An Ethical Framework for Artificial Intelligence and Sustainable Cities

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Abstract: The digital revolution has brought ethical crossroads of technology and behavior, especially in the realm of sustainable cities. The need for a comprehensive and constructive ethical framework is emerging as digital platforms encounter trouble to articulate the transformations required to accomplish the sustainable development goal (SDG) 11 (on sustainable cities), and the remainder of the related SDGs. The unequal structure of the global system leads to dynamic and systemic problems, which have a more significant impact on those that are most vulnerable. Ethical frameworks based only on the individual level are no longer sufficient as they lack the necessary articulation to provide solutions to the new systemic challenges. A new ethical vision of digitalization must comprise the understanding of the scales and complex interconnections among SDGs and the ongoing socioeconomic and industrial revolutions. Many of the current social systems are internally fragile and very sensitive to external factors and threats, which lead to unethical situations. Furthermore, the multilayered net-like social tissue generates clusters of influence and leadership that prevent communities from a proper development. Digital technology has also had an impact at the individual level, posing several risks including a more homogeneous and predictable humankind. To preserve the core of humanity, we propose an ethical framework to empower individuals centered on the cities and interconnected with the socioeconomic ecosystem and the environment through the complex relationships of the SDGs. Only by combining human-centered and collectiveness-oriented digital development will it be possible to construct new social models and interactions that are ethical. Thus, it is necessary to combine ethical principles with the digital innovation undergoing in all the dimensions of sustainability.

Keywords: ethics; data; machine learning; sustainable development goals; complexity; collective intelligence; systemic risk; human rights

1. Introduction

Ethics has always been a fundamental matter for humanity [1–3]. Evolving from the myth and the great chronical literature, Greek philosophers brought a new political and philosophical dimension to ethics [4,5]. Throughout the classical culture of Greece and Rome, ethics was already related to the cosmical and urban order because philosophy was very related to mathematics and cosmology. They established a relationship between the order in the Universe and the order that they should have in cities, as well as what was considered ethical looking at the Universe. Currently, cities are becoming the center of innovation in Europe in what could be called the era of green, neutral, and digital cities. We can expect ethics to provide insights about how we should develop new cities with a high level of order to be neutral and green, where every variable is measured and analyzed. The medieval age was an enforced turn to religions all around the globe, and ethics was related to and constrained by religion.

The Enlightenment brought a new vision of ethics centered in humans and their reason and science with important contributions to idealism, Kant and Hegel transcendental philosophies, and the beginning of aesthetics as a discipline in philosophy [6]. Modernity started with the suspicion of a single truth which could be achieved by religion or human reason, especially Freud, Marx, and Nietzsche [7–9]. Modernity was the end of the big systems of philosophy because it was impossible to build a system based on human reason that could be justified through reason itself. The concept of life took more importance because of the hermeneutical philosophers and the philosophers of phenomenology, especially in Dilthey. Modernity can be characterized by the end of ethics and the opening of subjectivism. Postmodernity was, therefore, characterized by a bunch of trends in philosophy. The trust in reason led to ethics that trusted in scientific truth (positivism) or the truth that could be achieved through democratic systems ("school of Frankfurt"). On the other hand, the vision of ethics without truth led to the different authors of structuralism with a very strong sense of subjectivism, as well as to authors that relied on anthropology to observe different cultures as the basis for societal order. Lastly, big philosophical systems found different authors that revisited the systems and proposed new innovations that tried to lead the economics of the globe (materialism). In this landscape, capitalism and economic globalization led to a mosaic of cultures around the globe with a strong sense of individuality [10]. As a result, ethics became highly fragmented and enclosed within communities of practice. Ethics was forced to establish its own limits [11].

Lately, computational social science has gained traction by using big data to analyze human behaviors. This research has not included ethical principles, but development guidelines of United Nations for sustainable and fair societies. However, recent studies on ethics and laws of AI have opened the discussion on ethical frameworks and the impact of data and AI behavior on society [12–15], including AI audits. Thus, we can see a reflection of trustworthy AI that intends to rely on ethical principles to have a grounded justification. On the other hand, we can observe technology-oriented work to self-evaluate AI using AI and analytical methods. In both cases, there is no grounded framework to evaluate how these efforts impact society and their implication for a longer-term future.

