SOCIETY 5.0 AND SUSTAINABILITY DIGITAL INNOVATIONS: A SOCIAL PROCESS

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ABSTRACT

Digital technology is an increasingly present element in contemporary societies, being relevant in the reconfiguration of the contexts of reference for human action and in shaping the relationships between human and nonhuman actors. This opinion paper seeks to develop a theoretically-oriented reflection on sustainability digital innovations within the context of Society 5.0 and the inherent heuristic potentials of this relationship. To this end, the document analysis was chosen for the collection, selection and analysis of the literature on this topic. This analysis allowed concluding that there is the need to acknowledge that this is not just a socially neutral technological phenomenon and, therefore, to mobilise the appropriate instruments, both to maximise the efficiency of sustainability digital innovations and, more broadly, to successful development of a Society 5.0 desirably for all individuals.

Keywords: Sustainability, Society 5.0, Sustainable Digital Innovation, Digital Culture, Social Innovation.

INTRODUCTION

The adoption of digital technology increasingly influences multiple societal dimensions, such as social relationships, economy, industry, organisations and individuals, as well as science itself (Brunswicker et al., 2016; Fuck, & Vilha, 2012), which poses new and deep challenges (Wu et al., 2019; Nambisan, 2018; Ferreira & Serpa, 2018).

These processes of structural transformation, namely those concerning financial markets or the liberalisation of telecommunication markets, have been global, despite the fact that some regions or areas have been having more active participation than others. Underlying many of these large structural transformations, sometimes even causing them, sometimes allowing them to take place, have been the rapid changes in the area of information and communication technologies. Three features of these technologies have played a key role: the first feature has been the large reduction in the costs of information and communication processing; the second has been the "digital convergence", led by technology, between communication and information technology; the third has been the fast growth of international network connections (Soete, 2010). These features significantly affect all aspects of society. On the one hand, they are not restricted to the production and distribution of goods and services, although the economic transformation they are causing may be the most visible aspect. On the other hand, they are affecting mainly communication between individuals and between organisations, regardless of their formal structure, such as in the case of business companies, or informal, such as in the case of virtually organised communities, and, clearly and gradually, between individuals and machines (Soete, 2010). In this regard, Cangiano et al. (2017) maintain that digital social innovation enables people to collaborate using digital technologies to co-create knowledge and

solutions for a wide range of social needs, and at a scale that was unimaginable. Digital social innovation serves as an emerging umbrella definition to describe a nascent field where digital technologies are used to address societal challenges and promote alternative models to the centralization of information, data and resources in the hands of a few big players in the tech industry. Digital innovation is the appropriation of digital technologies in the process of and as the result of innovation (Hevner et al., 2019).

In this context, digital innovation entails two dimensions. The first one regards the way

"How investments in digital information and technologies lead to a new product, service, organizational, and social innovation. Furthermore, it also covers how the use of digital technology transforms the way that value is created and extracted with new products and services" (Bogers et al., 2019).

The second dimension relates to the way

"How digitization influences the invention process itself and how the innovation process becomes digitized" (Bogers et al., 2019).

The need to deepen these consequences of digital innovations also at the societal level (Wu et al., 2019; Henfridsson et al., 2018) emerges, for example, in the representation of reality as interpretation, perception and justification of action. In this sense, social representations work as autonomous dynamic entities with central importance in shaping both cognition and the behaviour of individuals in groups (Rubira-García et al., 2018).

As an illustrative example, and following Serpa & Ferreira (2018), digital technology potentially involves a diversified look at Goffman's classic analysis of face-to-face interaction situations, insofar as actors are not physically present. Gilmore (2014), building on the work developed by Goffman, identifies three critical forms of interaction:

1. **Front stage online**: the space where an online actor gives a performance, this space can be *"seen"* by the organization, for example, the online discussion board and actor activity logs.
2. **Backstage online**: a space where an online actor prepares for a performance using the Internet but cannot be seen by the organization, for example, websites, Facebook, and email.
3. **Backstage offline**: a space where an online actor prepares for a performance without an Internet connection; for example, in a Word document, in face-to-face conversations, and in self-talk (Gilmore, 2014).

MATERIAL AND METHODS

The purpose of this paper is to develop a theoretically-oriented reflection on sustainability digital innovations within the context of Society 5.0 and the inherent heuristic potentials of this relationship. To this end, the document analysis was adopted in the collection and analysis of articles addressing the topic under study. The choice for the article as an empirical field of analysis results from the fact that this scientific outlet is considered to be the central formal means of the process of scientific production and communication. It accounts for the scientific activity of the scientists, develops argumentative strategies of persuasion and puts forth the interpretive principles favoured by authors and legitimised by peers are presented (Ferreira & Serpa, 2017; Sá et al., 2019; Serpa & Ferreira, 2018).

