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Julia Kotlarsky
University of Auckland Business School, j.kotlarsky@auckland.ac.nz

Ilan Oshri
University of Auckland Business School, ilan.oshri@auckland.ac.nz

Nevena Sekulic
University of Auckland Business School, nevena.sekulic@auckland.ac.nz

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EDITORIAL

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Digital Sustainability in Information Systems Research: Conceptual Foundations and Future Directions

Julia Kotlarsky,[1] Ilan Oshri,[2] Nevena Sekulic[3]

[1]University of Auckland Business School, New Zealand, j.kotlarsky@auckland.ac.nz
[2]University of Auckland Business School, New Zealand, ilan.oshri@auckland.ac.nz
[3]University of Auckland Business School, New Zealand, nevena.sekulic@auckland.ac.nz

Abstract

In this editorial, we develop the concept of digital sustainability for the IS community. By systematically reviewing the Green IT and Green IS literatures, we show that the IS field has lagged behind current discourse in practice and therefore lacks the conceptualization of the relationships between digital technologies and sustainability. Digital sustainability is defined in this editorial as the development and deployment of digital resources and artifacts toward improving the environment, society, and economic welfare. We hope that this editorial motivates IS researchers to engage in digital sustainability as an emerging research area.

Keywords: Digital Sustainability, Green IS, Green IT, Conceptualization

Dorothy E. Leidner was the accepting senior editor. This editorial was submitted on July 29, 2022 and underwent two revisions. Julia Kotlarsky is a JAIS editorial board member.

1 Introduction

Sustainability[1] has been repeatedly acknowledged as a moral and existential imperative of our time. In the 50 years since the establishment of the United Nations Environmental Programme (UNEP) in 1972, the UN has been central to building awareness around sustainability issues on a global scale. Further, the UN's initial focus on environmental issues has expanded more recently to include the economic and social aspects of sustainability, as laid out in the 2015 UN Agenda for Sustainable Development. The agenda presents 17 sustainable development goals (SDGs), with 169 associated targets to be achieved by 2030 (UN Department of Economic and Social Affairs, 2015). Since the release of the agenda, many organizations worldwide have come under pressure from various stakeholders to meet SDGs in their operations. For example, achieving net-zero targets for greenhouse gas emissions is one of the latest SDGs that nations[2] and companies have committed to—including the European Union's goal of achieving net-zero by 2050.

Different organizations focus on specific SDGs relevant to their industry and geography (i.e., country-specific socioeconomic and political aspects) to comply with emerging carbon emissions regulations. In this respect, it has become increasingly evident that *digital technology* has a major role to play not only in measuring the carbon footprint of organizations, but also in addressing a range of SDGs by providing the means for organizations, nations, and societies to meet sustainability-related objectives.

[1] One of the most commonly used references to sustainability is attributed to the Brundtland report entitled "Our Common Future," published in 1987 by the United Nations World Commission on Environment and Development (WCED). This report established the concept of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

[2] https://www.un.org/en/climatechange/net-zero-coalition

Specifically, fast-paced technological development has fueled the digitalization of services and digital transformation across industries. This has created opportunities for organizations and industries to become more sustainable in the way they consume environmental resources (e.g., by implementing paperless business processes) and develop and deliver products and services (e.g., reducing carbon emissions by optimizing business processes based on data analytics enabled by sensors and/or embracing virtual ways of working that reduce the need to travel). We have also witnessed the emergence of a whole new industry—"clean technology" (cleantech, for short). The focus of this industry is technologies that enable processes, products or services that reduce negative environmental impacts through energy efficiency, the sustainable use of resources, and activities that protect the environment. The cleantech industry embraces a broad range of technologies such as solar power, wind power, biofuels, green buildings, personal transportation, smart grids, mobile applications, and water filtration (Pernick & Wilder, 2008). *Digital technologies* encompassing traditional information technology (IT) (including cloud services) as well as emerging technologies such as artificial intelligence (AI), blockchain, and IoT are important contributors to the cleantech industry and are used as stand-alone solutions and services (e.g., specific mobile applications, data analytics, and remote monitoring services) or integrated with other technologies.

Furthermore, the last decade has seen the birth of many new data-driven companies. These companies harness technology to offer data services that apply advanced analytics and AI to sustainability-related problems. For example, IoT sensors are now being used by organizations and nations around the world in their efforts to pursue sustainability objectives and solve sustainability-related problems. The recently established UNEP Digital Transformation Subprogramme (DT) "focuses on accelerating and scaling environmental sustainability by applying data, digital technologies, and solutions to UNEP's key activities, products, and services and ultimately delivers on its key action areas—climate, nature, and pollution,"[3] highlighting the growing recognition of digital technologies.