The exponentially increasing need to address more specific and heterogeneous challenges in different parts of the world has led to a global commitment that resulted in the sustainable development agenda and the sustainable development goals [16,17]. Current ethics must embrace sustainable development goals as a global achievement of humanity working as a community of theory and practice, and not as a fragmented society. This is because ethics has evolved throughout the history of philosophy; thus, it has to be justified through inter-subjective reasoning, work, and community. In SDG-11 (sustainable cities and communities—make cities and human settlements inclusive, safe, resilient and sustainable), humans are considered equal and not as targeted beneficiaries; hence, it is a proper SDG to establish ethical principles that apply to everybody. All SDGs are interconnected through targets that overlap and are related as a complex system, especially in this digital era where we can connect the environment with infrastructures and society using big data [18,19]. Thus, SDG-11 can help in articulating ethical frameworks using principles for citizens that are concrete and conceived within regulation and that connect with the remainder of the world's problems through SDG relationships and digital development. Urban dynamics and structure that are reminiscent of Greece are currently being revitalized, combining human values with the ecosystem through the SDGs on different scales and with levels of complexity. The work by Khamis [20] provides a good set of examples illustrating the areas where AI can help achieve the SDGs from a technical point of view. The present work complements [20] in the sense that we add the philosophical principles and discussions beyond the technical aspects. Furthermore, Astobiza [21] emphasized the ethical dimension of AI, which is supplemented with concrete SDG examples and quantitative evidence in the present contribution.

Poverty, gender, inequality, vulnerability, and how we live on our planet have become central issues for humankind and governments worldwide. The long-term development

goals are also challenged by crises of different kinds and large-scale transformations that produce systemic changes. The dynamics of societies and the relationships with the planet have become part of a framework that has strong ethical implications. In this scenario, the big data revolution has been identified as an opportunity to drive all societal changes for a better world [22]. These challenges to tackle are a new opportunity to revitalize ethics in a more universal sense so that we succeed in building a better humanity [23]. Integrating the data revolution, industrial change, SDGs, and the philosophical method is definitely an opportunity to build new societal structures in an era of complexity and technology [24–29].

In Section 2, we analyze the current society to define a philosophical framework and establish the criteria and requirements for it. We conclude that the current digitalization is not granted as an ethical digital society. Then, we hypothesize that an ethical framework should gravitate to the city and the digital development that appears for humans as citizens, producers, consumers, etc. The research question is whether we can find a comprehensive set of principles with an ontological foundation and if they can be connected with the SDGs as the basis of societal development. Section 3 presents the principle-based framework and the connections to SDGs through digital development and articulating fundaments. Section 4 provides a discussion on the implications of the framework for the environment. The conclusion is presented in Section 5.

2. Methods

2.1. Analysis of Digitalization

Over the last few decades, technological development has become one of the main drivers of socioeconomic configuration of the world map. Through technology, humans are better connected, have better accessibility to resources and information, can build economies and leisure, can develop jobs, can enjoy media, etc. In contrast, the unequal development of digitalization leads to a "digital gap" where some humans do not have the same benefits. Furthermore, the wrong use of digitalization can result in problems for human self-development or inequalities at a larger scale. The Internet enables hyper-connectivity and real-time flows of information with strong implications in communication and financial systems [30]. The awareness of the power of the data generated by the society brought the hope of a data revolution [31]. Furthermore, artificial intelligence (AI) is reaching its expected potential [32,33] having been the core of an industrial revolution [34] which poses questions about the future path of humankind. An important issue is that, so far, technological development has gone at a faster pace than the evolution of ethics, as few professionals are devoted to a formal analysis of ethics and digitalization. The fragmented ethical landscape of AI guidelines is a significant problem to establish a truth-grounded governance of technology and its applications [12]. Nevertheless, the guidelines by the United Nations, specifically the millennium goals and the sustainable development goals (SDGs), have been the most comprehensive tools to drive societal development.

The UN data revolution was established to help to drive the SDGs and humanitarian action worldwide. The deployment of the revolution has been hampered by poverty and epidemics in the developing world, whereas, in more advanced societies, the revolution depends on governments' programs. We have witnessed how private–public partnerships for data and digitalization have slowed down significantly since the mid-2010s where global challenges and partnerships such as Orange's D4D, NetMob, Italy Telecom Challenge, or Telefonica's data for good were frequent. We also witnessed that development programs do not include digitalization as a core pillar, but just as a way for capacity building. Developed societies are not caring or do not have enough incentives to work on ethical and sustainable AI development in basic issues such as responsible consumptions, and there are no specific guidelines for practitioners and young AI developers [35–38].