The collection was made on the B-on database of the Foundation for Science and Technology (FCT) in Portugal. This is an electronic library resource that includes databases of scientific articles, such as the Web of Knowledge, DOAJ, SCIELO, and also institutional

repositories (Biblioteca do Conhecimento Online, 2019). A search was carried out between January 10 and 20, 2019, by searching for the following expressions/keywords, either in the articles' abstract or title: *"digital culture", "innovation" + "digital"* (by title, abstract and subject terms). Moreover, the collection of complementary literature was added to this online literature search.

RESULTS & DISCUSSION

Digital Innovations

Technology can be understood as the use of scientific knowledge to create procedures that may be replicated (Castells, 2004). New technologies, with a significant weight of the digital component, are increasingly present in all spheres of society. There is widespread digitisation of the processing, dissemination and conservation of information in its various modalities, together with the development of coding activities (software), as key activities in the development of economic systems. Furthermore, there is broad access to global information networks, with interactive functioning and multimedia content, fostering innovation processes in terminal equipment, in the development of new software and in the creation and updating of databases. Digital technological processes are at the basis of the on-going shift in the processes of design and development of products and systems, as well as in educational and entertainment services. Another relevant transformation regards the significant changes in the monetary and commercial arenas, with the development of electronic money and forms of tele- and e-commerce (Rodrigues & Ribeiro, 2000).

Pochenchuk et al. (2018) carry out an interesting analysis of the main new technologies, which is depicted in Table 1.

Table 1
KEY NEW TECHNOLOGIES

Technology	Content
Application Program Interface (API)	A set of ready-made protocols, functions, structures that determine the interaction of different programs
Machine learning	Can be regarded as a subspecies of artificial intelligence, which focuses on the fact that computers were able to study without being specifically programmed for this through handwritten codes. Technology focuses on analysing and studying large volumes of data, for the purpose of identification or forecasting uses a variety of methods, including neural networks and in-depth training. Today, such technology analyses the large amount and variety of data to recognize patterns that should not be intuitive or rational, or translated into software codes.
Internet of Things (IoT)	This is not a technology, but a concept. It uses several technologies to connect household appliances to the Internet in order to provide value to the client, including facilitating financial transactions, or calling the security service among other applications.
Big Data analytics	Big Data is a free term for identifying large volumes of unstructured (for example, emails, Internet traffic) and structured (for example, databases) data that can't be analysed by traditional analytics tools. Also included are data collected through networks such as the Internet or corporate intranets, and other data that organizations create and store during normal business operations. Large data analysis focuses, for example, on identifying patterns, correlations and trends in customer data or preferences, based on machine learning or other technologies.

Distributed ledger technology (DLT)	It is a database divided between several parties (nodes) for performing mutually agreed transactions based on a certain consensus mechanism. A key feature is that all nodes have identical versions of data that are output from the central trusted party (for example, a clearing house). These characteristics make cyber-attacks and data changes difficult. An example is Block chain technology.
Smart contracts	A digital contract that can be fulfilled independently when the conditions are met.
Cloud computing	The use of remote and shared servers hosted on the Internet to store, manage and process data, and not servers and computers owned by each cloud user (such as a bank) and locally supported by them. This greatly increased the ability of financial institutions and other organizations to generate, store, manage and use data with lower costs and greater flexibility.
Cryptography	Protecting information by turning it into a secure format (for example, by encrypting).
Biometrics	Technology refers to the digital reach and storage of unique characteristics of individuals such as clients (for example, fingerprints, iris, voice, face), mainly for the purpose of increasing the security (and convenience) of financial transactions.

Source: Pochenchuk et al. (2018).

New technologies often require new forms of work organisation, new types of markets, new legislation and new forms of collective action. However, the prevailing institutional structure at any time exerts a very significant effect and mirrors the technologies used at that time and those that are under development. In a basic sense, technologies and institutions evolve together (Nelson, 2010).

The progressive use of new technologies, together with increasingly higher levels of production per worker, in addition to the possibility of producing new or improved services and goods, has enabled economic growth. As a general trend, these new technologies have required increasingly large capital investments (Nelson, 2010). The process has required more and more the participation of highly specialised scientists and technical staff to carry out the research and development work needed to create and put in place new technologies. Moreover, in many cases, this process demands highly skilled human resources to work with new technologies. The large increases in physical and human capital that resulted from economic growth should not be viewed as independent sources of growth but as supports of technological progress, and institutions are an important part of the process (Nelson, 2010). This positioning clearly moves away from the technological determinism that ascribes scientific development and technological applications the ability, *per se*, to transform societies. Interventions or policies of scientific and technological development are assumed to necessarily and inevitably lead to linear, cumulative effects, resulting in processes of social development (Almeida, 2010).

In the digital context, innovation, mobilising the digital, is the key concept (Lokuge et al., 2019; Corrales-Garay et al., 2019; Fukuyama, 2018). Innovation is a complex process, irreducible in a unilinear way to scientific and technological dimensions. Innovation, whether corporate or social, finds in different societies its starting and arrival point, as well as its specific conditions of welcome and stimulus (Almeida, 2010).

