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In an older version of this paper, only one of Devinder Thapa's two affiliations was listed. This has been corrected.

Exploring the Link Between Digitalization and Sustainable Development: Research Agendas

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Abstract. In this paper, we argue that the existing research looking at digitalization (DT) and sustainable development (SD) in Business Management and Information Systems takes a dualist view, where digitalization and sustainable development is studied independently. Such a dualistic approach has limitations because these two areas are interconnected and mutually influence each other. Hence, we need to take a non-dualistic view to better understand these two phenomena. By conducting a selective literature review, we describe how digitalization and sustainable development concepts are used; and revealed how these two areas are linked in the current literatures. Finally, based on our analysis, we propose four research agendas: first, need for a *paradigm shift (ontology, epistemology, axiology, methodology, and domain)*; second, *conceptual clarity in terms of digitalization and sustainable development*; third, *theories to link DT and SD*; and fourth, *the role of social enterprises in linking DT and SD*.

Keywords: Digitalization (DT), Sustainable Development (SD), Sustainability, Ethics, Research Agenda.

1 Introduction

Digitalization (DT) and Sustainable Development (SD) are the two most sought-after research areas these days. Digitalization is the introduction of technology in a fundamental way in order to upgrade the performance or expand the reach of enterprises [1]. It is a process that improves an entity by triggering significant changes in its processes and properties through combination of information, computing, communication, and connectivity technologies [2]. The use of digital technologies enables major business improvements in the enterprises such as enhancing customer experience, improving operational efficiencies, or creating new business models [3]. Digitalization as information technology (IT) comes in several forms starting from infrastructural IT such as servers, networks, laptops, and smart devices, transactional IT for example business process automation, informational IT to improve management through decision support system, planning, sales and forecasts, and strategic IT for the development of new products and services [4].

The concept of sustainability was raised after the establishment of the Brundtland commission - chaired by Norwegian Prime Minister Gro Harlem Brundtland. It broadly defines sustainable development as the “ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their needs.” This idea of sustainable development has been used in researches (e.g. Chichilnisky [5]). The definition has evolved over time to include three dimensions of sustainable development: economic development, social inclusion, and environmental sustainability [6]. To operationalize the concept of sustainable development, a set of 17 sustainable development goals (SDG) was promulgated by the United Nations General Assembly in 2015¹. Later, it was adopted by all UN member states. The SDGs provide a global framework for cooperation to address these three dimensions within an ethical framework.

From a digitalization perspective, the main focus so far is on environmental sustainability at three different levels; production, consumption, and disposal of IT devices [7]. However, digitalization can create the possibility to contribute to the overall SDG [8]. For example, digitalization generates enormous data, and collection, extraction, and analysis of such data can be critical to SDG. There is a need for an information system to integrate the data collected from various source and involve multiple parties to interoperate and collaborate [9]. The process of digitalization, therefore, does not seem straightforward. On the other hand, from sustainable development perspective, the development issues are complex, interrelated, and interdependent [6]. Therefore, it is not enough to relate the research outcome to seventeen SDGs, rather, it needs systemic solutions [10, 11]. If we compare two concepts; digitalization and sustainable development, one looks into connectivity and automatization of the organizational process [2], the other looks into the coexistence of economic, social, and environmental spheres [11]. The former focuses on efficiency and competitive advantage; the latter focuses on economic value embedded in social, and environmental values. However, the dualistic perspective of analyzing these two phenomena in isolation might not show the complete picture. These two phenomena are intertwined, entangled, and interdependent [10], which may lead to contradictory goals if we take a dualistic approach. Digitalization sometimes may not go according to the principles of sustainability. To state explicitly, the digitalization process for merely economic benefits may shelter as Zuboff [12] says 'surveillance capitalism' and other unintended consequences [13]. For example, as in surveillance capitalism, the data generated through the digitalization process mainly focuses on capturing the users' micro-level experiences (clicking) and gaining economic benefits by selling the behavioral prediction in the market [12].

On the other hand, taking sustainable development as a mark to justify any isolated activities is also a blind approach [14]. The developmental process considering technology as a black box can also keep the possibilities of the technologies unclear. Therefore, we argue that it is important to link DT to SD because sustainable development is based on the philosophy of 'deep ecology' [15], for example, not compromising the

¹ See for details: <https://sdgs.un.org/goals>

future resources to meet current needs. It puts the impetus that technology has to be designed in such a way that it should not disrupt nature's inherent ability to sustain [10]. So, connecting DT to SD may lead to ethical designing of the technology. Furthermore, organization while introducing the digitalization process can follow an ethical framework of deep ecology. Meaning, not only focusing on economic values but also social and environmental values.