We can conclude that the data revolution was partially successful, as substantial data innovation has occurred, many data sources were explored [39] and integrated, and pilot projects were undertaken worldwide led by the UN. However, AI has never been a well-established revolution, and there are scarce means to drive ethical digitalization [40–45]. In

this situation, we face the more immersive digital word where the metaverse is demanded by society [46], with a need to scale up the projects for social good and development [47,48].

2.2. Requirements of an Ethical Framework

The data revolution postulated in the early 2010s that assumed computational decisions and data as new elements of most decision-making mechanisms has only partially changed the world, presumably less than expected a decade ago. On the global scale, the interconnections among different global subsystems, the real-time information, and the social response to information, events, and crises make the world a tangled network of complex processes. Nevertheless, at the individual level, the use of digital platforms, apps, and tools facilitate peoples' lives in many aspects and generate massive amounts of behavioral data with very high-value and large ubiquity, considering that artificial intelligence (AI) tools to analyze them are provided [49,50].

The local and the global scales are not fully Interconnected. Furthermore, the topology of these interconnections is very clustered, unevenly layered, and hierarchical, which translates into inequalities, power concentration, marginalization, vulnerability, and fragility [51]. In this scenario, humanity is introducing the basis of the Fifth Industrial Revolution, the metaverse. An integrative and high-impact transformative action starts from making ethical principles become a reality to not repeat the same mistakes.

For this transformation, a top-down process based on contrasted knowledge has to be integrated with a bottom-up process of interindividual consensus. Evidence-based consensus can articulate a framework that applies to cities and discover commonalities and invariants within the heterogeneities to identify what principles should be universal and promoted [12]. Digitalization is then a subject of ethics as an induction tool, and computation can be a part of evidence-based ethical frameworks as a deduction tool. Some examples of this evidence, in the context of sustainable cities, have to do with gathering information for accurately assessing the pollution levels or deploying autonomous vehicles. While objective data can be obtained for improving the situation toward these targets using data-driven methods, gathering data has ethical implications and consequences that need to be addressed in the context of citizen privacy and data protection.

To overcome the problems of industrialization and automation, ethical frameworks must embody conceptual and systemic risks. It is important to ensure not only the rights, but also the narratives that outlast and shape the perception and lives [52]. Digital technologies have proven to be a differential tool to create the mechanisms that protect rights and allow a faster recovery necessary to sustain development [49,53,54]. However, digitalization as a global process also poses important risks in terms of individual rights and values, as well as cultural heterogeneity, which cannot be neglected by design if we want to avoid industrialization inequalities.

Complexity, climate evolution, and computational methods give rise to new systemic risks that require a construct to drive interindividual consensus built from communities, starting from so-called collective intelligence [55–57]. In contrast with the current evolution of digitalization, ethics must guide how to build models of society according to a vision of humanity as the lens to define principles through innovation and deduction methodologies [25]. For instance, digitally-interconnected communities can use technologies to reach agreements and share them with other communities such as virtual congress [58]. Reducing the risks associated with digitalization and augmenting social systems through digital technologies are complementary processes that must be undertaken under the light of ethics formulated not only as protection rights but also as actionable universal principles [25]. These principles would not be meant to increase globalization of digitalization, but to promote actions at the local level to implement the necessary mechanisms according to the cultures. This is essential in order to ensure a more prosperous future enabled by novel digital technologies, while not compromising the achievement of SDG-10 on reduced inequalities [13].

Cities are targeted by the SDG-11 of United Nations to make them more sustainable but also more inclusive and resilient. This SDG comprises 10 targets including small-scale targets based on indicators and large financial and economic targets that evolve considering large-scale complexity.

2.3. Features of the Ethical Framework

In order to achieve the goal described above, ethics has to adopt concepts and language from science and develop shared knowledge and terminology in order to organically integrate the wisdom of tradition into the paradigm of global digitalization. Ethical principles such as truth, liberty, or solidarity must be revisited to be inserted into digitalization at the very core of its design, development, and deployment in the real world considering the current use of digital technologies. On the contrary, digitalization is being led by technical and industrial principles [59], as well as a number of fragmented ethical principles [60].

Data and AI are being used to make better decisions, optimize processes, customize services, predict patterns, and understand society. As ethical questions emerge, several guidelines have been proposed to ease the ongoing AI penetration, as well as analyze the risks. In [12], five principles were identified as a convergent set across multiple frameworks: transparency, justice and fairness, non-maleficence, responsibility, and privacy. In particular, transparency of AI models [61] was identified as a key aspect that needs to be achieved with interpretability methods, as discussed in [62]. However, universal ethical principles within transcendental ethics [6] must become central for a sustainable industry and digitalization as enumerated above. The misuse or missed use of digital technologies depends on understanding the catalyzing or inhibiting roles of technology [13]; thus, an ethical framework based on principles for new governance is necessary [24].