Innovation, as a type of transformation, gives rise to several issues: there may be a scale disconnection between the *"cause"* (e.g. the initiative of an *"innovator"*) and the *"effect"* (e.g. transforming a population's way of life); the impact of innovation may be considered as generally beneficial, i.e., to add to progress (in particular, economic and/or social progress); this impact can be viewed according to several aspects at the same time: if only the scientific and technical aspect is considered, the notions of *"invention"* and *"discovery"* are preferably used; this impact is neither anodyne (in which case it could be called *"improvement"*), nor very

important (it could be called *"mutation"*); innovation may only be designated as such once it starts to be accepted and disseminated, that is to say, after being the object of imitation (Béjin, 1990).

Wolffenbuttel (2018), when presenting Ramella's 2013 *Sociologia dell'innovazione económica*, sustains that, according to Ramella, innovation may be seen as a multi-faceted social phenomenon, understood as a multidimensional concept and the expression of a complex process that encompasses, not only the technical and economic aspects but also the social, cultural and organisational ones. Thus, innovation is procedural, being a complex activity that comprises a number of interconnected phenomena. However, innovation is not necessarily linear, with steady flow and direction over time, but it is also relational and relates to a given period and to a given context. However, innovation is not necessarily positive. Unlike the notion of progress, the introduction of a novelty does not always lead to the expected successes-due to unintended consequences; innovation may fail or not be beneficial to the innovator or to the reference community (Wolffenbuttel, 2018).

Organisational innovation means the implementation of new principles to the production of goods and services, new structures and new action processes, a new type of relationship between people and new behaviour models (values, mentalities and attitudes). It is an innovation based on more tacit knowledge than those that technological innovation is based on, whose costs and benefits are more difficult to quantify and observe (Kovács, 2010).

Technological innovations may be understood as the introduction of technologically novel products, services or production processes and significant improvements in existing products and processes. The technological innovation of a product, service or process is considered to have been implemented if it has been placed on the market (product innovation) or used in the production process (process innovation) (OECD, 2005 & 2008).

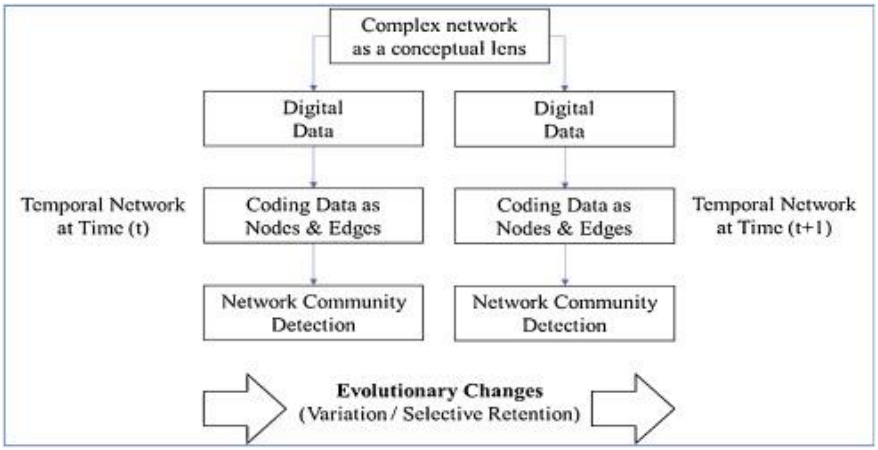
Process innovations deal mainly with the implementation of new equipment, software, techniques or procedures, whereas organisational innovations deal primarily with people and the organisation of work (OECD, 2005). To understand the phenomenon of innovation, it is important to address the degree of change involved, by categorising technological innovations as incremental or radical. Incremental technological innovations may be understood as continuous and gradual improvements of existing products, services or processes, and relate to most of the innovations generated. Radical innovations correspond to the placement of entirely new products, services or processes in the market, and are strongly related to R&D (Research & Development) activities. The innovation process, seen in an interactive way, is related to the concept of innovation system, which may be understood as a set of public and private institutions that contribute, in macro and microeconomic contexts, to the development and dissemination of innovations of a given sector, region or country (Sbicca & Pelaez, 2006).

The valuation of networks and virtual organisations as models of the information society and that are adequate to the conditions of instability of a globalised economy, with its provisional structures, is deemed *"ideal"* to meet an uncertain and varied demand (Kóvacs, 2010). Networking can be an extended area for technological and organisational innovation, provided that it functions according to the logic of cooperation and autonomy, linked to a balanced division of labour between the organisations that make up the network. The network's efficient functioning requires more than technological infrastructures. It requires (i) trust relationships and an agreement on long-term investments and benefit-sharing; (ii) interdependence relationships strong enough to create a feeling of belonging and of linked destinies, as well as a balance of powers; (iii) some degree of integration that allows for the establishment of reliable liaisons and

communications with a high degree of quality; (iv) transparent and adequate information, so that everyone knows others' plans and orientations; and (v) the institutionalisation of partnership through legal and social connections, recognition and explanation of values (Kovács, 2010).