Linking ICT to development has been discussed in the ICT4D literature. However, their focus is on ICT artifacts and specific development goals such as individual/collective capabilities [16, 17]. Digitalization, the phenomenon itself is broader and wider than the use of ICT artifacts for attaining certain pre-specified goals. Therefore, linking DT to SD needs an ecosystem approach [18] to uncover the broader realm of these phenomena. There are works of literatures in IS and management that discuss the importance of digitalization in the light of sustainable development [19, 20], however, there is still a lack of research on identifying the mechanism or process that relates DT to SD.

In order to fill this gap, we build upon the understanding of the concepts: digitalization and sustainable development, in the existing literatures and explore how the digitalization processes and sustainable development are interlinked. Furthermore, we study what kind of theory, framework, or model can be found in the literature to connect these two areas, and what methodologies should be applied to understand such phenomena. In order to look for such results, we have conducted a selective literature review [21]. Subsequently, we provide four research agendas: *the need for a paradigm shift*, *conceptual clarity in terms of DT and SD*, *theories to link DT and SD*, and *the role of social enterprises in linking DT and SD*.

2 Selective Literature Review

Since the research area is still emerging in terms of linking DT to SD, literature reviews can create a foundation for advancing knowledge through identifying the current status, research gaps, and the areas where more research is needed [22]. In this paper, unlike a comprehensive review that attempts to discuss as many published sources on the topic as possible, we apply a selective literature review approach that only uses a certain number of specific sources [21]. In our study, digitalization², sustainable development, and the relation between these two phenomena were the main criteria. The articles were selected by using the Scopus and IS databases (basket journals). Because of the authors' expertise in the relevant fields, we limited our search for the literatures in business management and information systems (IS) domain. In the

² We use the term digitalization because digitization is just converting analog to digital form, whereas digital transformation is a complete transformation of an organization or society. Digitalization here refers introduction of digital tools in some specific process of change (organizational or societal).

review process, we followed concept centric approach suggested by Webster and Watson [22].

From the search based on the keywords presented in Table 1, we have selected a list of 165 articles in total. There was further addition of 20 articles that we identified through backward and forward search. To make it more inclusive, we further conducted an author-based search on the most cited authors. Finally, two authors independently read and shortlisted the titles and abstracts of the papers to identify a set of highly relevant articles. We excluded the papers that were not focused on digitalization and sustainable development, for example just mentioning digitalization, sustainability used as business viability and sustainability of the organizations. We also excluded the official reports and papers that were not published in academic journals in our final selection. Based on the most relevant articles, we finally selected 45 papers for review.

The caveat however is, all literature reviews are based on some kind of selection strategy. Therefore, our study also runs the risk of excluding potentially relevant articles and reports from sources that are not included in the search criterion [17]. We do agree that the inclusion of more material might have provided additional information regarding contemporary research in the digitalization and sustainable development area. We see this caveat as an opportunity to validate and elaborate on our findings by extending the literature list. Despite these limitations, we believe that our literature review provides a good summary of the status of the link between DT and SD.

Table 1: Literature review

Search Library	Scopus; IS basket of journals
Keywords	Digitalization, sustainability, Sustainable Development
Subject Areas	Business Management and Information Systems
Total Relevant Articles	185
Selected and Reviewed	45
Language	English
Inclusion/Exclusion	Journal articles only Cross checking the relevance, backward & forward search based on authors and citations, recent articles [22]

3 Findings

In this section, we present our findings from the review. The findings include the current literature that describes digitalization and sustainability, and how these two areas are interlinked. We also present the examples from our findings that show the link between DT and SD (see Table 2).

Table 2: Examples of studies linking DT to SD

Refs.	Concept of Digitalization	Concept of Sustainable development	Linking DT to SD approaches/Theory and method	Research agenda
Teo, Nishant [4]	Use of green IT	Green initiative (environmental sustainability)	Through the use of green IT and resources to support green initiatives	Need of further research and theory development
Tim, Pan [19]	Use of social media	Environmental and social sustainability	Through identification and actualization of social media affordances by incorporating societal perspectives	Application of affordances lens to reveal possibilities of DT for SD
Ordieres-Meré, Remón [23]	Use of internet of things (IoT)	Environmental and economic sustainability	Through improved institutional knowledge (knowledge creation and knowledge sharing)	Design of digital functionalities around sustainability goals
von Kutzschbach and Daub [24]	Use of digital technologies	Sustainability in general	Through organizational learning, the change in mindset, from firm centric to systemic change and from solution oriented to learning oriented	Change in mindset, from firm centric to systemic change and from solution oriented to learning oriented
Pankaj and Seetharaman [20]	Use of IT	Social and economic sustainability	Through generating income create a sustainable society. Understanding DT and SD as sociomaterial practice	Importance of social enterprises on finding a link between DT and SD

