






## Article

# Including Digital Connection in the United Nations Sustainable Development Goals: A Systems Thinking Approach for Achieving the SDGs

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**Abstract:** In the two decades since the establishment of the 2030 Agenda, the world has faced significant challenges to achieve the 17 Sustainable Development Goals (SDGs). Before COVID-19, the SDGs were not on track to be achieved, and disruptions in implementation resulting from the pandemic have had significant effects, turning back years of progress. The pandemic has highlighted the essential nature of digital technologies in advancing the SDGs, continuing education, including higher education, social, and commercial activities, as well as enabling people to participate in society, democracy, and the economy during crises. As humanity enters this new period and begins to reset after the 'great pause', it is imperative to reconsider how the digital revolution has affected progress, especially in realizing the SDGs. Digital inclusion and connectivity inform and are essential to achieve all of the Goals. This article builds on the Just Digital Ethical Framework conceptualized by the authors in O'Sullivan et al. published in *Nature Communications*, which argues that four strategic drivers (digital capabilities, technology, infrastructure, and governance) are imperative to complete all of the 17 SDGs. It takes the Just Digital Ethical Framework to the next critical step, in which there needs to be a new SDG dedicated to these four drivers. This article is an exploratory study that uses a systems thinking approach and presents an 18th SDG called Digital Connection. Digital Connection focuses on the equitable distribution of digital wealth guided by the drivers. Understanding the relationship between these drivers and how they operate, where they are used, the pace of change, and systems' ability to adapt are essential for sustainable development and to address the challenges that face society equitably and fairly.

**Keywords:** sustainable development; digital technologies; digital technologies in higher education; digital inclusion; United Nations; sustainable development goals



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## 1. Introduction

In the two decades since the establishment of the 2030 Agenda, the world has faced significant challenges to achieve the 17 Sustainable Development Goals (SDGs). Before COVID-19, progress in reaching the Goals was behind schedule, and the disruptions in implementation resulting from the pandemic have had significant effects. The pandemic emphasizes the essential nature of the digital sphere in advancing the SDGs, continuing education, including higher education, social, and commercial activities, as well as enabling people to participate in society, democracy, and the economy during crises. School and learning space closures exacerbated the existing education inequalities, making it more

difficult for the most vulnerable to continue their education, especially for girls, those in rural areas, refugees, and forcibly displaced persons [1]. On this basis, the United Nations (UN) projects that 2.8 million young people and children are at risk of lacking access to education or dropping out in 2021, when learning about the losses that are likely to transcend this generation [1]. The situation has impacted all of the countries, but the most vulnerable and impoverished are experiencing it more profoundly. Before 2020, nearly half of the world could not access the essential technologies needed in the contemporary era, such as the internet [2]. The restrictions imposed by governments worldwide exacerbated these disparities, stressing the gap between those with and without access to the digital sphere.

Throughout the pandemic, digital wealth has become a determining factor in the ability of individuals and communities to engage in society. With regards to the Just Digital Ethical Framework conceptualized by the authors [3], ‘digital wealth’ is defined as the capacity to have adequate access to four critical digital drivers: Digital capabilities, commodities, infrastructure, and ethical governance. Technologies including supercomputers and advanced algorithms analyzed thousands of drug compounds to develop vaccines, e-commerce ensured access to medical supplies and infrastructure, and digitally-mediated good governance helped in facilitating these activities. However, inequities in the current system of digital wealth indicate that there is an unequal distribution both between and within nation-states. For example, digital skills and literacy predicted which sectors of education and business could continue during the pandemic. While the digitally wealthy could utilize technologies to ‘survive’ hardships, digitally deprived populations were marginalized. These populations often could not participate in the same activities or access equivalent goods and services, fostering an emerging class of poor—the digital poor.

If not addressed through ethical governance, the gap between the under-connected and the hyper-digitalized groups will worsen the existing inequalities [4]. This scenario has significant implications for the SDGs. Without proper development and implementation of the four drivers of digital wealth, the world will fail to achieve the 2030 Agenda [5]. As a result, it is imperative to reflect on how the digital sphere influences sustainable development, recognizing that the world is amidst a technological revolution, where participation in modern society depends on digital wealth. It is now time to consider developing a new SDG dedicated solely to digital wealth. Based on these observations and to progress the essential nature of the Just Digital Ethical framework [3], this article explores the possibility of establishing a new SDG, Digital Connection, using a systems thinking approach. To achieve this, the study addresses two primary research questions: (1) Is there a need for an 18th SDG focused on digital wealth?; (2) How can an SDG based on digital wealth and its four associated drivers (digital capabilities, commodities, infrastructure, and ethical governance) help in progressing the SDGs and the 2030 Agenda?

## 2. Rethinking Digital: The Just Digital Framework and an 18th SDG

Observing the historical patterns of how technologies ebb and flow from invention to mass adoption, society has now reached the point of the digital sphere, which is a systemically essential part of society. It is no longer siloed in the ‘Information Technology’ category, but is pervasive throughout people’s working, learning, health, personal, political, and social lives. The technological revolution has followed the lines of all previous revolutions. It has been driven by ‘creative destruction’ and significant productivity leaps. While countless traditional jobs and skills may have become obsolete during this phase, this productive leap creates enough new wealth and opportunities to ignite innovation, new types of business models, and jobs, while redefining perspectives and assumptions. Critically, it is followed by a period of ‘creative construction’, in which society ‘catches up.’ When considering the impact of the technological revolution, it is clear that the world is at a moment where society needs to ‘catch up’ [6]. This is taken alongside the growing concerns that new technologies could lead to counterproductive impacts, setting back progress towards the SDGs rather than moving the 2030 Agenda forward [7]. The Just

Digital Ethical framework explores how an ethical way to ensure that creative construction incorporates all of the society's needs and values can be created [3]. Due to its holistic and imperative nature in achieving the SDGs, this framework provides a starting point to consider the development of an 18th SDG, responding to the advancements in technology and digitization. As observed by Perez et al., the period of creative construction is the ideal time for society to catch up with modern developments and utilize the revolution to ensure society is best served by its advancements [6].