There are several factors involved in innovations (Holmström, 2018; Kohli & Melville, 2018), notably the social component (Hinings et al. 2018; Chae, 2019). This is advocated by Chae (2019), when the author maintains that

"Diverse elements, both social and technical, dynamically interact, and the digital innovation ecosystem emerges from such interaction and evolves over time. The boundary of the digital innovation ecosystem is fluid" (Figure 1).



Source: Chae (2019).

FIGURE 1
A GENERAL FRAMEWORK FOR STUDYING THE DIGITAL INNOVATION ECOSYSTEM

The relationship between digital technology and innovation has three central features. The first is that after being digitised, information may be saved, transformed, disseminated, and tracked down by any digital instrument, regardless of the content. The second feature relates to the fact that there is the possibility of edit digital information by re-programming; making digital solutions that may be changed after being developed via the interaction with external systems. Finally, the third feature is that digital technology is, simultaneously, the result and the basis for the development of digital innovations; this entails high scalability and low entry barriers, and results in wide participation and democratised innovation (Ciriello et al., 2018).

Big data may be an excellent way to generate innovation, insofar as open data is an external source that may be used to produce open innovation, and open innovations may create open data. In their study, Corrales-Garay et al. (2019) conclude that

"It is necessary to know how to implement open innovation using open data. We have considered two types of open innovation: inbound (to insource external ideas and technologies to enhance products' values) and outbound (to outsource internal resources for refining, exploiting and bringing them to market)".

We also consider the two types together, or coupled (a combination of the inbound and outbound processes).

Sustainable Digital Innovations in Society 5.0

Sustainable innovation may be understood as a process where sustainability considerations-environmental, social and financial-are integrated into the systems of organisations from idea generation to R&D and the subsequent marketing of its results. This applies to products, services and technologies, as well as to new business and organisational models (Charter & Clark, 2007).

The mention of the concept of sustainability, as a key element gearing innovation, refers to the relevance of the economic, social and environmental dimensions inherent in the innovation process. The economic dimension of sustainability is related to the profit component, with issues such as economic growth, the efficient use of resources and the financial viability of business companies. The environmental dimension focuses on fighting pollution and the efficient and judicious use of natural resources. The social dimension regards issues such as equal opportunities, justice in wealth distribution, ethical behaviour, equity and justice. Advocating a more competitive economy, which generates sustainable economic growth with more and better jobs and social cohesion, entails, according to the European Commission (2010), intelligent, sustainable and inclusive growth.

An analysis of the relationship between innovation and sustainable development can be based on the triple bottom line (Figure 2). This perspective is grounded on the sustainability triangle and establishes a systemic relationship between the innovation dimensions (Silva et al., 2010).

Source: Adapted from Silva et al. (2010).

FIGURE 2
THE TRIPOD OF SUSTAINABILITY WITHIN THE CONTEXT OF INNOVATION

As stressed by Drori (2010); Fukuyama (2018) and Pyka (2017), among many other authors who focus on these issues, sustainability is one of the greatest contemporary challenges, and innovation is, thus, vital to the establishment of a sustainable society. Fukuyama (2018) draws attention to the importance, within this context, of the Sustainable Development Goals adopted by the United Nations.

This sustainability, which is present at various levels, will have to be attained in a social context in which digitisation will shape many of its innovation processes, and in a society based on the articulation between the individual level and digital technology, Society 5.0 (Ferreira, & Serpa, 2018; Serpa & Ferreira, 2018; Ang et al., 2017; i-SCOOP, 2019; Serpanos, 2018). In this context, Wang et al. (2018) argue that

"The fundamental theory of Societies 5.0 research is parallel intelligence, which is a novel methodology that extends the traditional artificial intelligence theories to the emerging cyber-physical-social systems (CPSS)".

According to Ferreira & Serpa (2018), Society 5.0, as the Japanese national strategic political initiative, seeks the improvement of productivity via the digitisation and redesign of business models, and simultaneously, to build the new economy and society through the promotion of innovation and globalisation (Keidanren, 2016).

Innovation is critical to the establishment of Society 5.0. This is confirmed by Savanevičienė et al. (2019), who sustain that

"The initiative Society 5.0 aims are to solve these problems and create the Super Smart Society, when innovation brings together the virtual world and reality […] individual innovativeness is an important precondition for the development of Society 5.0 in a long-term perspective. Moreover, for the successful creation of the Super Smart Society, the contribution of each generation of society is important to the development, implementation and use of innovation".

Consequently, the social dynamics expressed in the concept of Society 5.0, notwithstanding its recent mobilisation by the scientific community, will, we believe, deeply influence all dimensions of social life (Fukuyama, 2018; Serpa & Ferreira, 2018), by

"Proposing to further the potential of the individual-technology relationship in fostering the enhancement of the quality of life of all people through a super smart society" (Serpa & Ferreira, 2018).