3.1 The concept of Digitalization and Sustainable Development

Our analysis shows that digitalization is explained as the use of digital tools [4, 20], big data analytics [25], social media use [19], and the role of IT [4]. There is a confusion about whether digitalization is design, implementation, use, or outcome. A few studies in our analysis, however, differentiated digitization as converting analog data to digital format, digitalization as applying digital tools in existing business processes, and digital transformation as the system level restructuring of organizations and society occurred through digital diffusion, and it is an ongoing evolutionary process of innovation [24]. Hence, digital transformation is a broader concept than digitalization.

Similarly, sustainable development also carries different meanings and definitions. For example, sustainability of digitalization process, products or services, economic values, environmental values, or community empowerment. The concept of sustainability has been defined in the literature in three domains of it: social, economic, and environmental. These three domains have been studied both independently and simultaneously. Perhaps, because of the complexity that there is a lack of empirical studies showing the interrelation among these three domains. A few papers have managed to study the overall phenomenon of sustainability considering all three domains [26, 27].

Economic sustainability has been defined as the improvement in corporate profitability, human resource development, and the overall economic development of the country through the creation of employment [28]. Economic sustainability can be achieved through enhancing the efficiency of the business processes and by enabling new functionalities, processes, and business models [29], reduced transaction (logistic) cost, reduction in delivery time, inventory reduction [27]. The concept of social sustainability in existing literature has been defined as social capital, social support, community resilience, and community development [20]. Social sustainability has been studied as a grassroots initiation for reaching the environmental sustainability, and ultimately the overall sustainability goal [19]. Environmental sustainability resulted through digitalization counts in the form of energy and resource optimization [27, 28], reducing waste and pollution [27], reduction of harmful GHG emissions [27, 28], and the development of proactive environmental-friendly practices [28]. Furthermore, environmental sustainability seems to be more frequently studied either in the combination with economic or social sustainability. However, some studies theoretically suggest that investigating three domains to understand the overall phenomenon of sustainable development is necessary [27, 30]. The use of social media, for example, helps societies and communities to create sustainability-related awareness and empowers them to take necessary action to create a sustainable society [19]. Similarly, Ghobakhloo [28] explains that the economic sustainability of Industry 4.0 shows the way to develop socio-environmental sustainability functions.

Once we understand the concept of digitalization and sustainable development, the next question is how to link digitalization with sustainable development. The following section summarizes our findings on the link between digitalization and sustainable development.

3.2 Linking Digitalization to Sustainable Development

Our analysis further shows that it is important to connect DT with SD to address economic, social, and environmental challenges; however, the mechanism or process to show the interrelation is vaguely described. To illustrate the link between DT and SD, we used five examples from the literatures. Our study reveals the primary objective of digitalization is to address some kind of economic, social, or environmental challenges. For example, illiteracy, poverty, lack of physical infrastructure, and political pressures hindered the relationship between DT and SD [31]. However, there are

several factors that can enable or hinder the developmental process. Through this analysis, we want to show that the use of this approach (linking DT to SD) could help in better understanding the nuances of the digitalization process for sustainable development.

The importance of linking DT to SD conceptually as well as empirically has been advocated by the research community. For example, Pappas, Mikalef [18] presented an ecosystem-based model in which they suggested exploring the capabilities of big data analytics to connect digitalization to the social innovation process and societal change. They argue that digitalization generates a huge dataset (big data). Utilizing analytics; with an understanding of the big data ecosystem, the data can be converted to actionable information. The refined knowledge in turn can facilitate the social innovation process vis-a-vis sustainable society. Other empirical studies in this regard show that if the affordances of social media [19] are actualized with the help of the community it can empower them socially and economically. Exploring the link through knowledge creation and institutional improvement [23], and through a change in mindset [24] are also advocated in the literature. These studies have targeted one or two dimensions of sustainable development, however, all of them agreed that understanding the link between digitalization and sustainable development is not possible without having a holistic approach. Studies show that Industry 4.0 is one way of designing the digitalization process keeping the holistic view of sustainability in focus [28]. They argue that the functions of economic sustainability such as production efficiency and business model innovation resulted through Industry 4.0 adds to more socioenvironmental sustainable activities like reduction of harmful emissions, sustainable consumption of energy, and improvement in social welfare [28].

The analysis, therefore, shows that the ecosystem approach, actualization of IT affordances, knowledge creation, institutional improvement, and change in mindset can address the challenges in three dimensions of sustainable development.