There are efforts to address the issues arising from the growth and influence of the digital sphere globally, such as the UN Secretary-Generals Roadmap for Digital Cooperation [7]. However, these endeavors fail to have an integrated and universal approach that supports digital wealth, access, and inclusion. This research contributes to these ongoing debates by considering what this article argues as the next logical step, the 18th SDG. The proposed concepts in this article theorize that developing new and innovative ways to support digital access, wealth, and inclusion in this context is necessary. Digital Connection is this reformulation, and as an SDG, it can reduce inequalities, provide access to employment, education, and healthcare in remote areas, create opportunities for co-creation of policies, and enable the education of girls, women, and other marginalized groups. Moreover, it can help in building disadvantaged communities' resilience to climate change through the increasing capacity for innovation. Furthermore, it can enhance agricultural productivity and logistic systems and provide market access and financial services, such as mobile money.

With society reaching a digital tipping point, it is critical to re-evaluate the entire system alongside the interconnected drivers of the Just Digital Ethical Framework [3] to inform of a new SDG. Reconceptualizing the digital sphere into a framework that considers the inter-related nature of digital capabilities, commodities, infrastructure, and governance allows for a modern review of digital inclusion, poverty, and the SDGs. The value of this research and Digital Connection is in its potential to re-imagine the factors that support digital inclusion, which inform digital wealth, poverty, and the broader goal of sustainable development. This model shows that these core drivers enable digital inclusion, which is crucial in mitigating digital poverty. These four inter-related concepts play an essential role in developing a digitally connected society and achieving the SDGs, illustrating the need for Digital Connection as an 18th SDG.

The first part of this process looks at how the Digital Connection drivers work within the existing system to achieve the SDGs. Using the systems thinking approach previously undertaken by the authors in health [8], disability [9], and education [10], the following sections identify the specific points and places within the current system where these drivers can solve digital inequalities and support the achievement of the SDGs.

### *2.1. Digital Capabilities*

Digital capabilities are the skills deemed essential for driving digital transformation, supporting digital wealth, and sustainable development. Digitally literate citizens can benefit from the digital economy through accessing quality and safer information, e-government services, commercial products, media, and engagement with the global community. Conversely, digitally illiterate citizens can be victims of the digital economy, experiencing financial fraud and physical or other forms of exploitation and abuse. Consequently, equality in digital skills is vital to shared prosperity in the digital economy [11].

The need for employers and educators to move 'online' during COVID-19 highlighted the realities of the digital economy in both developed and developing nations. The pandemic has increased global dependence on digital technologies, and with this, the requirement for digital skills to participate in social, economic, and democratic aspects of society. Even the most developed countries found it challenging to guarantee that people had adequate skills to continue engaging in work and school activities. The situation was worse in less developed countries. As demonstrated in 2020, fewer than one in five people in the Least Developed Countries (LDCs) had the digital skills to use the internet, compared to four out of five in developed countries [12].

The distribution of digital literacy varies between the global North, global South, and within and between countries. Lack of Information and Communication Technology (ICT) skills is a significant barrier to accessing the digital economy, which is predicted to reach USD 23 trillion by 2025 [13]. The Broadband Commission for Sustainable Development recognizes this challenge and has set targets to ensure that 60% of youth and adults have minimum proficiency levels in digital skills by 2025 [13]. Even with these goals, there are disparities in skills. In 2019, the International Telecommunications Union (ITU) reported that less than 50% of the population possessed basic computer skills, including sending emails with an attachment or copying a file. Less than 50% of people in 60 countries worldwide had ‘standard’ skills, such as using basic arithmetic formulae in a spreadsheet or downloading and installing new software. For advanced skills, only two countries reported that more than 15% of people had written a computer program using a specialized language in the last 3 months [14]. These statistics demonstrate the differences between those who have and those who do not have access to digital capabilities and the potential impact on achieving the SDGs. People who have digital capabilities are better served in modern society in terms of work (SDG 8) [15], health (SDG 3) [15], and education (SDG 4) [15], which reduces the risk of poverty (SDG 1) [14], and unequal access to society (SDG 5) [15].

Several OECD countries and some Latin American and Asian countries have guidelines for measuring digital skills and developing education and training courses. On the other hand, Africa does not have any of these frameworks. However, the World Bank’s Digital Economy for Africa (DE4A) Initiative aims to make Africa digitally enabled by 2030 [11,16], recognizing that Africa’s young people need to be digitally literate and have access to technology and markets. This access ensures that they can thrive in a world increasingly driven by the digitalized economy [16]. One of the most comprehensive and commonly used frameworks to measure general digital skills is the European Union’s DigComp 2.0 and updated DigComp 2.1. These frameworks consist of 21 competencies within five areas: Information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. Each competency has eight proficiency levels [11,17].

Digital capabilities are essential, and there needs to be a more significant focus on increasing digital literacy alongside sustainable development. For example, innovation, reducing poverty, and decreasing inequalities depend on the employability of people. With the growth in automation of service roles and the expanding dependence on technology, it is necessary to provide all of society with access to basic and advanced digital skills. These include the capability to communicate effectively using technology, be represented in developing technologies, and stay connected to self and services with emerging technologies.