However, the promotion of skills and competencies in the digital world – digital literacy as a concept associated with numerous agendas and stances, e.g., technical *"know-how"* through cognitive skills, social practices and proactive involvement with digital content (Spante et al., 2018) – is central. It is worrying to note that the promotion of the attainment and development of these skills is not guaranteed, even in the new generations (Santos & Serpa, 2017; Spante et al., 2018; Sá & Serpa, 2018). Yet, several authors stress that there are still inequalities in access to digital technology and that this gap undermines citizens' participation in decision-making processes. This gap is also addressed by Atif & Chou (2018), who advocate that

The induced digital gap defines the degree of digital citizenship for which, unified policies have yet to be drawn at various educational levels to reduce that gap. The quest for a broad participation to develop digital citizenship competencies needs further investigations into innovative educational approaches, pedagogical methods, and routine practices that foster digital literacy, and narrows the digital divide.

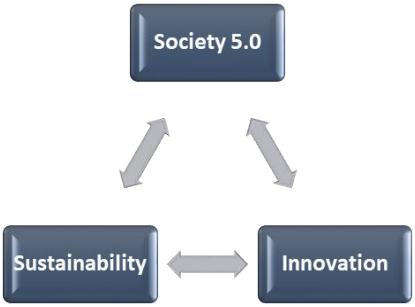
An important aspect of this issue is the fact that innovation should not be confused with change. Innovation is not necessarily good. It involves some risks, of which Curran (2017) highlights

"the remaking of interpersonal co-presence and solitary life; the growing potential threats of revolutions in artificial intelligence (AI) to intensify unemployment and inequality; and the threat to the environment of an 'always on' and 'always upgrading' digital communication ecosystem".

Innovation is fuelled by ambiguity and unpredictability (Cunha et al., 2007; Nepelski, 2019; Chae, 2019). According to Cangiano et al. (2017), the broad expression "digital social innovation" is used to describe countless projects that use digital technologies, involvement and collaboration on the part of the community, co-creation strategies and bottom-up policies to address needs felt by the society. In this regard, Fukuyama (2018) highlights that digital transformation has often had a drastic impact on conventional industries and has increased social complexity. The author outlines some negative aspects of a digital society, namely security risks and privacy challenges. Fukuyama (2018) alerts that,

"At the same time, the trend towards creating new value through digital technologies and contributing to future society can now be seen throughout the world. The evolution of digital transformation is not a path that can be avoided".

Furthermore, the big data itself is not fully accessible and can act as a factor of economic and social differentiation in surveillance and control strategies (Possamai-Inesedy, Rowe, & Stevenson, 2017) (Figure 3).



Source: Own production.

FIGURE 3
INTERDEPENDENCE RELATIONSHIPS BETWEEN SOCIETY 5.0, SUSTAINABLE AND INNOVATION

In this process, the human factor is vital, insofar as innovation is a complex social process (Kohli, & Melville, 2018; Pyka, 2017; Wolffenbuttel, 2018). Following Ciriello et al. (2018), digital innovation practices may be considered to be. The authors maintain that digital innovation practices are not predictable and focused on the improvement and renovation in well-established areas. Rather, they are exploratory and their focus is on experimentation. Therefore, digital innovation is a multifaceted and privileged source of insights for cross-disciplinary research studies (Ciriello et al., 2018). However, this social dimension of digital innovation clearly shows that technology is not, *per se*, the key focus of innovation. In fact, technology is perceived as a relevant pathway that may lead to social challenges (Gaggioli, 2017) (Table 2).

To address these challenges, several strategies may provide explanations of digital innovation, without forgetting the complexity of the process of socio-material interaction in digital innovation. Moreover, explanations of digital innovation should be produced on the basis of the specificities underlying digital technology. Finally, there is also the need to seek

explanations of digital innovation that are based on a constant iteration between the specific and the general (Holmström, 2018).