This harnessing of digital technologies to address sustainability challenges has also impacted the way practitioners view this emerging sector. Indeed, practitioners are increasingly using the term "digital sustainability" to describe the link between digital technologies and sustainability-related challenges. For example, according to Bettina Tratz-Ryan, Gartner's vice president of research, "Digital sustainability harnesses the tools of digital transformation, such as enhanced connectivity and the Internet of Things (IoT), to improve the environment and support sustainable business operations."[4] In a similar vein KPMG refers to digital sustainability as the "synergy between digitalization and sustainability, e.g., using data insights to 'steer sustainability with technology.'"[5,6] Such recent changes in the terminology used to bring together information systems and sustainability support Baskerville et al.'s (2020) contention that the classical view of an information system as representing and reflecting physical reality has become obsolete. We believe that an *ontological reversal* (Baskerville et al., 2020) has indeed taken place at the junction between technology and sustainability in which the digital version of business solutions is created first (e.g., algorithms and data analytics solutions) and the physical version second (material waste). The emerging discourse around the term "digital sustainability" makes precisely this point in that "digital technologies are now creating and shaping physical reality" (Baskerville et al., 2020, p. 509)[7] in the case of sustainability. In this editorial we seek to build on Baskerville et al.'s (2020) view that such an "ontological reversal … challenges us to think about our role as IS scholars in this digital world and what it means for our research agendas" (p. 509). To better frame the ontological reversal, we acknowledge that the information systems (IS) literature has a long tradition of engaging in the subject of sustainability, resulting in two key streams of studies, namely *Green IS* and *Green IT*. Green IT is defined as the practice of creating and using environmentally sustainable technology (Molla, 2013; Murugesan, 2008; Thomas et al., 2016), while Green IS refers to the use of technology to achieve environmental objectives (Leidner et al., 2022; Hedman & Henningsson, 2016; Loeser et al., 2017; Malhotra et al., 2013). We argue that while the IS literature recognizes the potential offered by digital technology to address sustainability challenges (e.g., Ketter et al., 2020; Medaglia & Damsgaard, 2020; Pan & Zhang, 2020), the field can build on the foundations

[3] https://www.unep.org/explore-topics/technology/what-we-do/digital-transformation

[4] https://techmonitor.ai/leadership/sustainability/what-is-digital-sustainability-how-can-it-support-esg-goals

[5] https://kpmg.com/be/en/home/insights/2021/07/sus-digitalization-can-give-direction-to-your-sustainability-transformation.html

[6] Further examples of practitioners and professional media using the term "digital sustainability" include: "Digital sustainability focuses on the everyday technology used by businesses to reduce environmental impact. It usually means adapting existing infrastructure or introducing new initiatives to help reach sustainability goals" (Nintex, 2022) and "Digital sustainability offers solutions to manage our environmental footprint, minimize greenhouse emissions, use our resources cleverly and adopt a more eco-conscious mindset in every aspect of our day-to-day lives" (Indiegetup, 2022).

[7] In a similar vein Recker et al. (2021) argue that "the role of IS as representations of real-world systems is changing in an increasingly digitalized world" (p. 269).

offered by Green IT and Green IS studies to adopt a more inclusive definition of digital sustainability that encompasses the impact of digital technologies on environmental, social and economic objectives. Digital sustainability is, therefore, *the development and deployment of digital resources and artifacts toward improving the environment, society, and economic welfare*. Defining digital sustainability in this way will allow the IS field to link the academic conversation to practice and join the effort to provide solutions to a grand challenge the planet has been facing in recent years.

In the following sections, we build on past Green IS/IT and other sustainability-related IS studies that we consider ontologically related to *digital sustainability*, identifying directions for future research under this broad umbrella concept. This approach reflects the recent shift in the IS field toward studying digital phenomena to offer a contemporary perspective on digital technologies, data, and other digital resources and assets.

2 Sustainability in Information Systems Research: The Current State of the IS Literature

The topic of sustainability in the IS literature has evolved under two main concepts—Green IT and Green IS. Traditionally the term Green IT refers to reducing the negative environmental effects of IT by using and disposing of IT resources in an energy-efficient and cost-effective manner, enhancing energy efficiency, diminishing emissions, and reusing and recycling materials (Molla, 2013; Murugesan, 2008; Thomas et al., 2016). The term Green IS relates to configuring and applying IS to achieve environmental objectives through reducing the ecological footprint of businesses and supporting organizational decision-making toward sustainability, along with more efficient economic performance (Leidner et al., 2022; Hedman & Henningsson, 2016; Loeser et al., 2017; Malhotra et al., 2013).[8] While both concepts have been applied extensively in the IS literature, sometimes interchangeably, some scholars have highlighted the that a focus on IT is too narrow, arguing for the broader perspective of Green IS (e.g., Watson et al., 2010) seen in more recent studies (e.g., Leidner et al., 2022). The IS literature on Green IS and Green IT distinguishes three sustainability outcomes—environmental, economic, and social, which align with the UN's[9] three pillars of sustainability.

2.1 Three Sustainability Outcomes in IS Research

The first and most popular sustainability outcome in the IS literature is *environmental sustainability*, in particular in relation to organizations decreasing their consumption of natural resources and engaging in practices to enhance the overall health of the planet (Melville, 2010). The objective is to take responsibility for the environment by decreasing the production of greenhouse gases and prioritizing renewable resources, thereby preserving the potential of the environment to sustain all forms of life (Ekins, 2011; Melville, 2010; Sutton, 2004). The focus of studies on this aspect of sustainability is strengthening the products, practices, and services deemed critical to meeting responsibilities to society and the environment, including preserving biological diversity and successfully governing natural resources so that they are accessible to future generations (Morelli, 2011).

Social sustainability entails promoting healthy social growth through the development of civil society and meeting the requirements of the present without compromising the future well-being of succeeding generations (McKenzie, 2004; Vallance et al., 2011). The aim is to promote compatibility across cultural and social differences, enhance people's quality of life, and manage business impacts on people (McKenzie, 2004; Mohamed et al., 2020; United Nations Global Compact, 2021). One example is enhancing access to healthcare in rural communities through novel applications of information and communication technologies (ICT) (Barjis et al., 2013). In a similar vein, Tim et al. (2021) illustrate how long-term sustainable social change can be achieved in poor rural areas by nurturing and supporting entrepreneurship and online business (e-commerce) through the innovative use of digital technology.