## 2.2. Digital Commodities

Digital commodities are the fundamental technologies and solutions which were the cornerstone to continuing normal activities during COVID-19 and are needed for full participation in society. These commodities are a means of increasing people’s engagement in society, improving accountability and transparency, public service delivery, and inclusion. They include hardware, such as laptops, computers, mobile phones, and software, such as word processing applications, coding capabilities, and access to cloud computing. The pandemic necessitated integrating technological solutions to work, learning from home, and building and sharing medical support. The past 2 years have highlighted digital inequalities, in which there are clear socioeconomic and political divides in who has access to essential technology [2].

Digital commodities are central for employment, education, and innovation. Research shows that digital technologies facilitate financial inclusion, access to markets, mobile banking, microcredits, and remittances [18]. Specifically, ICTs contribute to poverty alleviation by highlighting the needs of vulnerable groups using real-time data and analytics and simultaneously enabling people to work in partnership and co-create solutions with diverse stakeholders. As it currently stands, there is no SDG dedicated to ICT, and only four ICT

related indicators appear in four of the Goals (SDGs 4, 5, 9, 17). However, the 2030 Agenda emphasizes technologies' essential role in achieving all of the 17 Goals [19]. In addition, more recently, the introduction of the six SDG Transformations, one of which is dedicated to digital technologies, demonstrates the importance of providing a framework to consider how the SDGs are affected by access to digital commodities [20].

An example of how access to technologies impacts the SDGs is evident in the growth in innovations in digital finance, e-commerce, and e-governance. These are increasing access to information and services. In China, e-governance has been seen to reduce the rural-urban divide through access to health, education, and the rising non-agricultural income-generating opportunities for rural areas. Furthermore, millions can now access financial services through social networks and e-commerce platforms, enabling marginalized and impoverished populations to save, invest, and build credit scores. In Bangladesh, iFarmer, a digital crowdfunding platform, allows the investors to offer capital to rural women cattle farmers and the e-commerce platform ekShop Shoron helps Rohingya refugees create livelihoods in Cox Bazaar [19]. These growths in e-commerce must be seen as more than an opportunity to shift from a traditional retail trade model to a more sustainable one, but also as an opportunity to use digitalization to advance this goal [21]. Without access to technologies that support engagement in these activities, these innovations do not serve the marginalized.

Although these examples in China and Bangladesh show how digital commodities empower these populations, there is a growing divide between urban and rural access to technologies. In China, rural areas still disproportionately lack access to technologies. Moreover, the cost of devices, data plans, as well as the speed and quality of connectivity are additional exclusionary factors. More than 70% of urban households have internet access in Bhutan compared to 29% of rural households [19]. COVID-19 has threatened to push nearly 71 million people into severe poverty due to a lack of digital commodities, which will most likely increase these divisions [18,19]. Commodities, infrastructure, and affordable services are necessary to mitigate this impact.

### 2.3. Digital Infrastructure

Digital infrastructures and services are essential for achieving several of the SDGs. In less than two decades, commercial internet has moved from innovation to a requirement for full participation in society. Although it might seem that the digital economy is a system in itself, several actors have invested in capital and operating expenditures, research, and development to construct and sustain the 'digital ecosystem' that facilitates the digital economy. Some of these actors include Communication Service Providers (CSPs), digital service and content providers, and hardware and software manufacturers. Moreover, governments are highly involved and act as policymakers, regulators, owners, and distributors of mobile networks. Non-Profit Organizations (NGOs), industry groups, and multi-stakeholders, such as the United Nations (UN) agency ITU, are crucial players. Collectively, these stakeholders are responsible for fixed and mobile networks, data centers, internet protocols, and technological equipment. As the number of people and companies that use the internet increases, companies invent more ways to service these needs, such as the Cloud, machine-to-machine communications, and the Internet of Things. This phenomenon makes good, working, digital infrastructure networks necessary for successful engagement in contemporary society [22].

A new face of inequality emerges when considering who has meaningful access to the technology and its associated infrastructure. While technologies, such as Artificial Intelligence (AI) and blockchain provide unique opportunities to people, they pose numerous risks, including exclusion [23]. Deputy Secretary-General Amina Mohammed stated that 'almost half the world's population ... the majority of them women, and most in developing countries, are still offline' [23]. In 2016, more than 4 billion people in emerging economies did not have access to the internet, many living in rural or remote areas [24]. In India, a country with the second-largest online market, only 50% of the population has



access to the internet [25]. Additionally, recent data demonstrate that 66% of Caucasians have access to high-speed internet at home compared to 49% of African Americans and 51% of Hispanics [24]. The rural versus urban divide also shows the increasing marginalization of communities living in rural or remote areas. Studies by large industries demonstrate that poor broadband is a significant obstacle to employment in rural areas. As underfunded national governments remain primarily responsible for these infrastructure systems, there has often been minimal progress in providing digital networks in rural areas [26].

Although there have been developments in promoting inclusive and sustainable industry, including investing in infrastructure and connectivity guided by SDG 9, industrialization in LDCs is still slow [15]. There is a substantial variance in levels of digital infrastructure in emerging markets. This is especially prevalent in Low-Income Countries (LICs), where there are frequently low levels of internet penetration and usage, gaps in coverage between rural and urban settings, and barriers in affordability, specifically for the mobile internet. The pandemic shows that digital connectivity is essential to business continuity and societal resilience. However, there is still limited data on the effect of COVID-19 on digital infrastructure in emerging markets. Most of the COVID-19 analysis concentrates on government interventions or infrastructure subsectors [27].

In emerging markets, digital infrastructure providers may see higher demand, in which a series of adverse shocks can counterbalance. These shocks can impact broadband operators and smaller companies, resulting in reduced competition, technological innovation, and availability of open-access broadband infrastructure. COVID-19 is causing a decrease in funding into emerging markets. As a result, significant support may be required from development finance institutions for financing of smaller or independent companies in the most impoverished economies to ensure competition, resilience, and the promotion of digital inclusion for the poorest [27].