Although there is an evident trend for ethical principles in digitalization and AI development, an ethical approach to a more comprehensive vision of humanity and socio-technological models is needed. To this end, some approaches have been proposed, such as human rights-based digitalization or the systematic integration of heterogeneous ethical frameworks [12]. These approaches rely on consensus, although they do not guarantee that the actual actions, projects, and initiatives lead to a more sustainable and better world. However, a global human vision is needed to make sense of the consensus. This vision could complement existing initiatives oriented toward digital governance including AI audits, trustworthy AI, machine behavior, evaluation algorithms, and macro tech-indices. We consider that the sustainable development goals (SDGs) constitute a step forward on having such a vision, but the lack of a longer-term vision of humanity and the non-ethically-driven response to crises hamper the actual implementation of the SDGs and structures for building up the future and ethics-based governance [24].

As SDG-11, all SDGs include targets affecting individuals (no hunger, no poverty, and gender equality), but imply a direct systemic change in economies, relationships with the planet, and social behavior and regulation. The relationship between digitalization and the SDGs is complex and bidirectional. Several projects in the field of sustainable development have shown the potential of digital innovation [49,50,54]. Further innovation and deduction work based on AI and data will lead to soft regulation and new governance systems based on the principles mentioned.

Ethical principles are the basis to articulate a comprehensive framework based on the SDGs. For this mission, two main processes have to be carried out: first, understanding the ethical implications of the actions, roadmaps, and digital innovations needed to achieve the SDGs; second, using and deducing structures from the principles that comprise protection and actionable principles, as well as project the future as constitutive elements in policies and governance. Overcoming vulnerability and individual-level problems of the current world requires not only formal structures based on technology, but also the use of technology to shed light and truth as the basis for responsible governance. Considering this, beyond protection-oriented ethical principles that address misuse, actionable and future projection principles are proposed in the next section.

Revisiting Kant, his ethics based on the "categorical imperative" can be translated into protective and actionable principles. However, humanity has gone further since the Enlightenment with principles such as sustainability and resilience that are projective and included in the SDGs. Thus, SDGs are a proper framework to propose ethical principles because of the targets that go from individual indicator-based targets to more complex targets that are conceived at larger scales. By deducing and innovating on SDGs and their targets and indicators through computational approaches, it is possible to reach several scales and make ethical principles come into force and become a reality. Moreover, computational approaches take into consideration local (cultural) data; thus, the integration of universal principles and cultural differences is possible thanks to science-powered ethics and computation. For instance, socioeconomic and production level insights were connected with individual human mobility [19]. Furthermore, networks of concepts were related to the evolution of constitutions [63].

From a constructive point of view, computational approaches can be articulate ethical frameworks to draw conclusions that could not be made before due to the lack of evidence and large-scale inference processes. Computational intelligence can help remove biases and personal interests of power, as well as make more transparent and fair transactions [64]. This type of intelligence must be based on a hybrid approach involving both humans and machines, i.e., collective intelligence [24]. However, we lack the technology-governance entities and mechanisms to evaluate digitalization. There is a latent high risk in simplifying the science behind AI in the context of an industrialization process that impacts our society and well-being.

An ethical framework should address the configuration of the social tissue, soft regulation, and new governance, as well as how digital technologies are leveraged for public purposes or high-impact private platforms. The capacities to have these mechanisms and criticism are yet to be developed. Proactive actions based on collaboration, educational programs engaging practitioners and citizens, and collective intelligence initiatives and platforms are key to harness the visions of the future society, especially in city science and the computational socioeconomics and dynamics of the city [25,65].

2.4. Discovery of Ethical Principles

In order to discover ethical principles for the city, we propose an approach that seeks to find ontological justification to principles based on the exploration of UN agencies, government's areas, letters of digital rights, and the existing literature on ethical principles. By exploring current institutions, departments, and areas, it is possible to develop and ontologically enumerate ideas and potential principles of interest that can be further refined by applying semantic and pragmatic clustering techniques. Digital rights can also be translated into principles through deduction and induction. The existing literature contrasts the history of well-known and accepted principles in the societal order.

