Reflections on digital Sustainability:

epistemological considerations, ethical Issues and complexity challenges

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Abstract

We face today significant global challenges. The quest for a more balanced social and economic development, the changes in the climate conditions and the push towards a digital transformation of our lives and businesses forces us to better addressing the implications these issues have for current and future generations. The recent financial, sanitary and geopolitical crises have introduced new complexities and uncertainties into the pursuit of the 2030 Sustainable Development Goals (SDGs). All these events have raised questions about the role of science, technology and innovation in fostering sustainability and achieving long-term societal, environmental and economic well-being. Moreover they pose challenges to the long-term goals of sustainable energy practices and climate change mitigation.

This work aims at contributing to the digital sustainability discourses by reflecting upon the role of Information and Communication Technologies (ICTs) across the social, environmental and economic dimensions, exploring the intrinsic complexity involved.

In doing so, we provide a conceptual support to the notion of digital sustainability by adopting the complexity science lens and discussing the relationship between ethics and epistemology as essential to properly address the positive and negative effects of ICTs, in particular of artificial intelligence (AI) backed applications, on the future society, economy and environment. This paper adopts a conceptual reasoning approach involving reflections on extant knowledge from social, technological and philosophical domains. The authors emphasize the trans-disciplinary nature of digital sustainability and the need to move beyond simplistic instrumental and deterministic views of technology (Trinchini & Baggio, 2023).

The COVID-19 pandemic has acted as a catalyst for an increased widespread adoption and integration of Information and Communication Technologies (ICTs) into various aspects of our lives. Remote work, online education, virtual healthcare, and digital communications have become integral components of daily routines, as virtualized patterns of interactions and tasks (Zhu et al, 2021). This digital acceleration has fundamentally transformed our understanding of sustainability and how we relate with the external environment, in terms of its socio-political, economic and environmental factors.

A further element contributing to this accelerated change is the ongoing fast evolution of artificial intelligence tools and techniques that make available unprecedented capabilities. If correctly used they allow analyzing the wealth of digital traces left behind by millions of users of the advanced technological platforms thus providing much better resources for improving decision making and, ultimately, our potential for a better interaction with the world. This with all the ethical implications for the use of AI *for* sustainable achievements and "the sustainability of developing and using AI

systems" (Moallemi et al, 2021; Van Wynsberghe, 2021 p. 213). The role of Artificial Intelligence (AI) and Machine Learning (ML) has also become prominent in computational simulation tools when analyzing and predicting the behavior of complex ecosystems, as, for example, in the case of climate change impacts modelling (Maeda et al, 2021).

The increasing attention to digital sustainability emerges from two meaningful socio-technological trends, the push for a global environmental sustainable development and the blurring boundaries between human activities and the digital realm. These discourses are not new, but they saw an expansion in recent times as a result of the ubiquity of digital technologies and the increased frequency of extreme climate-related events. Alongside the environmental concerns, however, social and economic issues need to be simultaneously considered for a digital sustainable development. Across all three domains, the development and use of digital ICTs can have both positive and negative impact. In short, "the concept of digital sustainability underlines the consideration of digital technologies' potential negative effects on the environment, society, individuals and the economy." (Sparviero & Ragnedda, 2021 p. 223).

In the environmental domain, smart ICTs can improve the efficiency of energy, transportation, manufacturing and water systems, but, in so doing, they contribute to increased energy consumption, e-waste, and carbon emissions. In the economic domain, the debates on sustainable development have been historically influenced by the market-based ideas of growth and instrumental approaches to ICTs in the production and consumption dynamics. The current digital economy rests upon this narrow view of technologies, with its concentration of wealth and technological moligopoly (i.e., monopoly and oligopoly combined), and lacks a holistic sustainable approach essential for systemic transformation and the decoupling of digital resources use from negative impacts (Hindman, 2018; Petit, 2020). In the socio-cultural domain, the pervasive use of data, algorithms, and social media brings about ethical concerns over privacy, bias, surveillance and psychological well-being. In this hyperconnected reality, within which the distinction between online and offline is fading, ICTs are not neutral or value-free tools but important proactive agents of the socio-cultural changes.

Digital sustainability can be defined as "the convergence of digital and sustainability imperatives that involves a trans-disciplinary approach of deploying digital technologies in tackling sustainability issues" (Pan and Zhang, 2020 p. 4). Even if this definition provides an ecological account of digital sustainability, including its transdisciplinary nature, different meanings and interpretations are still reflected in scholarly conversations within management and business circles (Sharma et al, 2021).

The paper's primary objective is not to define but to advance awareness and knowledge of digital sustainability by delving into the disruptive impact brought about by the pandemic. It seeks to explore the ethical and epistemological issues surrounding the rapid integration of digital ICTs and their implications for sustainable development. Drawing upon complexity science, the paper aims to establish a coherent framework that can better help understanding the complexities of our rapidly changing world.

Central to this exploration is the recognition that ICTs are not just tools but instrumental technologies that significantly shape our perception of reality (Floridi, 2015; Zuboff, 2019). The paper stresses the importance of avoiding technological determinism, where technology is seen as the sole driver of change, and instead, advocates for a nuanced appreciation of the interplay between science, technology, and society. Technology should not be considered solely as a utilitarian tool but as a means of interpreting reality (Verbeek, 2013) and its prominence over knowledge needs to be questioned to rebalance science, technology, and ethics relations (Russo, 2018).

Furthermore, the paper seeks to highlight the distributed morality of multi-agent ecosystems (Floridi, 2013), acknowledging that ethical considerations should be extended beyond human actors to encompass the broader network of interactions involving technologies, nature, and society. Assuming and/or attributing responsibility and accountability to actions and decisions in dynamic,

networked ecosystems is challenging, particularly in the context of artificial/autonomous entities interacting with human, non-human, and hybrid agents (Simon, 2015). Emphasizing this aspect of epistemic responsibility can help in informing ethical decision-making and policy formulation in the realm of digital sustainability.

This contribution is conceptual and the reflections made on current phenomena are not generating new concepts or theories for digital sustainability, but they are rather pointed towards a better rationalization and framing of the various issues. Considering the very broad areas of research fields involved and the lack of an agreed definition of digital sustainability, the authors might have overlooked or ignored some of the relevant literature because of the chosen perspective.

In conclusion, the authors intend to foster the debate on digital sustainability through a combination of perspectives not fully explored so far in the literature and by shedding light on the profound transformations caused by ICTs. Our contribution can be found in the logical reasoning adopted to discuss how the impacts of ICTs as ethical and epistemic proactive agents are increasing the level of complexity of the whole matter, and in particular when pointing toward a sustainable and more balanced future society. Practical contributions can be deducted from employing a correct approach to modelling and simulations that is also suggested in the paper.

Keywords: Digital sustainability, determinism, ethics, epistemology, complexity science

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