Funding is also a challenge for universal digital inclusion. Many independent actors provide funding for these goals, but often do not work as a coordinated mechanism. Gaining access to this funding can require onerous processes that many governments and non-state actors lack the capacity to complete, such as feasibility studies. In some regions, there are high levels of investment for infrastructure. In others, funding is significantly lacking, especially in LDCs and countries afflicted by conflict, where connectivity could help decrease poverty. Although the private sector has access to finance, technology, and resources to fund digital connectivity and inclusion, there is a reluctance to invest in places that are considered to have associated risks, lack of collateral, and little short-term returns [2]. Access to working infrastructure in the form of internet connection, cloud computing, and operating systems that connect critical stakeholders at the country and local levels are fundamental to achieve a fair and equitable society for all. This relates to nearly all of the elements of the SDGs. Failure to consider who has access and how they access the digital world hinders the ability to ensure that everyone's basic needs are met, which allows them to flourish in a way they value.

#### 2.4. Digital Governance

Ethical governance plays a significant role in ensuring specific protections in conjunction with digital inclusivity. The UN has stated that digital technologies are a primary supporter of sustainable development, making it even more essential for the ethical management of all things digital to create an ecosystem that supports the integration of digital technologies into people's daily lives in a fair and safe way [28]. This system must ethically promote social inclusion and ensure national policies protecting citizens' rights and confidentiality, while considering data infrastructure and ownership. One of the core challenges for digital transformation is the lack of coordination or mechanisms to create relevant policies supporting digital innovation and private enterprise [13].

Universally, digital wealth is inextricably linked to human rights. The strategies and policies to achieve this goal must reflect on human rights online and enhance capacities for cybersecurity. Alongside an acceleration in digital connection resulting from the pandemic,

the human right protections, both online and offline, continue to deteriorate. There has been a decrease in internet freedom and increased internet shutdowns, as well as surveillance and privacy violations. These violations extend beyond government abuses, and if action is not taken, incidences of misinformation, hate speech, online violence, and sexual exploitation will continue to grow. However, the linkage between digital wealth and human rights is more than political rights. As COVID-19 illustrates, access to the digital sphere is crucial to accessing fundamental, economic, social, and cultural rights and critical to achieve the SDGs, such as access to education (SDG 4), employment (SDG 8), and health and wellbeing services (SDG 3) [2]. SDG 8 recognizes the right to work as a fundamental human right. Promoting decent work and economic opportunity through ensuring that everyone has access to digital commodities and capabilities is a cornerstone for success to SDG 8 and is critical to achieve progress in alleviating poverty (SDG 1) and in promoting health and wellbeing (SDG 3) [15].

While more attention is given to human rights in the digital sphere, there is a lack of cooperation and consensus around this topic, specifically among UN member states. The different approaches are challenges to digital security and safety, hindering a global approach to digital human right issues. The involvement of business and civil society groups to regulate online human right protections is also controversial [2].

Before the beginning of 2020, many governments tried to strengthen their strategic approach to digital transformation and focused on emerging digital technologies, such as AI, blockchain, and 5G infrastructure. In 2020, 34 OECD countries had a national digital strategy, and by mid-2020, 60 countries had a national AI strategy. Between 2017 and 2020, several OECD countries issued 5G strategies including, Australia, Austria, Colombia, France, Germany, Korea, Spain, the United Kingdom, and the United States. There is also increasing attention to blockchain and quantum computing strategies. Australia, the People's Republic of China, Germany, India, and Switzerland have policies, and France and Italy are developing them [29].

The ongoing cyclical relationship between digital innovation and digital transformation is crucial for new business strategies and markets, and digital technologies are playing a pivotal role in improving science and research systems that strongly influence countries' COVID-19 response and recovery. However, there is a growing awareness of how these technologies can challenge human-centred values, privacy, consumer protection, and security [30]. Countries need to respond to these issues when making policies. While these trends are encouraging, the pandemic shows that policymakers must adopt a whole government approach to digital transformation and governance [29]. Additionally, governments need to use metrics to measure digital inclusion within this system to produce evidence-based policymaking and to ensure that no one is left behind [7].

### 3. Methodology

#### 3.1. Systems Thinking Approach

This research aims to use a systems thinking approach to explore the possibilities and potential need for an 18th SDG. This method allows for the understanding of reciprocal relationships, interactions, and differing perspectives of a system, including its boundaries [31]. In this article, a system is defined as a range of connected components forming a whole, showing properties that are a part of the whole rather than properties as individual elements [32]. This method uses four principal characteristics of a system: Emergence, hierarchy, communication, and control. Holistically, it aims to find solutions to problems by analyzing a system's framework where they occur [32].

An essential distinction in considering systems is whether the system is 'closed' or 'open.' Generally, closed systems function autonomously, independently from their environment, and are configured to be consistent, generating identical outcomes [8,33]. In contrast, open systems are rooted in, dependent on, and often designed to respond to their environment. Unlike closed systems, they may not be consistent, with their outcomes potentially requiring a change over time [8,33].

The systems thinking approach that guided the researchers' inquiry drew on four process steps as informed by Richmond (2000) and MacLachlan and Schere (2018) [8,34,35]. The first step focuses on identifying the problem using one of four 'thinking approaches': Dynamic thinking, system-as-cause thinking, forest thinking or loop thinking. Dynamic thinking demonstrates behavioral patterns over time or how these patterns are distinct in different contexts [8,34,35]. System-as-cause thinking concentrates on what can change in a system to solve the problem. This type of systems thinking can include changing the element's relationship to each other or introducing new components that may alter and impact the outcomes in other parts of the system that are not in direct contact with the changed elements [8,34,35]. Forest thinking seeks to understand the context in which the system exists and its interrelationships and defines its boundaries [34,35]. It emphasizes the significance of identifying the broader 'wooded area' from the individual trees and addressing the trees' relationship with one another [8]. Loop thinking focuses on the cause and effect and bi-directional relationships that are maintained in a continuous loop [8].