Economic sustainability relates to practices that support long-term economic growth while preserving environmental assets, maintaining or improving living standards, and strengthening the viability of social institutions (Anand & Sen, 2000; Econation, 2021; Foy, 1990; Spangenberg, 2005). Economic sustainability can be achieved through the diffusion of Green IT in organizations (Bose & Luo, 2011; Cooper & Molla, 2017; Thomas et al., 2016). For example, IT-enabled solutions can be used to reduce energy costs (Bose & Luo, 2011). In this regard, Green IT leads

[8] These definitions portray Green IT as a subset of Green IS. As further discussed by Jenkin et al. (2011) and reflected in several studies (e.g., Watson et al., 2010; Sarkis et al., 2013; and Hanelt et al., 2017), IS and IT collectively refer to technologies and systems that often are not separate in practice. These studies extend green approaches from IT to IS to encompass a broader range of activities to support sustainable business operations. Here, the term Green IS is preferred to the more "commonly used Green IT expression" because "it incorporates a greater variety of possible initiatives to support sustainable business processes. Clearly, Green IS is inclusive of Green IT" (Watson et al., 2010, p. 24).

[9] https://www.un.org/en/ccoi/ecosoc

to economic benefits for organizations by supporting sustainable processes and practices and encouraging economically responsible business behavior (Thomas et al., 2016). Process virtualization, another example, is playing an increasingly significant role in a rapidly changing business environment. Among the advantages of virtualization are improved efficiency and reduced overhead, better online transaction management and after-sales support, and improved strategic alignment with business partners, all leading to cost reductions and greater value delivered to stakeholders via technology. Studies by Aubert et al. (2012) and Loock et al. (2013) provide additional examples in which technology was respectively found to influence consumer energy conservation behavior and improve efficiencies in farming operations, supporting economic sustainability.

While most studies focus on one sustainability outcome, a small subset of studies consider more than one outcome. Among these, Ryoo and Koo (2013) link environmental and economic outcomes, arguing that ecological performance may encourage organizations to engage in green initiatives, with environmental performance subsequently becoming a strong predictor of economic performance. Kurkalova and Carter (2017) explore the economic and ecological impact of IS on strengthening energy efficiency throughout the entire corporate value chain and contributing to sustainable development. Their findings suggest that IS-related expenditure toward energy efficiency minimizes organizations' reliance on variable energy costs and, as a result, reduces their susceptibility to energy market volatility. Moreover, with a dual focus on economic and environmental sustainability, Doherty and Terry (2009) show that the effective application of IS capabilities has the potential to significantly enhance organizations' competitive positioning. Figure 1 provides a high-level picture of sustainability outcomes as addressed in the IS literature[10] (see full list of studies in Appendix A).

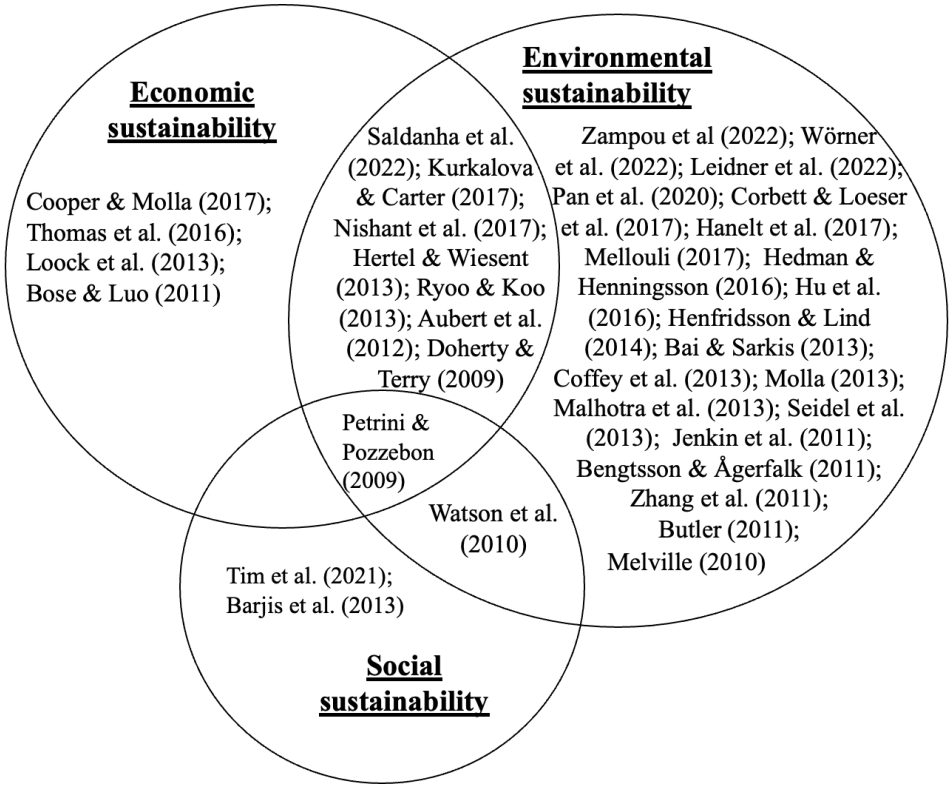

Figure 1. High-Level Overview of Green IS/IT Studies, Organized According to the Sustainability Outcomes They Discuss

[10] These studies were identified based on a systematic search of premier IS journals (our original focus on Basket of Eight journals was later expanded to include a few additional journals such as *Decision Support Systems* and *Information and Management*, which were added to the Senior Scholars' List of Premier Journals in early 2023, and *Information Systems Frontiers*). This selection of journals is in line with IS literature reviews that include journal quality criteria in their search strategies (e.g., Nevo & Kotlarsky, 2019; Mamonov & Peterson, 2021) and also reflects the Chartered Association of Business Schools' Academic Journal Guide quality criteria for 3, 4 and 4*-rated journals). This approach is consistent with our intention to capture the current state of the IS literature on sustainability. The time frame used in our search covers articles published before May 2023 (when we repeated the search to identify the most recent articles).