Along with the principles, we postulate several tools to articulate the ethical framework. First, digital innovation is key for development and wellbeing. Different types of innovation can enforce ethical principles, and ethics-driven design can be a source of digital innovation and epistemology. Philosophical reasoning based on logical deduction and induction should still be used to drive sustainable and digital development. For instance, we have witnessed several advances in computational social science based on philosophical reasoning. Lastly, the collaboration between machines and people leads to collective intelligence as a paradigm to imagine ways in which digital development can enhance human activities. From orgs based on collective intelligence to algorithms combining people and machines, it is necessary to deepen research on collective intelligence to fully exploit an ethical framework for digitalization and progress of humankind. Another articulating fundament is multiscale organization and complexity. Multiscale systems-like approaches are necessary to integrate local actions and global actions for an ethical framework to work and integrate human specificities and cultural heterogeneity with a proposed world that has a common vision of what societal development is.

3. Framework

3.1. SDG-11 and Principles

One essential area to be able to achieve important sustainability goals is that of SDG 11 on sustainable cities and communities. Firstly, in the European Union (EU), 75% of the population lives in cities, and it is expected that, in the next three decades, around 70% of the population worldwide will be urban dwellers [66]. Furthermore, cities are directly or indirectly responsible for over 60% of the greenhouse gas emissions in the world. In fact, over 800,000 premature deaths in Europe are associated with exposure to high levels of air pollution in cities, and a significant fraction of these is connected with cardiovascular events [67]. Due to the close connections between SDG 11 and other key SDGs (as discussed below), cities will play a significant role in the achievement of the climate targets indicated by the Paris Agreement. The range of targets within SDG 11 is quite broad, ranging from goals connected with air pollution to efficient transportation, economical aspects, and inclusion of communities.

As presented in the previous section, an ethical framework to achieve the SDG-11 targets requires a number of ethical principles: protective, actionable, and projection principles [25]. Protective principles are cybersecurity, anti-virality, integrity, privacy, legality, explicability, trustfulness, transparency/accessibility, accountability, and no discrimination. Actionable principles are democratization, impact-based self-sustainability, literacy, digital inclusion, participation, capacity building, digital solidarity/philanthropy, collaboration, robustness, anti-discrimination, and responsibility. Projection principles are multiculturality, multilevel society, internationality, autonomous society, sustainability, resilience, and sensibility/sensitivity. Having these principles come into force as a framework, it is possible to build soft regulation and social tissues to help achieve the SDG-11 targets. A summary of the framework is presented in Figure 1, and a detailed discussion if provided next.
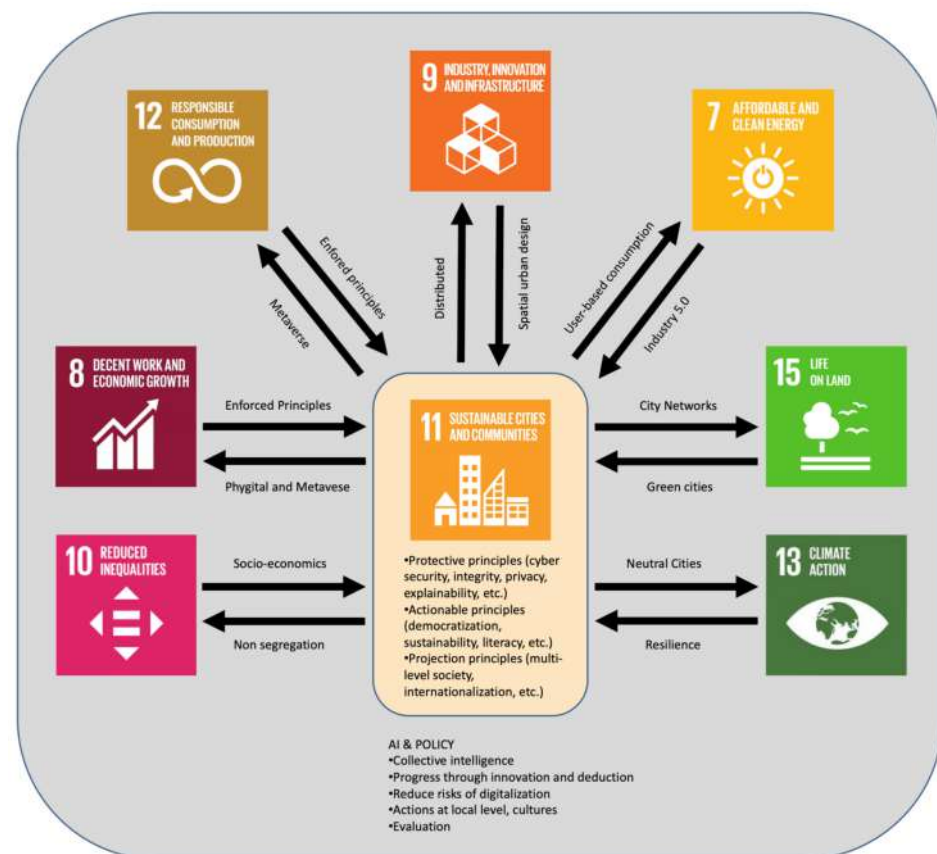