Table 2
CATEGORIES OF PARTICIPANTS WHOSE ANALOGUES EXISTED IN EARLIER NON-TECHNOLOGICALLY POST-HUMANISED SOCIETIES

Participants Incorporated through non-technologically post-humanised		**Participants Incorporated through technologically post-humanised**
More prototypical cases • Conscious, healthy, educated adult human beings **Less prototypical cases** • Sleeping or comatose human beings • Embryos, infants, and children • The elderly infirm • Intoxicated or hallucinating individuals • Individuals suffering from emotional or mental disorders or physical or cognitive disabilities • Individuals whose illnesses or medical conditions have been treated through the consumption of ordinary foods or medicines that possess some nutritional or therapeutic properties	*"Natural"* biological human beings (possess an ontic fundament, sensory emotional *"soul"* and intentional "I" whose structures and dynamics are considered unextraordinary for human beings)	**More prototypical cases** • Human beings who are not maintained, modified, or linked by technology • Human beings wearing clothing • Users of eyeglasses or hearing aids • Users of automobiles, telephones, desktop computers, and some other external devices **Less prototypical cases** • Possessors of therapeutic neuroprostheses • Patients who have undergone cell gene therapy • Individuals given synthetic pharmaceuticals that alter their sensory or emotional experiences by placing them in an extraordinary state • Individuals whose sensation or emotion is impaired or altered due to artificial electrical stimulation of the brain that puts them in an extraordinary state
With an augmented ontic fundament • Human beings affected by certain types of viruses, parasites, or other entities that grant certain immunities or capacities **With an augmented intentional** • Priests or shamans believed to possess supernatural powers • Political or military leaders with great social influence or authority	**Artificial augmented human beings** (have been granted non-human additions to their ontic fundament or extraordinary powers over their environment)	**With an augmented ontic fundament** • Neuroprosthetically enhanced persons (e.g. military cyborgs) • Human beings whose bodies possess an atypical and significant number of cells of non-human origin (e.g., chimeras) **With an augmented intentional** • Persons who are undergoing transcranial magnetic or deep brain stimulation or who possess cognitive neuroprostheses that alter their memory, reasoning, metavolition, etc.
• Ghosts and incorporeal spirits of deceased human beings • Draugar, vampires, zombies, and other corporeal undead of established folk belief • Revenants of ambiguous corporeality	**Metahuman beings** (possess a qualitatively transformed ontic fundament)	• Persons genetically engineered through germline gene therapy (GGT) to possess superhuman or non-human capacities • Transgenic human beings with genes introduced from non-human animals or plants
• Families, clans, religious	**Epihuman beings**	• Neuroprosthetically facilitated

communities, nations, governments, and commercial organizations	(built on multiple linked human ontic fundaments)	collective human *"hive minds"*
• Dolphins, apes, and some other highly intelligent animals • Angels and demons • Anthropomorphic monsters • Fictional human characters • A personal deity	**Parahuman beings** (possess a non-human ontic fundament but some human-like characteristics)	• Androids with human-like artificial general intelligence and emotion • Artificial agents existing in virtual worlds that resemble human beings or serve as autonomous proxies for real human persons
• Less intelligent animals (e.g. unicellular organisms) that lack human-like sensory capacities, emotion, and self-awareness • Non-anthropomorphic monsters • Impersonal deities • The bodies of deceased human beings • Plants, fungi, crystals, and rocks • Planets, stars, and other astronomical bodies • Abstract cosmic forces (fate, destiny, karma, etc.)	**Nonhuman beings** (do not possess a sensory-emotional system or intentional system that gives the impression of being significantly human-like)	• Synthetic biological computers modelled after human brains • Nanorobotic swarms • Sentient computer networks • Artificial general intelligences with radically non-human cognitive structures and dynamics • Non-social smart buildings • Paintings and statues • Mechanical clocks • Photographs of human beings

Source: Gladden (2019).

Within the framework of Society 5.0, sustainability digital innovations have, thus, the purpose of meeting the challenges depicted in Table 2 and to increase the potential of the individual-technology relationship in promoting the improvement of the quality of life of all people through a super-intelligent society – Society 5.0. This is an extremely recent concept as a guiding principle for social development that may have a profound impact on societies at all levels, such as, for instance, in terms of quality of life and sustainability (Ferreira & Serpa, 2018).

CONCLUSION

This paper sought to offer a contribution to the reflection on the relevance of the relationship between Society 5.0 and sustainability digital innovations. Digital Social Innovation emphasises the intersection of three elements: the innovation process, the social world and the digital ecosystem. The social dimension warns that the focus of innovation is not the technology in itself. On the contrary, it should be seen as a means to address important social challenges. The concept of innovation concerns the production of solutions that are more effective, sustainable and ethically adequate than those that is in place today. Finally, the digital dimension highlights the potential benefits of integrating emerging technologies (such as social computing platforms, the Internet of Things, robotics and artificial intelligence, among others) in services to society (Gaggioli, 2017).

Thus, digitisation itself is part of social phenomena, and, as such, it should also be studied and, if necessary, these studies should dispel any underlying ideology (Curran, 2017; Wu et al., 2019; Javeau, 1998; Drori, 2010). The criteria for decision-making on the type and nature of technology to be put at the service of all are indisputable: The impact of technology on humans and on the planet must be positive, by fostering progress in a way that does not cause harm or involves any kind of injustice. However, as Drodi (2010) points out with some

apprehension, for now, it remains to be known which technologies meet these criteria in a clear and objective way.

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REFERENCES

Almeida, J.F. (2010). Inovação e atitude cultural [Innovation and cultural attitude]. In *Sociedade, tecnologia e inovação empresarial* [Society, technology and business innovation]. Lisboa: Imprensa Nacional-Casa da Moeda.

Ang, J., Goh, C., Saldivar, A., & Li, Y. (2017). Energy-efficient through-life smart design, manufacturing and operation of ships in an Industry 4.0 environment. *Energies*, *10*(5), 610.

Atif, Y., & Chou, C. (2018). Guest editorial: Digital citizenship: Innovations in education, practice, and pedagogy. *Educational Technology & Society, 21*(1), 152-154.

Béjin, A. (1990). Inovação [Innovation]. In R. Boudon, P. Besnard, M. Cherkaoui, & B.-P. Lécuyer (Dirs.), *Dicionário de sociologia* [Dictionary of sociology] (pp. 132–133). Lisboa: Publicações Dom Quixote.