2.2 Key Sustainability Themes in IS Research

Three main themes are evident in IS studies related to sustainability: (1) the drivers for the adoption of IS sustainable solutions (i.e., addressing the question—*Why* apply IT/IS for the purpose of sustainability?); (2) technologies and systems in Green IT/IS (i.e., addressing the question—*What* is IT/IS for sustainability?), and (3) approaches to implementing Green IT/IS (i.e., addressing the question—*How* can IT/IS be deployed for sustainability?). We next provide a brief discussion of these themes.

The drivers for the adoption of IS sustainable solutions: Studies under this theme mainly focus on the individual and organizational levels. At the individual level, studies have identified the perceived ease of use, user friendliness, and the perceived utility of a technology (Aubert et al., 2012; Wunderlich et al., 2019) as key in the context of sustainability. At the organizational level, studies have explored issues concerning awareness of the impact of IT on the environment, understanding emerging sustainability trends, ensuring leadership commitment to Green IT, recognizing the positive financial benefits of implementing green sustainability practices, and positive management attitudes toward Green IT (Coffey et al., 2013; Hu et al., 2016).

Technologies and systems in Green IT/IS: Studies under this theme focus on the use of tools, technologies, and systems to achieve sustainability outcomes. For example, technologies for process virtualization have been found to play a significant role in increasing efficiency and environmental sustainability. Transforming physical processes into virtual processes for both IT infrastructure and business operations (Bose & Luo, 2011; Thomas et al., 2016) has also been identified as supporting environmental and economic sustainability (Bose & Luo, 2011; Thomas et al., 2016). For example, IT reporting systems that track sustainability indicators in transport logistics make the impact of sustainable technology more visible to stakeholders (Bengtsson and Ågerfalk, 2011). Portals and technological platforms have also been investigated as digital artifacts that raise awareness of Green IT/IS initiatives (Loock et al., 2013; Gholami et al., 2018; Tim et al., 2021). Moreover, decision support systems (DSS) and business intelligence (BI) systems are contributing to sustainability (Petrini and Pozzebon, 2009). For example, the wildlife management analytics system (WMAS) described by Pan et al. (2020) has helped manage biodiversity and human well-being. Others, including Aubert et al. (2012), Kurkalova and Carter (2017), and Barjis et al. (2013), have described the use of DSS to provide timely information for the management of various sustainability risks.

Approaches to implementing Green IT/IS: Studies under this theme mainly focus on design principles and frameworks to guide managers in introducing and implementing Green IT/IS initiatives. A few studies have proposed a set of design principles for Green IT/IS based on sensemaking support systems and management analytics systems (Seidel et al., 2018; Pan et al., 2020). Others, such as Kurkalova and Carter (2017), have used simulation modeling to assist managers in designing a sustainable production system. Goal-oriented requirement language (GRL) is another design approach that has been applied to help capture the design requirements for sustainable business processes (Zhang et al., 2011) and green data centers (Bai and Sarkis, 2013). Applied frameworks (Melville, 2010; Zhang et al., 2011) have also been suggested as a design approach, with a focus on the role of IS in establishing sustainable processes and practices in organizations (e.g., Melville (2010) with the belief-action-outcome framework). Leidner et al. (2022) recently extended this framework to consider interorganizational Green IS (i.e., a platform employed to encourage organizations in a supply chain to undertake environmental sustainability initiatives). These studies offer various tools to managers for assessing the environmental cost of their activities and evaluating the costs of greening their systems versus the benefits of long-term investment in Green IT/IS.

2.3 Taking Stock of the Current State of the IS Sustainability Literature and Moving Forward

The existing IS literature on Green IT/IS has established strong foundations upon which other aspects can now be explored. With growing pressure to become more sustainable, further amplified by the need for enterprises to demonstrate they have been contributing to meeting the 17 UN SDGs, decision makers in organizations are turning to embrace *digital* resources (including data) and digital artifacts in the search for new ways to address sustainability challenges. Examples include establishing crowdsourcing communities to utilize the power of collective intelligence to address major sustainability challenges (e.g., MIT Climate CoLab[11]), and greater reliance on data-driven insights to calculate environmental risks. In this vein, many banks now rely on advanced data analytics to calculate risks associated with floods, tsunamis, and other environmental factors that may affect a particular property when making a mortgage offer.

[11] https://www.climatecolab.org

The increasing pressure to consider sustainability has given rise to new data-driven and digitally enabled solutions and services. For example, the AI-enabled visualization of geospatial data by Orbica uses three-band imagery from any source to distinguish between building outlines, roads, forestry, and surface water types. Orbita's digital geography services can adapt to any natural or man-made feature, making them particularly relevant to environmental and disaster management. [12] Furthermore, consultancies (large generalists as well as specialist advisories) and service providers are increasingly including sustainability in their service offerings as a free or paid service. In this regard, Amazon (AWS) and Microsoft offer data-driven insights to their customers on the carbon footprint associated with different cloud services compared to traditional services. The rapidly expanding niche market for the provision of sustainable solutions is characterized by new data-driven business models, [13] such as the geospatial services offered by Orbica and applications that calculate carbon emissions (e.g., by Cogo[14]).

While many sustainability-related initiatives in the past were driven by the goodwill and ingenuity of individual organizations, today's organizations need to comply with government regulations and pressure from stakeholders (e.g., executive boards, the public) to make sustainable choices, with many decisions concerning sustainability investments that may (or may not) go hand in hand with investment in digital technologies (e.g., digital transformation).