The second step is constructing a hypothesis or model using one of three methods of thinking: Operational thinking, closed-loop thinking or qualitative thinking. Operational thinking focuses on causality and behavioral patterns to understand the nature of the process. Closed-loop thinking seeks to understand feedback relationships between the different elements of the system, and quantitative thinking quantifies the core variables. The third step is testing the hypothesis or model. The fourth step is communicating, understanding or implementing changes [34,35].

This research used system-as-cause thinking and closed-loop thinking approaches to propose a way to solve the problem of inequality in digital access, wealth, and inclusion. This article is the starting point for advocating for Digital Connection as an SDG in order that the theory can be tested and holistic changes to the system can be implemented. This research hypothesizes that an 18th SDG dedicated to Digital Connection will help in progressing the 2030 Agenda, while promoting equality and access to goods and services, such as education, employment, and healthcare.

### 3.2. The Development of a Systems Thinking Diagram

Relationships in a system can be captured and represented in causal loop diagrams. These diagrams use reinforcing and balancing loops to produce system maps. Reinforcing loops represent feedback loops that accelerate change, and balancing loops depict ones that resist change. This approach assists in collecting data that can inform policy, feedback loops, and the negative impacts of policy change [31].

In this research, the systems thinking approach was used to evaluate the present global system that uses digital wealth as a determinant for full participation in society and is arguably a critical factor in achieving the SDGs. The systems diagram developed as part of this research illustrates the imperative nature of the four proposed drivers of digital wealth in the system and as an 18th SDG.

## 4. Results and Discussion

This paper explores the case for developing an 18th SDG based on digital wealth and its four associated drivers: Digital capabilities, commodities, infrastructure, and ethical governance. The relationship between digital technology and individual SDGs has been discussed extensively in recent years [2,19]. However, since the pandemic, there is a growing sense that the impact of technological innovation in society could be profound. The rate at which innovation grows is causing social and economic disruptions of which the consequences are not yet clear. While AI, robotics, and blockchain have become a driving force for change in modern society, the capacity for inclusion in this period of innovation is predicted by access to digital capabilities, commodities, and infrastructure. Furthermore, the policies and practices that ensure a safe and equitable use of invention need to be in place to steer innovation in order to ensure that all of the society benefits. As has been stated, digital wealth is often available only to those that can afford access, while excluding



the most vulnerable in society if a proactive stance is not taken. With the SDGs' pledge to 'leave no one behind,' there is a considerable risk that will happen. Digital Connection not only analyzes the digital divide, but additionally focuses on the core commodities and capabilities essential for a meaningful engagement in society and achieving 'a good life'. The targets and associated indicators of Digital Connection are detailed in Table 1.

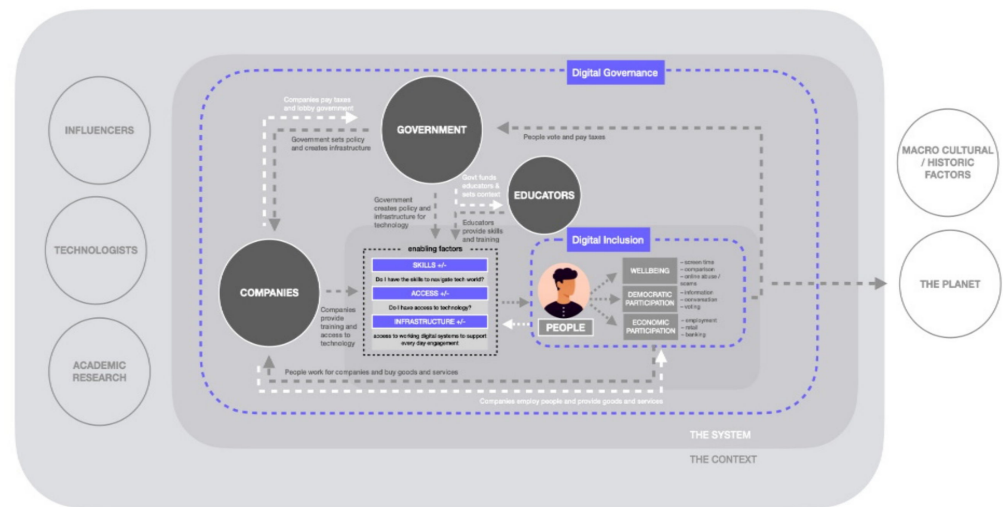
**Table 1.** Outlines the targets and indicators of the proposed SDG Digital Connection.

<i>Goal</i>	<i>Indicators</i>
Ensure everyone has equitable access to <b>Digital Connection</b>	
1.1 Digital Capabilities, Ensure all education systems provide everyone with the capacity to engage in the digital sphere	1.1.1 Proportion of population without access to education that teaching digital skills
1.2 Digital Commodities, Ensure everyone has access to the hardware required to engage in a basic standard of living	1.1.2 Proportion of population without access to required hardware
1.3 Digital Infrastructure, Ensure equal access to working communication systems that enable everyone to engage in work, school and daily life.	1.1.3 Proportion of population unable to access communication
1.4 Digital Governance, Ensure (and develop where needed) international standards to support the integration of digital technologies into everyone's daily lives	1.1.4 Proportion of population without access to digital technologies

Amartya Sen argues, 'poverty is not just a lack of money; it is not having the capability to realize one's full potential as a human being' [36]. Access to the commodities and capabilities that allow for the participation in society are fundamental to sustainable development. Reconsidering the digital sphere is a way of rethinking sustainable development in a broader sense. The capacity to gain employment, access services remotely, and have personal data represented in emerging technologies and algorithms are crucial factors that predict participation and encourage the equal distribution of digital wealth.