Biblioteca do Conhecimento Online (n.d.). *What is b-on?* Retrieved from https://www.b-on.pt/en/what-is-b-on/

Bogers, M, Garud, R., Leiponen, A., Thomas, L.D.W., Tuertscher, P. & Yoo, Y. (2019). Innovation: Organization & Management Special Issue call for papers-Digital Innovation. *Innovation*, *21*(1), 249-251.

Brunswicker, S., Matei, S.A., Zentner, M., Zentner, L., & Klimeck, G. (2016). Creating impact in the digital space: Digital practice dependency in communities of digital scientific innovations. *Scientometrics, 110*(1), 417-442.

Cangiano, S., Romano, Z., & Loglio, M. (2017). The growth of digital social innovation in Europe. An Open Design approach to support innovation for the societal good. *The Design Journal, 20*(1), S3546-S3559.

Castells, M. (2004) *A Galáxia Internet*. Lisboa: Fundação Calouste Gulbenkian.

Chae, B. (2019). A general framework for studying the evolution of the digital innovation ecosystem: The case of big data. *International Journal of Information Management, 45*, 83-94.

Charter, M & Clark, T. (2007). Sustainable innovation: Key conclusions from sustainable innovation – Conferences 2003-2006. *The Centre for Sustainable Design, University College for the Creative Arts*, May. Available at http://www.cfsd.org.uk/Sustainable%20Innovation/Sustainable_Innovation_ report.pdf. Accessed on July 3, 2019.

Ciriello, R.F., Richter, A., & Schwabe, G. (2018). Digital innovation. *Business & Information Systems Engineering, 60*(6), 563-569.

Corrales-Garay, D., Mora-Valentín, E.M., & Ortiz-de-Urbina-Criado, M. (2019). Open data for open innovation: An analysis of literature characteristics. *Future Internet, 11*(3), 77.

Cunha, M.P., Rego, A., Cunha, R.C., & Cardoso, C.C. (2007). *Manual of organizational behavior and management*. Lisbon: Editora RH, 2007.

Curran, D. (2017). Risk, innovation, and democracy in the digital economy. *European Journal of Social Theory, 21*(2), 207-226.

Drori, G. S. (2010). Globalization and technology divides: Bifurcation of policy between the "digital divide" and the "innovation divide". *Sociological Inquiry, 80*(1), 63-91.

European Commission (2010). *Communication from the Commission – Europe 2020 – A strategy for smart, sustainable and inclusive growth*.

Ferreira, C., & Serpa, S. (2017). Challenges in the teaching of sociology in higher education. Contributions to a discussion. *Societies, 7*(4), 30.

Ferreira, C.M. & Serpa, S. (2018). Publicising the Identified Peer-Reviewer: Legitimacy and Quality of the Scientific Publication. *The International Journal of Interdisciplinary Educational Studies. 13*(1), 11-17.

Ferreira, C.M., & Serpa, S. (2018). Society 5.0 and social development: Contributions to a discussion. *Management and Organizational Studies, 5*(4), 26.

Fuck, M.P., & Vilha, A. M. (2011). Technological Innovation: from definition to action. *Revista Contemporâneos*, 9, 1-21.

Fukuyama, M. (2018). Society 5.0: Aiming for a new human-centered society. *Japan SPOTLIGHT*, 47-50.

Gaggioli, A. (2017). Digital social innovation. *Cyberpsychology, Behavior, and Social Networking, 20*(11), 723-723.

Gilmore, D.M. (2014). Goffman's front stage and backstage behaviors in online education. *Journal of Learning Analytics, 1*(3), 187-190.

Gladden, M.E. (2019). Who will be the members of Society 5.0? Towards an anthropology of technologically posthumanized future societies. *Social Sciences, 8*(148), 1-39.

Henfridsson, O., Nandhakumar, J., Scarbrough, H., & Panourgias, N. (2018). Recombination in the open-ended value landscape of digital innovation. *Information and Organization, 28*(2), 89-100.

Hevner, A., vom Brocke, J. & Maedche, A. (2019). Roles of digital innovation in design science research. *Business & Information Systems Engineering, 61*(1), 3-8.

Hinings, B., Gegenhuber, T., & Greenwood, R. (2018). Digital innovation and transformation: An institutional perspective. *Information and Organization, 28*(1), 52-61.

Holmström, J. (2018). Recombination in digital innovation: Challenges, opportunities, and the importance of a theoretical framework. *Information and Organization, 28*(2), 107-110.

http://www.excelenciaemgestao.org/Portals/2/ documents/cneg6/anais/T10_0297_1372.pdf.

i-SCOOP. (n.d.). *From Industry 4.0 to Society 5.0: The big societal transformation plan of Japan*. Retrieved July 3, 2019 from https://www.i-scoop.eu/industry-4-0-society-5-0/

Javeau, C. (1998). *Lições de sociologia* [Lessons of sociology]. Oeiras: Celta Editora.