3 From Green IT/IS To Digital Sustainability

While we are seeing the term *digital sustainability* used widely by industry practitioners, consultants, and in the professional media, there has been a much slower adoption of the term in the IS literature. Pan et al. (2022) refer to digital sustainability in their article, acknowledging its roots in Green IT/IS. Outside IS, George et al. (2021) engage with the concept *digital sustainability* in relation to technological entrepreneurship, defining it as "organisational activities that seek to advance the sustainable development goals through creative deployment of technologies that create, use, transmit, or source electronic data" (p. 1000). In essence, this definition corresponds to what the IS literature refers to as Green IS. These studies signal a shift toward relabeling Green IS/IT as digital sustainability. We support this emerging discourse in the IS and broader management literature and hope this editorial contributes toward establishing consistency and synergy in future research on this topic.

As an initial step toward creating a conceptual definition, we attempt in the following section to integrate the current use of the word *digital*, which has become central to the IS community over the last decade, with how *sustainability* has been understood so far in the IS literature, i.e., in terms of environmental, economic, and social welfare.

An important observation that becomes very evident when reading IS journals published over the last few years is that the word *digital* is being increasingly used as a synonym or replacement for *information systems*. As stated in a recent *MIS Quarterly* editorial (Monteiro et al., 2022, p. i), "compared to relatively stable phenomena that some fields study, information systems (IS) phenomena are inherently emergent. … The terms used for such emergent IS phenomena change over time, both in research and practice. The term 'digital' is now commonly used for such phenomena in IS and neighboring fields, such as organization studies." In essence, the IS community is increasingly referring to "digital phenomena" as a core feature of IS research, rather than an "information systems phenomena." What seemed at first glance to be a simple relabeling, has been raised as an important shift in our research domain—an ontological reversal. Baskerville et al. (2020) point out there are "legacy research themes" and "emerging research themes" within the IS research domain. The Green IS and Green IT topics developed under the classical view of IS—and its assumption that IS represents physical assets—are becoming such legacy research themes. We believe that Green IS/IT will gradually become recognized as specific themes under the broader umbrella of *digital sustainability* as an emerging research theme. This editorial is the first step in that direction.

3.1 Conceptualizing Digital Sustainability

Within the organizational context, IS academics and practitioners typically use the word *digital* to refer to digital resources (including data), artifacts, software tools, and digital technologies.[15] Even IT functions and IT leadership roles are increasingly being (re)named as digital functions—chief digital officer, for example. Traditional concepts once central to the IS literature, such as innovation, strategy, agility, and transformation, have been extended in the digital era to

[12] https://orbica.world/services
[13] For extensive review of data-driven business models see Wiener et al. (2020).
[14] https://www.cogo.co/about

[15] Today "digital technologies" is one of the most widely adopted terms by IS scholars. It is often used as a synonym for what earlier studies called "information systems" and "information technologies."

become *digital innovation* (e.g., Nambisan et al., 2017; Kohli & Melville, 2019), *digital agility* (e.g., Salmela et al., 2022), *digital strategy* (e.g., Morton et al., 2022), *digital resilience* (e.g., Tim et al., 2021, Boh et al., 2023), and *digital transformation* (e.g., Wessel et al., 2021), to name a few (see a summary of these definitions in Appendix B). Digital transformation is particularly controversial, as its meaning is imprecise (Chen & King, 2022). "Digital sustainability" could face the same fate of becoming a commonly used but imprecise term if there is no conceptual definition that distinguishes its unique characteristics and boundaries and establishes its ontological links.

Through the lens of digital phenomena (which is at the heart of our discipline) and taking into account three sustainability outcomes discussed in the IS literature—environmental, economic, and social—we propose a (conceptual) definition of digital sustainability as "the development and deployment of digital resources and artifacts toward improving the environment, society, and economic welfare."

Consistent with the rules and guidelines requiring conceptual definitions[16] to be clear[17] (Suddaby, 2010; Wacker, 2004), this definition does not limit "digital sustainability" to organizational tools and capabilities but opens it up to different levels of analysis (at the individual, industry, and organizational levels). The definition clearly distinguishes between environmental, societal, and economic sustainability outcomes, thus aligning with the UN SDGs, but also allows these outcomes to be studied from the perspective of different stakeholders. While this proposed definition encompasses what we have known as Green IS/IT, it is a broader term that takes into account new developments in the digital space, both current ones (e.g., new industries, markets, and services as discussed earlier) and what will emerge in the future. This definition is also consistent with the contemporary view on IS research represented by the term ontological reversal—that digital technologies are now creating and shaping physical reality. In line with this view, digital resources and artifacts can be deployed to improve the physical environment and people's well-being and to meet their material needs in the physical world.

4 Directions for Future Information Systems Research on Digital Sustainability

The IS field is moving away from studying "information systems phenomena" based on the classical view of an information system and toward studying "digital phenomena." Coupled with the growing importance of sustainability as the biggest global challenge of our times, we see implications for future IS research on sustainability. The IS field needs to consider expanding the discourse around sustainability using the lens of *digital sustainability*—a contemporary concept that reflects the reality that digital technologies are increasingly shaping our world and closely related to practice—while building on the key advances established in the Green IT and Green IS literature over the years.

In particular, researchers should consider questions around the governance of digital sustainability, digital sustainability performance, and digital sustainability ecosystems, as we elaborate on below.

While the current IS literature on sustainability is predominantly focused on Green IS/IT activities initiated and implemented by IT departments to address sustainability objectives, digital sustainability initiatives emerge at the intersection between digital/IT and sustainability organizational functions. We posit that there is a need to examine the relationship between the business (product/service units), its sustainability functions (e.g., chief sustainability officer), and its IT/digital functions. Anecdotal evidence (including our own empirical research[18] based on interviews with digital and sustainability leaders in large international firms) suggests that sustainability initiatives are decentralized and often initiated by a business unit in collaboration with digital/IT functions. It is unclear how digital sustainability initiatives are governed and what forms of innovation are pursued to address sustainability objectives. Following this line of inquiry will assist in expanding the IS sustainability literature by considering the following aspects.