Using a system-as-cause thinking approach to understand the need of this SDG, the linkage between the four drivers and how they collectively inform the system can be determined. In Figure 1, a graphic system map illustrates how the four digital drivers in the system come together to enable (or undermine) sustainable development. This figure reflects how Digital Connection fosters sustainable development and allows for the full participation in society. It shows how the fulfilment of Digital Connection creates critical outcomes around the core dimensions of the 2030 Agenda, focusing specifically on the economic, social, and ecological aspects of sustainable development [37].

The system map demonstrates that digital drivers equally affect economic participation in terms of employment and commerce. This access allows for the society to take advantage of the technological revolution and employment. Furthermore, it enables democratic participation, whereby people can access information and use that information to participate in the democracy. The governance of digital data and information guarantees that democratic participation is fair and equal. In the social realm, access to digital capabilities, commodities, and infrastructure alongside an ethical governance structure allows for 'all things digital' to be used to support wellbeing. For example, understanding how screen time can affect mental health supports wellbeing. Without the commodities and capabilities to navigate all things digital, wellbeing can potentially be negatively affected.



**Figure 1.** Figure 1 is a system map of Digital Connection, which explores how the four drivers interconnect and inform the whole system.

Another example is illustrated in how understanding internet frauds, fake news, and engaging with technological advances can also impact how individuals act, feel, and behave. Furthermore, representation in datasets that decide the future of service and innovation is a critical element of the social world. This representation depends on the digital capabilities, commodities infrastructure, and ethical governance of data in developing technologies. Moreover, it shows how the digital drivers affect the ecological and sustainability of the planet.

Creating a closed-loop feedback map shows how digital capabilities, commodities, infrastructure, and ethical governance are inter-related constructs that facilitate and enable inclusion. For instance, digital capabilities are required for full participation in education, yet these capabilities still depend on education systems that provide skill development. This is equally reliant on national and international policies that support and value digital capabilities and working infrastructure, as well as commodities that allow for skill development. Within this system, educators and companies play an essential role in developing Digital Connection and how individuals can build some skills themselves—only within a system that supports the process.

Highlighted within this system is the industry. For people to have the technology, they need to afford technology, indicating that companies must consider the cost and condition of use. Companies can make technology affordable and available, and they are an essential feature of the system. Notably, when looking at companies and industries, there is a strong need for ethical governance of who, how, and why they develop technologies and how they utilize data from technologies to develop technologies of the future and information systems. For technology to be usable and inclusive, companies need to design it well. If it is not designed well, it can be challenging to use and even exploitative or exclusionary. Therefore, the companies in the system, their ethics, the governance system, and their ambition are essential features facilitating digital wealth and ethical use of technology in modern society or acting as a barrier. Governments are a necessary feature of the system. They play a facilitatory role in developing the infrastructure that makes digital wealth possible and the policies that drive education and access. More importantly, they control the funding to run the system and potential legislation that ensures digital society is constructed ethically. The macro influencers in this system include technologists, academics, and researchers who set the context for Digital Connection and add insight and voice independent of the system players.

## 5. Limitations and Contributions

The researchers acknowledge that this study has certain limitations. Although a systems thinking approach can be advantageous, it also has limitations. In genuinely complex systems, minor variations in preceding periods of time significantly impact as time progresses, and the feedback loops are incomprehensible. These systems have an inherent complexity that systems thinking cannot penetrate. Systems thinking focuses on finding patterns in complexity in phenomena that look complex at the surface level, but have a more straightforward order below the surface. With this, systems thinking applies to instances where apparent complexity is high and inherent complexity is low [34,35]. Accounting for this limitation in the method, researchers conducted a preliminary research, which continued through the entire process to ensure that the case which is studied fits within the parameters of the systems thinking approach.

Beyond the methodological limitations, the study is limited in the understanding of the practical application of implementing the proposed SDG. This limitation elicits further research to be conducted on its practical application. Although there are limitations, this research contributes to the debates around progressing the 2030 Agenda and promoting global sustainable development. This article provides a framework from which to conduct these investigations into how this SDG would function and interact within the current SDG framework.

## 6. Conclusions

The pandemic has adversely affected the implementation of the SDGs. A significant factor is the increased global dependence on the digital realm. To address the study's research questions, the researchers analyzed specific variables that were predicted to help in mitigating these adverse effects and help in promoting sustainable development. In addition, the present article evaluated if adding an 18th SDG dedicated to Digital Connection with four underlying drivers (digital capabilities, technology, infrastructure, and governance) would effectively advance this desired outcome. By applying a systems thinking methodology, the study's objectives were met and the research questions were answered.

The primary finding derived from the discussion of the system map indicates that the four drivers of Digital Connection can effectively support and progress sustainable development. This outcome is sustained through the bi-directional relationships and proximal and distal factors of the four drivers. Each of these variables interconnects in a closed-loop system that stimulates responses that encourage the equitable distribution of digital wealth. In addition, with digital wealth as a determining factor in achieving the SDGs, as this article argues, it would be beneficial to include an SDG that concentrates on Digital Connection. As shown in the model, the critical outcomes related to digital wealth are health and wellbeing and economic and democratic participation at an individual and societal level, which eventually positively affects the planet. This system demonstrates the importance of Digital Connection in the contemporary era and how its reach is significantly important that it merits consideration as an SDG.