Figure 1. Ethical framework proposed in this work in the context of sustainable cities.

3.2. Relational Framework

From the ethical principles relevant to SDG-11, we establish a comprehensive set of relationships with other SDGs to cover all aspects of human life in the context of developed and developing cities.

SDG-10 (Reduced Inequalities)

The ethical principles of SDG-11 enforce non-segregation to preserve SDG-10. This includes data and AI-driven computational frameworks to monitor, control, and lead action for non-segregation (spatial and social). Spatial segregation is structural in city layout and dynamics; thus, it has to be studied to ensure that non-segregated scenarios emerge where social integration and individual progress are possible to enable equality. Social segregation depends on social bounds, as well as the interaction of communities and work. Thus, SDG-10 requires high-resolution satellite imagery, GIS resources, landcovers, building, and city accounting, as well as data for fine-grained mobility, semantic clusters, and social networks. SDG-10 enforces dynamic socioeconomic models where the ethical principles of cities hold and have to be applied. It also enforces data-driven policy and mechanisms to anticipate situations of segregation and even conflict. Comprehensive socioeconomic models should be built on top of SDG-11 principles. Protective principles are frequent in socioeconomic models, but actionable and projection principles are not so common. For instance, the digital economy appears as a demand in socioeconomic models considering actionable principles for increased participation and democracy in the digital era.

SDG-8 (Decent Work and Economic Growth)

The life in a sustainable city needs to go digital for principles to be productive and to improve work. AI-driven work and AI monitoring can help enforce ethical principles, especially beyond protective principles that are mostly covered by regulation. Actionable principles and projection principles need to be enforced through AI-based systems that allow high-level activities in work, especially considering human–machine interactions and AI-powered collective intelligence [64,68]. Human–machine systems are an opportunity to increase the ethics of work as machines can empower human intelligence and relieve from tasks. Furthermore, collective intelligence is an opportunity to reach local and global consensus and achievements. The metaverse and phygital spaces are the new technologies that are immersive enough to change work and make it more digital and inclusive through data streams, experiences, and sensing. SDG-8 requires analyzing socioeconomic variables and predicting the evolution of economic variables such as price consumer index, GDP, or poverty indices using machine learning models (i.e., boost gradient trees, LSTM, GRU, etc.). More connected work through digital tools would help make audits and surveillance to enforce and enable ethical principles. Moreover, digital platforms such as meta-innovation platforms based on collective intelligence (i.e., idea generation, collaboration, and assessment) are a suitable mechanism to improve work enforcing principles. The enforcement of SDG-11 principles for work can lead to new workspaces and a new distribution of the city layout including phygital spaces (i.e., parks to work) and spaces for the metaverse. Moreover, thinking on principles such as resilience, the city can change to have nuclei and clusters for resilience integrating work forces.

SDG-12 (Responsible Consumption and Production)

Consumption has to go fully digital to measure and achieve the SDG-12 indicators. Actionable principles are necessary to go from consumption to sustainable development. Consumption data and innovation are necessary to enforce projection principles and measure sustainability and resilience. Through digital innovation, it is possible to enforce principles in consumption. Moreover, consumption is key to drive sustainability and the lifestyle in cities and develop vitality and resilience in cities. The metaverse will be the next step toward responsible consumption and better environments for suppliers and customers. Local actions specific for each culture are the main drivers for stimulating circular economy, green cities, and rich cultural environments. Livelihood analysis and socioeconomic models are necessary to understand the complex relationships between

consumption and production and better understand the vulnerability and resilience of cities, communities, and regions. This is necessary, for instance, to assess early warning and mitigation strategies for climate hazards. The metaverse allows scaling up experiences and consumption (i.e., tokenized consumption), and it favors the use of AI to analyze behaviors, enabling digital innovation to enforce ethical principles. It has been shown that scalability is the most important challenge to implement a data revolution; thus, the metaverse appears as a fundamental element to drive sustainable development and a better humankind.