Governance of digital sustainability: Orchestrating digital sustainability initiatives can differ from other IT projects. First, sustainability is a new area of interest in

[16] Wacker (2004) stresses that when "formal conceptual definitions exist at the abstract level and do not contain measurable attributes" (p. 631), they are a "property of a 'good' theory" and provide building blocks for theorizing. Conceptual definitions should be limited to a particular domain, which in our case is the information systems research domain.

[17] Suddaby (2010) highlight the following "three characteristics of a good definition" to clarify "the meaning of a theoretical term": (1) "The definition should effectively capture the essential properties and characteristics of the concept or phenomenon under consideration." (2) "A good definition should avoid tautology or circularity." (3) "A good definition should be parsimonious" (p. 347).

[18] See details on https://www.auckland.ac.nz/en/business/our-research/research-institutes-centres/centre-digital-enterprise/our-research/digital-sustainability-index.html
The "Digital Sustainability Index Report" is available at: https://cdn.auckland.ac.nz/assets/auckland/business/our-research/docs/CODE/Digital%20Sustainability%20Index%20Report%202022.pdf

organizations that is likely to require an entrepreneurial approach (George et al., 2021) when seeking solutions. Furthermore, few organizations have implemented an integrated approach to managing sustainability projects, with the vast majority executing them in a piecemeal manner. This current reality raises questions about whether the governance model for digital sustainability should follow the traditional IT governance approach to managing IT function and technology-related activities in an organization, and if so, how such governance would fit with the often entrepreneurial approach taken by many firms in their digital sustainability projects. Further, it is important to ask how knowledge about sustainability, the business, and digital solutions is being integrated and what the conditions for a successful collaboration between the business, IT, and sustainability are. Moreover, we need to understand what the role of the IT/digital department is in shaping sustainability solutions. Addressing these questions is likely to expand the body of knowledge on digital sustainability by considering new ways of organizing (for sustainability) and by exploring the integration of knowledge across multiple departments and areas of specialization. Some questions that may trigger future research include: Where do digital sustainability initiatives emerge (e.g., are these the ideas of senior managers or bottom-up initiatives) and how do they unfold? How do the different inter- and intraorganizational actors involved in digital sustainability projects engage and interact as they develop, deploy, and govern digital sustainability solutions?

Given that sustainability is a global challenge that has long-term implications for future generations, the traditional "IT business value" of computation, which typically has a short-term orientation, will not suffice. This gives rise to a series of future research questions under the digital sustainability performance theme.

Digital sustainability performance: A key challenge is capturing the multiple dimensions of performance that digital sustainability represents to various business and societal stakeholders. Treating digital sustainability as an IT initiative often results in any assessment being limited to the technology. However, digital sustainability can also be perceived as a strategic project in which the value delivered to stakeholders (consumers, shareholders) is the key outcome of such an investment. Yet given that the environment and future generations are the major stakeholders—meaning that performance will be very difficult to ascertain—how can progress toward long-term objectives be measured? What will the objectives be? How will they be linked to short-term performance objectives? How will digital sustainability performance be measured (in the short and long term) at the organizational, national, and industry levels? What needs to happen to make managers accepting of outcomes other than improvements to the bottom line?

Digital sustainability can be evaluated using performance indicators in terms of its actual impact on the environment (for example reduced carbon emissions). Studying digital sustainability in the IT context as both a strategic and environmental initiative will allow IS researchers to incorporate multiple aspects of performance that enrich and expand our understanding of the impact digital technologies have on various stakeholders.

As digital ecosystems are becoming more central in IS research, future research may focus on *the role of third parties in the digital sustainability ecosystem:* In light of the growing engagement of practitioners (e.g., consultancies, technology service providers) in digital sustainability initiatives and the emergence of markets/industries that offer sustainability-related technologies and services, IS research should consider the role of advisors and suppliers in bringing digital solutions to enterprises and acting as change agents, both within the enterprise and at the industry level. For example, solutions such as the "carbon manager" application developed by Cogo, [19] which allows individuals and businesses to measure, reduce, and offset their climate impacts, are becoming increasingly popular with client organizations as they strive to meet national net-zero targets. Nowadays, many technology companies and service providers are offering solutions encapsulating advanced data analytics, often combined with machine learning, artificial intelligence or blockchain technologies, for sustainability performance (e.g., reducing the carbon emissions of a fleet, optimizing the allocation of physical resources). Such solutions provide real-time data-driven insights, enabling decision makers to pursue more sustainable ways of working and thus improving internal (i.e., operational efficiency) as well as customer-facing sustainability performance indicators. Providers of such solutions (e.g., Orbica [20] and Cogo, both mentioned earlier) are becoming important players in the digital sustainability ecosystem.

Future studies should therefore explore the role of different actors in the digital sustainability ecosystem — providers of digital sustainability solutions, advisors, client representatives who are organizational actors (including IT and sustainability managers), and customers/end-users—and their impact on the emergence of the digital sustainability sector (e.g., cleantech).

[19] https://www.cogo.co/about

[20] https://orbica.world

Last but not least, as governments are imposing more compliance requirements—in line with recent net-zero commitments and SDGs in general—we are likely to see the emergence of different collectives and communities that will act as champions and/or activists to promote digital sustainability ideas and initiatives. *The role of a champion*, whether as an individual, group, or organization, and activism around digital sustainability are among the topics warranting further research.