The conclusion of this article, alongside the secondary sources cited, elicit the need for further investigation to establish how Digital Connection can operate in symbiosis with the existing Goals and objective timelines and how it would function in practice. On a positive note, introducing this new SDG may facilitate and hasten the achievements of the other 17 SDGs by providing education, support, and infrastructure of digital technologies to create a more equitable and fair society. However, a risk assessment is also required to evaluate and ensure that the introduction of Digital Connection does not exclude non-technology based solutions. It is imperative to analyze the advantages of walling in digital solutions and the potential disadvantages of walling out other solutions that are a part of the holistic approach of the 2030 Agenda. Conversely, providing digital capabilities, technology, infrastructure, and governance will not ensure an equitable distribution of these drivers with a clear SDG objective in mind. Further research on governance is required, and

it is crucial to safeguard the introduction of this goal, for example, to prevent companies from misinterpreting it as profiteering or greenwashing opportunities.

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## References

1. United Nations. *Policy Brief: Education during COVID-19 and Beyond*; United Nations: New York, NY, USA, 2020.
2. Roesch, J.L. *SDG Zero? A People Centered Approach to Universal Connectivity*; International Peace Institute: New York, NY, USA, 2021.
3. O'Sullivan, K.; Clark, S.; Marshall, K.; MacLachlan, M. A Just Digital framework to ensure equitable achievement of the Sustainable Development Goals. *Nat. Commun.* **2021**, *12*, 6345. [CrossRef] [PubMed]
4. UNCTAD. *Prosperity for All. Global Efforts Needed to Spread Digital Economy Benefits, UN Report Says*; UNCTAD: Geneva, Switzerland, 2019. Available online: <https://unctad.org/news/global-efforts-needed-spread-digital-economy-benefits-un-report-says> (accessed on 20 December 2021).
5. DeSI & Deloitte. *Digital with Purpose: Delivering a SMARTer 2030*; GeSI. 2019. Available online: [https://gesi.org/storage/files/DIGITAL%20WITH%20PURPOSE\\_Summary\\_A4-WEB\\_watermark.pdf](https://gesi.org/storage/files/DIGITAL%20WITH%20PURPOSE_Summary_A4-WEB_watermark.pdf) (accessed on 15 November 2021).
6. Perez, C.; Johnson, L.; Kleiner, A. Are we on the verge of a new golden age. *Strategy Bus* **2017**. Available online: <https://www.strategy-business.com/article/Are-We-on-the-Verge-of-a-New-Golden-Age> (accessed on 15 November 2021).
7. United Nations. *Report of the Secretary General: Roadmap for Digital Cooperation*; United Nations: Geneva, Switzerland, 2020. Available online: [https://www.un.org/en/content/digital-cooperation-roadmap/assets/pdf/Roadmap\\_for\\_Digital\\_Cooperation\\_EN.pdf](https://www.un.org/en/content/digital-cooperation-roadmap/assets/pdf/Roadmap_for_Digital_Cooperation_EN.pdf) (accessed on 20 December 2021).
8. MacLachlan, M.; Scherer, M.J. Systems thinking for assistive technology: A commentary on the GREAT summit. *Disabil. Rehabil. Assist. Technol.* **2018**, *13*, 492–496. [CrossRef] [PubMed]
9. MacLachlan, M. *Macropsychology: A Population Science for Sustainable Development Goals*; Springer Nature: Cham, Switzerland, 2020.
10. O'Sullivan, K.; McGrane, A.; Long, S.; Marshall, K.; MacLachlan, M. Using a systems thinking approach to understand teachers perceptions and use of assistive technology in the republic of Ireland. *Disabil. Rehabil. Assist. Technol.* **2021**, 1–9. [CrossRef] [PubMed]
11. Bashir, S.; Miyamoto, K. *Digital Skills: Frameworks and Programs*; The World Bank. 2020. Available online: <http://documents1.worldbank.org/curated/en/562351611824219616/pdf/Digital-Skills-Frameworks-and-Programs.pdf> (accessed on 15 November 2021).
12. Mekelberg, Y. Why the Digital Divide Is a Threat to Social Justice. *Arab News*. 2021. Available online: <https://www.arabnews.com/node/1812821> (accessed on 13 September 2021).
13. Sharma, S. Achieving the SDGs through digital transformation in digital economy & building skills. In *Proceedings of the Digital Transformation in Digital Economy*, Tehran, Iran, 6 July 2019. Available online: <https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/SiteAssets/Pages/Events/2019/jul-iran-dtx/Workshop-on-%E2%80%9CDigital-Transformation-in-Digital-Economy%E2%80%9D/ITU%20Keynote%20Presentation%20Session%202%202019%20R3.pdf> (accessed on 15 November 2021).
14. ITU. *Measuring Digital Development: Facts and Figures 2019*; ITU Publications: Geneva Switzerland, 2020. Available online: <https://news.itu.int/measuring-digital-development-facts-figures-2019/> (accessed on 15 November 2021).
15. United Nations. *The Sustainable Development Goals Report 2020*; United Nations: New York, NY, USA, 2020.
16. World Bank Digital Economy for Africa Initiative. Available online: <https://www.worldbank.org/en/programs/all-africa-digital-transformation> (accessed on 12 July 2021).
17. Gomez, C.; Vuorikari, R.; Punie, Y. *DigComp 2.1: The Digital Competence Framework for Citizens with Eight Proficiency Levels and Examples of Use*; Publications Office of the European Union: Luxembourg, 2017. [CrossRef]
18. International Telecommunication Sector (ITU). *Digital Financial Services: Regulating for Financial Inclusion—An ICT Perspective*; ITU: Geneva, Switzerland, 2016. Available online: [https://www.itu.int/dms\\_pub/itu-d/opb/pref/D-PREF-BB.REG\\_OUT02-2016-PDF-E.pdf](https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-BB.REG_OUT02-2016-PDF-E.pdf) (accessed on 13 November 2021).

