerations lead to the model of socially and digitally engaged universities that embrace new university roles in the ecosystem of innovation, understood as a multilayer framework in which institutions interconnect to develop and share information and knowledge required for the development of new innovation processes (Carayannis & Morawska-Jancelewicz, 2022). As Costa & Matias 2020, p. 2 claim: *The development of innovation demands a particular ecosystem in which they will emerge as a result of the collaboration and co-creation among different players. The ecosystem approach emphasises the position and roles of local and public actors in developing innovative activities, and the public policy challenge is to provide the means and instruments to transform traditional environments in an innovative milieu*. In our model the universities are envisioned as institutions engaged in social and digital transformations (SDT) and creating what we call a power capital. It has two dimensions. First, refers to a strong academic leadership that recognizes the value of diverse networks which extend beyond their zones of proximity, familiarity and competence; based on a dialogue and influence. It also reflects the power of scientists and students to become change agents. We agree with Blewitt (2010, p. 396) that claims: *with information growing by the second, knowledge expanding exponentially and wisdom still in short supply, applying new digital technologies to the sustainability imperative, requires a transdisciplinary synthesising mind and a higher educational specialist that helps students to become generalists*. Second dimension refers to the engaged and inclusive society, playing an active role in the innovation ecosystem. We might call it Super Smart Society in Society 5.0, where *value is generated not from clusters of tangible assets but rather from knowledge spaces where data and information are gathered and then deciphered and deployed through knowledge* (Deguchi et al., 2018a, p. 11).

This paper attempts to address the gap of relatively novel studies on institutional change and incentive structures that influence the ability of universities to engage in (digital) social innovation within digital and green transitions and fills the gap of identifying connection between Society 5.0 and Industry 5.0 concepts and the Q2HM framework. We argue that universities should take strategic measures and build comprehensive programmes and models of cooperation with society within the new growing

challenge of digital and green transitions. The socially and digitally engaged university model is an attempt to address those challenges and to stimulate and strengthen the social dimension of universities missions within a modern regional innovation system and allowing for a strategic approach towards the sustainable priorities.