5 Concluding Remarks

Given the urgency of addressing sustainability challenges and the growing relevance of digital solutions to this grand challenge, it is imperative that IS researchers continue developing an extensive, coherent, and impactful body of research around the notion of digital sustainability. This editorial has mapped the current state of the IS literature on sustainability and highlighted directions for future research with the aim of engaging IS researchers in the study of sustainability as a "digital" phenomena through the lens of *digital sustainability*. We hope the research directions offered in this editorial will motivate IS researchers to engage in this line of research to achieve lasting impacts on environmental, social, and economic sustainability.

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Appendix A

Table A1. Overview of the Studies Included in the Literature Review Sample

#	Year	Author(s)	Title	Journal	Level of analysis
1	2022	Saldanha, T. J., Mithas, S., Khuntia, J., Whitaker, J., & Melville, N. P.	"How Green Information Technology Standards and Strategies Influence Performance: Role of Environment, Cost and Dual Focus."	*MIS Quarterly*	Organizational
2	2022	Leidner, D., Sutanto, J., & Goutas, L.	"Multifarious Roles and Conflicts on an Interorganizational Green IS"	*MIS Quarterly*	Interorganizational
3	2022	Wörner, A., Tiefenbeck, V., Wortmann, F., Meeuw, A., Ableitner, L., Fleisch, E., & Azevedo, I.	"Bidding on a Peer-to-Peer Energy Market: An Exploratory Field Study"	*Information Systems Research*	Market (peer-to-peer energy market)
4	2022	Zampou, E., Mourtos, I., Pramatari, K., & Seidel, S.	"A Design Theory for Energy and Carbon Management Systems in the Supply Chain"	*Journal of the Association for Information Systems*	Interorganizational (supply chain)
5	2021	Pan, S. L., Li, M., Pee, L. G., & Sandeep, M. S.	"Sustainability Design Principles for a Wildlife Management Analytics System: An Action Design Research"	*European Journal of Information Systems*	National
6	2021	Tim, Y., Cui, L., & Sheng, Z.	"Digital Resilience: How Rural Communities Leapfrogged into Sustainable Development"	*Information Systems Journal*	National
7	2019	Wunderlich, P., Veit, D. J., & Sarker, S.	"Adoption of Sustainable Technologies: A Mixed-Methods Study of German Households"	*MIS Quarterly*	National
8	2018	Gholami, R., Molla, A., Goswami, S., & Brewster, C.	"Green Information Systems Use in Social Enterprise: The Case of a Community-Led Eco-Localization Website in the West Midlands Region of the UK"	*Information Systems Frontiers*	Organizational
9	2018	Seidel, S., Chandra Kruse, L., Székely, N., Gau, M., & Stieger, D.	"Design Principles for Sensemaking Support Systems in Environmental Sustainability Transformations"	*European Journal of Information Systems*	Organizational
10	2017	Cooper, V., & Molla, A.	"Information Systems Absorptive Capacity for Environmentally Driven Is‐Enabled Transformation"	*Information Systems Journal*	Organizational
11	2017	Hanelt, A., Busse, S., & Kolbe, L. M.	"Driving Business Transformation toward Sustainability: Exploring the Impact of Supporting IS on the Performance Contribution of Eco-Innovations"	*Information Systems Journal*	Organizational
12	2017	Corbett, J., & Mellouli, S.	"Winning the SDG Battle in Cities: How an Integrated Information Ecosystem Can Contribute to the Achievement of the 2030 Sustainable Development Goals"	*Information Systems Journal*	National
13	2017	Kurkalova, L. A., & Carter, L.	"Sustainable Production: Using Simulation Modeling to Identify the Benefits of Green Information Systems"	*Decision Support Systems*	National
14	2017	Nishant, R., Teo, T. S., & Goh, M.	"Do Shareholders Value Green Information Technology Announcements?"	*Journal of the Association for Information Systems*	Organizational
15	2017	Loeser, F., Recker, J., Brocke, J. v., Molla, A., & Zarnekow, R.	"How IT Executives Create Organizational Benefits by Translating Environmental Strategies into Green IS Initiatives"	*Information Systems Journal*	Organizational