19. UNESCAP. *Inequality in Access to Information and Communication Technologies (ICTs) in East and North-East Asia and South-East Asia*; United Nations: Geneva Switzerland, 2020. Available online: [https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP\\_InequalityICT.pdf](https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP_InequalityICT.pdf) (accessed on 16 September 2021).
20. SDSN. *Six Transformations to Achieve the Sustainable Development Goals (SDGs)*; Sustainable Development Solutions Network: New York, NY, USA, 2019.
21. Hategan, C.-D.; Pitorac, R.-I.; Hategan, V.-P.; Imbrescu, C.M. Opportunities and Challenges of Companies from the Romanian E-Commerce Market for Sustainable Competitiveness. *Sustainability* **2021**, *13*, 13358. [CrossRef]
22. World Economic Forum. *Delivering Digital Infrastructure: Advancing the Internet Economy*; World Economic Forum: Geneva Switzerland, 2014. Available online: [http://www3.weforum.org/docs/WEF\\_TC\\_DeliveringDigitalInfrastructure\\_InternetEconomy\\_Report\\_2014.pdf](http://www3.weforum.org/docs/WEF_TC_DeliveringDigitalInfrastructure_InternetEconomy_Report_2014.pdf) (accessed on 16 September 2021).
23. UN News. 'Don't Let the Digital Divide Become 'the New Face of 'Inequality': UN Deputy Chief. United Nations News Global Perspectives Human Stories. 27 April 2021. Available online: <https://news.un.org/en/story/2021/04/1090712> (accessed on 14 September 2021).
24. Shenglin, B.; Simonellie, F.; Ruidong, Z.; Romain, B.; Li, W. Digital infrastructure: Overcoming Digital Divide in Emerging Economies. G20 Insights. 3 April 2017, pp. 1–11. Available online: [https://www.g20-insights.org/wp-content/uploads/2017/05/Digital\\_Overcoming-Digital-Divide-II.pdf](https://www.g20-insights.org/wp-content/uploads/2017/05/Digital_Overcoming-Digital-Divide-II.pdf) (accessed on 14 September 2021).
25. World Economic Forum. These Are the Countries Where Internet Access Is Lowest. Available online: <https://www.weforum.org/agenda/2020/08/internet-users-usage-countries-change-demographics/> (accessed on 12 July 2021).
26. Guerot, U. Europe as a Republic: The Story of Europe in the Twenty First Century. Proceedings of RE:PUBLICA, Berlin, Germany. 2015. Available online: <https://www.opendemocracy.net/en/can-europe-make-it/europe-as-republic-story-of-europe-in-twenty-first-century/> (accessed on 15 November 2021).
27. Strusani, D.; Hounghonon, G. *What COVID-19 Means for Digital Infrastructure in Emerging Markets*; International Finance Corporation, World Bank: Geneva, Switzerland, 2020. Available online: [https://www.ifc.org/wps/wcm/connect/8f9237d2-ecb-433f-a2d0-300907808722/EMCompass\\_Note\\_83-for+web.pdf?MOD=AJPERES&CVID=n7M5wS](https://www.ifc.org/wps/wcm/connect/8f9237d2-ecb-433f-a2d0-300907808722/EMCompass_Note_83-for+web.pdf?MOD=AJPERES&CVID=n7M5wS) (accessed on 15 November 2021).
28. Gaiduk MSeepold, R.; Madrid, N.M.; Ortega, J.A. Digital Health and Care Study on Elderly Monitoring. *Sustainability* **2021**, *13*, 13376. [CrossRef]
29. OECD. *Digital Transformation in the Age of COVID-19*; OECD: Paris, France, 2020. Available online: <https://www.oecd.org/digital/digital-economy-outlook-covid.pdf> (accessed on 20 November 2021).
30. Nissenbaum, H. Contextual Integrity Up and Down the Data Food Chain. *Theor. Inq.* **2019**, *20*, 221–256. [CrossRef]
31. Pocock, N.S.; Chan, Z.; Loganathan, T.; Suphanchaimat, R.; Kosiyaporn, H.; Allotey, P.; Chan, W.-K.; Tan, D. Moving towards culturally competent health systems for migrants? Applying systems thinking in a qualitative study in Malaysia and Thailand. *PLoS ONE* **2020**, *15*, e0231154. [CrossRef] [PubMed]
32. White, D. Application of systems thinking to risk management: A review of the literature. *Manag. Decis.* **1995**, *33*, 35–45. [CrossRef]
33. MacLachlan, M.; McVeigh, J.; Cooke, M.; Ferri, D.; Holloway, C.J.; Austin, V.; Javadi, D. Intersections Between Systems Thinking and Market Shaping for Assistive Technology: The SMART (Systems-Market for Assistive and Related Technologies) Thinking Matrix. *Int. J. Environ. Res. Public Health* **2018**, *15*, 2627. [CrossRef] [PubMed]
34. Richmond, B. *The thinking in systems thinking: Eight Critical skills*; Pegasus Communication: Waltham, MA, USA, 2000.
35. Managing Research Library. Systems Thinking. 2022. Available online: <https://managingresearchlibrary.org/glossary/systems-thinking> (accessed on 6 January 2022).
36. Gurría, A. *Addressing the Hidden Dimensions of Poverty*; The Hidden Dimensions of Poverty: Paris, France, 10 May 2019. Available online: <https://www.oecd.org/about/secretary-general/addressing-the-hidden-dimensions-of-poverty-paris-may-2019.htm> (accessed on 20 November 2021).
37. Federal Department of Foreign Affairs. *17 Sustainable Development Goals*; s.l.; Federal Department of Foreign Affairs: Bern, Switzerland, 2021.