SDG-9 (Industry, Innovation, and Infrastructure)

We are moving toward Industry 5.0. Blockchain and AI have not yet fully been exploited to drive distributed and tokenized industry. Ethical principles demand circular economy into industry and a higher degree of technology-driven operations using more sophisticated machines as input for industry operations, as well as a better situation of people as input. Federated systems are likely the basis of a better socioeconomic model, as well as a mechanism to implement ethical principles at the level of cities, regions, and countries using technology to have a more homogenous industry that can be easily monitored and evaluated. For this reason, urban spatial design appears key to rethink industry in combining centralized systems, decentralization, and federated technology. Distributed technology can finally be applied for a distributed and remote industry. Digital technology must also help in controlling better lifecycles to measure their impact. Digital goods and services must also be better based on AI to have a better and futuristic experience and optimization. Multiscale complex systems represent a proper framework to drive economy and industrialization, considering that the local economy has to be stimulated to optimize resources at the regional or national level. Horizon scanning using data and machine learning is also necessary to identify trends, adapt, develop resilience, and change more quickly, including in the financial sector. The layout of cities is also key to enforce ethical principles of the cities. Human–machine and collective intelligence systems will be also key to unfold actionable and projection principles considering that humans will need to change work tasks and potentially management procedures, and that higher levels of automation will be necessary including in the start-up ecosystem. Meta-structures of operations and innovation are necessary to have more inputs for management and evaluation strategies to measure impact on society and enforce ethical principles.

SDG-7 (Affordable and Clean Energy)

Aligned with the European strategy, we propose user-centered energy to apply citizens' ethical principles and design the energy system to be responsible to achieve the SDG-7 targets. Data-driven profiling at the user level is key to properly study the whole energy network in an holistic way and analyze interactions with the ecosystem to enforce projection principles. The new energy sector needs to be designed to support Industry 5.0 to be immersive, including the metaverse, and to allow exhaustive computational frameworks and data-driven sustainable development. This implies rethinking and redesigning the scalability of the global and local energy networks to be oriented for a computational world where most of the variables are analyzed to extract indicators and enforce principles. Ethical principles also pose challenges in the energy distribution network topology and functioning, as well as the deployment of energy solutions. Data-driven systems can help achieve a better horizon scan of the global economy and development, as well as the resilience of countries and economies.

SDG-15 (Life on Land)

To achieve the SDG-15 targets, it is necessary that cities conform a networked intelligent space that interacts with land and develop AI-driven land systems to monitor land and land use. Data from remote sensing, ad hoc sensing, surveys, and expert organizations that collect in situ data are necessary to properly assess life on land and resilience, but they should also include basic social descriptors such as mobility networks to have sensitive indicators of change. Exhaustive machine learning has to be applied to classify all image pixels from remote sensing and extract raw indicators of vulnerability, adaptation, and

development. Regarding the complex structure of societies, cities in networks are capable of deploying ethical frameworks more effectively and equalizing the contribution of cities to life on land. Actionable principles are necessary for cities to contribute to land systems so that land systems can help enforce projection principles. AI-driven land systems require building collective intelligence platforms to collectively evaluate the life on cities and land so that agreements can be reached with a global scope. Green cities require AI-driven systems to monitor societal, governance, economic, and environmental variables with systems based on actionable principles that are regulated by projection principles.

SDG-13 (Climate Action)

Beyond green cities, it is necessary to make a transition to neutral cities which do not add carbon to the environment. Carbon-neutral cities are necessarily data- and AI-driven cities [69], so as to collect the necessary data to perform computational analysis and models. Cities working as a complex system require all societal levels to contribute to the decarbonization and harmonious functioning of the city. This implies measuring indicators with AI across several governance areas of the city and integrating them into policymaking including transportation modeling and air pollution modeling. Ethical principles need to be applied for the system to work properly and make the AI-driven city a working system. Furthermore, cities need to be resilient to climate change to make sure that ethical principles are preserved. Resilience is key to preserve protective principles, as well as enable projection principles. Early warning systems are basic to better adapt to climate conditions and natural hazards, saving lives and financial resources through humanitarian and anticipatory action of the UN, governments, and other humanitarian agencies. Through data-driven systems and AI, it will be possible to improve humanitarian operations to have better and earlier preparedness to face climate crises around the globe. Mitigation is also necessary for understanding, with data and AI, the complex relationships of the impact of climate changes and hazards for better recovery and resilience building. Actionable principles and AI are necessary to build up resilience from city complexity.