Keidanren (2016). *Toward realization of the new economy and society. Reform of the economy and society by the deepening of "Society 5.0"*. http://www.keidanren.or.jp/en/policy/2016/029_outline.pdf

Kohli, R., & Melville, N.P. (2018). Digital innovation: A review and synthesis. *Information Systems Journal, 29*(1), 200-223.

Kovács, I. (2000). Inovação e organização. In *Sociedade, tecnologia e inovação empresarial*. Lisboa: Imprensa Nacional-Casa da Moeda.

Lokuge, S., Sedera, D., Grover, V., & Dongming, X. (2019). Organizational readiness for digital innovation: Development and empirical calibration of a construct. *Information & Management, 56*(3), 445-461.

Nambisan, S. (2018). Architecture vs. ecosystem perspectives: Reflections on digital innovation. *Information and Organization, 28*(2), 104-106.

Nelson, R. (2010). *Technology, institutions and economic growth*. In Society, technology and business innovation. Lisboa: Imprensa Nacional-Casa da Moeda.

Nepelski, D. (2019). How to facilitate digital innovation in Europe. *Intereconomics, 54*(1), 47-52.

OECD (2005). *Oslo manual: The measurement of scientific and technological activities*. Paris: OECD Publishing.

OECD (2008). *OECD science, technology and industry outlook 2008*. Paris: OECD Publishing.

Pochenchuk, G., Fedkovich, Y, Babukh, I., & Baraniuk, D. (2018). Innovations of the digital era and economic choice. *The USV Annals of Economics and Public Administration, 18*(1), 63-69.

Possamai-Inesedy, A., Rowe, D., & Stevenson, D. (2017). Sociology in the 21st century: Challenges old and new. *Journal of Sociology, 53*(4), 723-729.

Pyka, A. (2017). Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy. *Journal of Open Innovation: Technology, Market, and Complexity, 3*(1), 27.

Ramella, F. (2013). *Sociology of economic innovation*. Il Mulino Publishing Company.

Rodrigues, M.J, & Ribeiro, J.F (2000). *Innovation, Technology and Globalization: the role of knowledge and the place of work in the new economy*.

Rubira-García, R., Puebla-Martínez, B., & Gelado-Marcos, R. (2018). Social representations in studying information, knowledge, and mediations: A critical review. *Social Sciences, 7*(12), 256.

Sá, M., & Serpa, S. (2018). Transversal competences: Their importance and learning processes by higher education students. *Education Sciences, 8*(3), 126..

Sá, M.J., Ferreira, C., & Serpa, S. (2019). (Un)professionalisation or (Re)professionalisation of the Academic in the Brave New World? *Postmodern Openings, 10*(2), 84–113. doi: http://dx.doi.org/10.18662/po/73.

Santos, A.I., & Serpa, S. (2017). The importance of promoting digital literacy in higher education. *International Journal of Social Science Studies, 5*(6), 90. doi: 10.11114/ijsss.v5i6.2330.

Savanevičienė, A., Statnickė, G., & Vaitkevičius, S. (2019). Individual innovativeness of different generations in the context of the forthcoming Society 5.0 in Lithuania. *Engineering Economics, 30*(2).

Sbicca, A., & Pelaez, V. (2006). Innovation systems. Pelaez, V .; Szmrecsányi, T. Economics of Technological Innovation. *São Paulo: Hucitec*.

Serpa, S., & Ferreira, C.M. (2018a). Goffman's backstage revisited: Conceptual relevance in contemporary social interactions. *International Journal of Social Science Studies, 6*(10), 74. doi: 10.11114/ijsss.v6i10.3659.

Serpa, S., & Ferreira, C.M. (2018b). Special Issue Society 5.0: Innovation, uncertainty and social sciences. Available at http://www.mdpi.com/journal/socsci/special_issues/Society_5.0. Accessed on August 18, 2018.

Serpa, S., & Sá, M. (2019). Sociology of education for a sustainable future. *Sustainability, 11*(6), 1757.

Serpanos, D. (2018). The cyber-physical systems revolution. *Computer, 51*(3), 70-73.

Silva, C.E. et al. (2010). Sustainable innovation: A literature review. *Proceedings of the National Congress of Excellence in Management*.

Soete, L. (2010). *Europe and national technology policies: New challenges.* In Society, technology and business innovation. Lisbon: National Press-Mint.

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, *5*(1), 1519143.

Wang, F.Y., Yuan, Y., Wang, X., & Qin, R. (2018). Societies 5.0: A new paradigm for computational social systems research. *IEEE Transactions on Computational Social Systems*, *5*(1), 2-8.

Wolffenbuttel, R. F. (2018). Inovação econômica: Trajetórias e contribuições de uma agenda de pesquisa sociológica. *Sociologias, 20*(48), 310-323.

Wu, Y.J., Shu-Jou, L., & Hsieh, Y.J. (2019). Entrepreneurship and innovation in the digital era. *Computers in Human Behavior, 95*, 233-237.