16	2016	Hu, P. J.-H., Hu, H.-F., Wei, C.-P., & Hsu, P.-F.	"Examining Firms' Green Information Technology Practices: A Hierarchical View of Key Drivers and Their Effects"	*Journal of Management Information Systems*	Organizational
17	2016	Hedman, J., & Henningsson, S.	"Developing Ecological Sustainability: A Green IS Response Model"	*Information Systems Journal*	Organizational
18	2016	Thomas, M., Costa, D., & Oliveira, T.	"Assessing the Role of IT-Enabled Process Virtualization on Green IT Adoption"	*Information Systems Frontiers*	Organizational
19	2014	Henfridsson, O., & Lind, M.	"Information Systems Strategizing, Organizational Sub-Communities, and the Emergence of a Sustainability Strategy"	*Journal of Strategic Information Systems*	Organizational
20	2013	Bai, C., & Sarkis, J.	"Green Information Technology Strategic Justification and Evaluation"	*Information Systems Frontiers*	Organizational
21	2013	Barjis, J., Kolfschoten, G., & Maritz, J.	"A Sustainable and Affordable Support System for Rural Healthcare Delivery"	*Decision Support Systems*	National
22	2013	Coffey, P., Tate, M., & Toland, J.	"Small Business in a Small Country: Attitudes to 'Green' IT"	*Information Systems Frontiers*	Organizational
23	2013	Hertel, M., & Wiesent, J.	"Investments in Information Systems: A Contribution towards Sustainability"	*Information Systems Frontiers*	Organizational
24	2013	Loock, C.-M., Staake, T., & Thiesse, F.	"Motivating Energy-Efficient Behaviour with Green IS: An Investigation of Goal Setting and the Role of Defaults"	*MIS Quarterly*	National
25	2013	Malhotra, A., Melville, N. P., & Watson, R. T.	"Spurring Impactful Research on Information Systems for Environmental Sustainability"	*MIS Quarterly*	National
26	2013	Molla, A.	"Identifying IT Sustainability Performance Drivers: Instrument Development and Validation"	*Information Systems Frontiers*	Organizational
27	2013	Ryoo, S. Y., & Koo, C.	"Green Practices-IS Alignment and Environmental Performance: The Mediating Effects of Coordination"	*Information Systems Frontiers*	Organizational
28	2013	Seidel, S., Recker, J., & vom Brocke, J.	"Sensemaking and Sustainable Practicing: Functional Affordances of Information Systems in Green Transformations"	*MIS Quarterly*	Organizational and individual
29	2012	Aubert, B. A., Schroeder, A., & Grimaudo, J.	"IT as Enabler of Sustainable Farming: An Empirical Analysis of Farmers' Adoption Decision of Precision Agriculture Technology"	*Decision Support Systems*	National
30	2011	Bengtsson, F., & Ågerfalk, P. J.	"Information Technology as a Change Actant in Sustainability Innovation: Insights from Uppsala"	*Journal of Strategic Information Systems*	Town (national level)
31	2011	Bose, R., & Luo, X.	"Integrative Framework for Assessing Firms' Potential to Undertake Green IT Initiatives via Virtualization: A Theoretical Perspective"	*Journal of Strategic Information Systems*	Organizational
32	2011	Butler, T.	"Compliance with Institutional Imperatives on Environmental Sustainability: Building Theory on the Role of Green IS"	*Journal of Strategic Information Systems*	Organizational
33	2011	Dao, V., Langella, I., & Carbo, J.	"From Green to Sustainability: Information Technology and an Integrated Sustainability Framework"	*Journal of Strategic Information Systems*	Organizational
34	2011	Jenkin, T. A., Webster, J., & McShane, L.	"An Agenda for 'Green' Information Technology And Systems Research"	*Information and Organization*	Organizational

35	2011	Zhang, H., Liu, L., & Li, T.	"Designing IT Systems According To Environmental Settings: A Strategic Analysis Framework"	*Journal of Strategic Information Systems*	National
36	2010	Melville, N. P.	"Information Systems Innovations for Environmental Sustainability	*MIS Quarterly*	Organizational
37	2010	Watson, R. T., Boudreau, M.-C., & Chen, A. J.	"Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community"	*MIS Quarterly*	National
38	2009	Doherty, N. F., & Terry, M.	"The Role of IS Capabilities in Delivering Sustainable Improvements to Competitive Positioning	*Journal of Strategic Information Systems*	Organizational
39	2009	Petrini, M., & Pozzebon, M.	"Managing Sustainability with the Support of Business Intelligence: Integrating Socioenvironmental Indicators and Organisational Context"	*Journal of Strategic Information Systems*	Organizational

Appendix B

Table B1. "Digital" Terms Introduced in the Recent IS literature and Their Conceptual Definitions

Term	Conceptual definition
Digital transformation	"A process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019, p. 118).
Digital agility	"The capability of a unit to capitalize on opportunities/threats induced by generative digital technologies under constrained or unfolding time frames" (Salmela et al., 2022, p. 1081).
Digital strategizing	"A domain focused on the interplay between digital technologies and people at different levels of organisations in processes that form, transmit, implement, host, and support strategy" (Morton et al., 2022, p. 4).
Digital innovation	"The creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology. Stated differently, in digital innovation, digital technologies and associated digitizing processes form an innate part of the new idea and/or its development, diffusion, or assimilation" (Nambisan et al., 2017, p. 224).
Digital resilience	"The capabilities developed with the use of digital technologies to absorb major shocks, adapt to disruptions, and transform to a new stable state" (Boh et al., 2023).

About the Authors

Julia Kotlarsky is a professor of information systems at the University of Auckland Business School (New Zealand). She holds a PhD from Rotterdam School of Management (Netherlands) and has worked previously in the UK. Julia's research interests revolve around digital sustainability; the interface between artificial intelligence technologies and humans, focusing on data and digital transformation; and technology sourcing. Her work has been published in *MIS Quarterly*, *Journal of Management Information Systems*, *Journal of Information Technology*, *Journal of Strategic Information Systems*, and other outlets. She has published 17 books, among them *The Handbook of Global Outsourcing and Offshoring*, which is widely used by practitioners and academics around the world. Julia is a co-founder of the AIS Special Interest Group on Advances in Sourcing. Julia serves as a senior editor for the *Journal of Information Technology*, an associate editor for *Journal of the Association for Information Systems*, and is on the editorial board of *Information Systems Research*.

Ilan Oshri is a professor of information systems at the University of Auckland Business School (New Zealand). Ilan's research interests revolve around sustainability, sourcing, work, and innovation in business services. Ilan's work has been published in numerous outlets including *MIS Quarterly*, *Journal of Management Information Systems*, *Journal of Strategic Information Systems*, *Journal of Information Technology*, *The Wall Street Journal*, and others. Ilan has published 22 books and dozens of industry reports and teaching cases on global sourcing, digital transformation, and emerging technologies. He is the co-founder of the Association for Information Systems Special Interest Group on Advances in Sourcing and the European and Chinese Global Sourcing Workshop. Ilan is currently serving as a senior editor for the *Journal of Information Technology* and *MIS Quarterly Executive*.

Nevena Sekulic is a PhD student in the Department of Information Systems and Operations Management (ISOM), University of Auckland Business School (New Zealand). Her PhD topic focuses on digital sustainability.