Considering the previous relationships, it is possible to build AI-driven policy systems based on collective intelligence to improve current expert-based systems. Furthermore, ethics can expand through innovation and deduction of the ethical principles. AI-driven policy requires computational evaluation to measure impact and progress and the interlinking of SDG targets. In this sense, having quantifiable parameters that can be used to drive technological development is essential. Some examples of these evidence-based parameters could be pollution levels, traffic efficiency, social inequality in urban environments, recycling rates, or the penetration of the circular economy. The complex role of AI on policy has to be monitored to avoid risks. Innovation and deduction are needed at the local level for sustainability to grow exponentially.

4. Discussion

In this article, we highlighted the strong coupling among the various SDGs requiring a holistic view of the sustainability agenda, together with an adequate ethical framework to be able to order, prioritize, and coordinate actions toward the greater good of humankind. In this context, there are studies suggesting novel approaches to tackle the SDGs at a target level by leveraging the new opportunities provided by AI and other digital technologies [70]. From the practical side of AI and data innovation, the particular case of SDG-11 is interesting, first, because AI can help achieve all its targets [13], second, because there are a number of complex interconnections among SDGs related to the particular case of sustainable cities as illustrated in Figure 1, and third, because cities have a prominent impact on our societies, contributing with over 60% of the total greenhouse emissions in the world and producing over 800,000 premature deaths per year in Europe [67]. One of the most promising areas within SDG-11 is the possibility to obtain enhanced measurements of the pollution levels in cities from few sparse measurements [71] or satellite data [72] via AI, a fact that could significantly improve the strategies to improve the air quality in urban areas worldwide, as well as lead to more effective urban-planning approaches.

An ethical framework is still required including protective principles because of privacy concerns, as well as risk algorithms, for instance, at the scales and levels of environment monitoring. This suggests that there are limitations in the current SDG agenda, particularly when it comes to AI and digital technologies, and a number of authors are proposing the development of a new SDG-18 focused on the particularities (both technical and ethical) of this type of technology [14]. Such an SDG could be implemented in the context of ongoing initiatives for AI regulation and audits [48], yielding an overall better and productive outcome of the AI.

5. Conclusions

The quickly growing development of machines can no longer motivated by interests to just develop smarter methods to perform human-like tasks. Traditionally, this vision has been denominated physicalism. Machines can hardly reproduce human reasoning; however, they can be used in applications that dehumanize society via a nonregulated industrialization that leads to a digital gap. Even tasks that are performed with accuracy such as text analysis, translation, and generation, or more creative tasks such as painting [73] still lack human characteristics such as open interpretability [62] and liberty.

On the other hand, humans are not perfect, and machines can help reshape how power relationships lead to the vulnerability and fragility of social systems. Computational frameworks are a way for not only efficiency but also transparency and accountability in implementing better governance systems without human-centric biases. Moreover, computations can help create different scenarios to improve decision making. This type of collective intelligence system has to be built with ethics by design, as well as a more comprehensive human–machine relationship vision. Collective intelligence presents several advantages. Firstly, it can make humans invest more time in high-level and abstract thinking. Secondly, it can power up machine workflows by introducing human skills and cognition. Thirdly, it can make humans' life easier without a sense of industrialization. Lastly, it allows scaling -up governance by integrating many people into machine workflows [24].

We can expect that cultures will adopt and develop different levels and applications of computation because of their tradition, religion, industry, and research systems. We should start wondering about the social status of machines and how they will collaborate with humans to potentially take humanity to a next level of self-development and wellbeing. In this context, digital divides and uneven access to AI resources are key aspects increasing inequalities worldwide; therefore, they need to be accounted for when developing ethics-based platforms.

A new universal ethical framework which learns from the evidence that science provides is required. This may be one of the most powerful contributions that digital technologies can provide to society. It is not sufficient that ethics reflects science as a subject; science has to be part of ethics because it can help it to understand this complex world. One critical aspect of this mission in the short term is to understand the relationships between the different social scales and the SDGs that drive the sustainable development progress in the next few years. As an alternative to negative techno-ethics that are limited to protection principles, it is necessary to promote an ethical framework that creates a conceptual construct and vision capable to drive technological development toward a better humanity. This means complementing protection guidelines with actionable principles, as well as with projection principles based on imagination, creativity, and collective intelligence.

This landscape prompts for an exciting return to formulating questions about human conceptions and expectations by ethical principles.

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