4 Discussion and Research Agendas

We started with the main question of what digitalization and Sustainable Development are, and how these are interconnected. Our finding shows that research in this area has been acknowledged its importance, but it is still in the initial stage and needs further deliberation. The digitalization process for merely economic benefits ignoring social and environmental dimensions can amplify the dark side [32]. Similarly, the developmental process considering technology as a black box can also be lopsided. The proponent of sustainable development should be at least aware of the various functionalities and affordances of technologies. In the absence of such knowledge, it will be difficult to figure out what kind of technological design may be done to address societal problems [14]. Hence, a well-designed digitalization process keeping sustainable development; based on the philosophy of deep ecology, in mind can lead to an ethical design and implementation of technology. The existing DT and SD related projects in most

cases are taking the approach of force-fitting the outcome to some goals of SDG. Such approaches do not address the true essence of sustainable development. The SDG framework suggested by the UN also has several challenges in terms of operationalization. For example, it does not explicitly state the link between DT and SD. However, the positive aspect of the SDG framework is its holistic approach and the underlying philosophy of deep ecology [10] that can be applied to research and practice.

The analysis in the previous section shows that studies lack systemic thinking, amongst clear conceptualization of DT and SD (with a few exceptions), and a lack of theoretical approaches to link DT with SD. Furthermore, our study reveals that the area needs a more conceptual and empirical base to move forward. One feasible way is to aim for greater impact on practice through digitalization studies, where the theoretical knowledge base can be leveraged to facilitate sustainable development initiatives. We elaborate our discussion in the rest of this section and propose four research agendas.

Agenda 1: Paradigm Shift

Exploring the link between DT and SD is not a simple process, but a complex inter-related phenomenon. To understand this complex phenomenon, we have to change our mindset [24], in other words, a paradigm shift is needed [13]. The details of the paradigm shift are as follows.

Ontology: The ontological view needs to be shifted from a mechanistic view to a systemic view of interconnected, interrelated, and interdependent entities.

Epistemology: The epistemological view needs advancement of knowledge from a concept-based approach to knowledge through action. For example, in addition to the dominating approaches in business management and IS such as interpretivism and positivism, critical realism and pragmatism-based approaches can generate more relevant and significant knowledge [33].

Axiology: The existing digitalization processes are mainly focused on the economic benefit resulting from it. However, the societal and environmental (ecological) impact is equally important, and they should be focused on while designing the process. Therefore, the axiological perspective should be extended from an anthropocentric (human centered) to an eco-centric approach. As Capra and Luisi [10] in their book stated that “sustainable society must design in such a way that its ways of life, businesses, economy, physical infrastructures, and technologies do not interfere with nature’s inherent ability to sustain life. (pp. 353)” This is only possible if the understanding of deep ecology, which is the essence of sustainable development, is embedded in the digitalization process.

Methodology: The existing methods are limited to focusing either on digitalization or sustainable development research. Since these two phenomena are interlinked and interdependent, the methodologies used for the study of this phenomenon should take a systemic approach. In other terms, we need to explore digitalization, sustainable development, and their linking mechanism. Such a holistic approach can provide a better

ontological and epistemological view in this regard. Instead of the unidirectional causal relationship between digitalization and sustainable development, we argue that bidirectional studies better explain the link between these two areas. Studies are required not just on the impact of digitalization on sustainability but also how the digitalization process can be designed based on the principles of sustainability. As we mentioned earlier, epistemology should also advance towards action to knowledge, proactive research approaches such as action-design research (ADR) should be encouraged [34]. ADR conceptualizes the research process as containing the inseparable and inherently interwoven activities of IT artifact building, intervening in the organization or communities, and evaluating the use of the artifact concurrently.

Domain: The shifting in paradigm should change its focus from developing countries to the global development issues. The existing issues such as relative poverty, climate change, and surveillance capitalism are not only affecting global south, but it has universal consequences. Hence, it is important to have a global perspective in such studies.

Agenda 2: Conceptual Clarity

There is confusion among the concepts such as digitization, digitalization, and digital transformation [23]. Few papers have mentioned the basic difference among these terminologies; however, the usage is vague and there is further call to clarify the concept of the digital transformation. To make advancement in any area of research it is important to have a common understanding of the concepts among researcher and practitioner. If we take the example of the least developed countries, they are experiencing the transition from digitization to digitalization (in some sectors), likewise, digital transformation is an advanced phenomenon in developed countries as well. Hence, conflating these terms may give the wrong portrayal. On the other side, ‘sustainability’ is also understood in many forms such as financial, organizational, economic, social, and environmental. We argue that sustainable development based on the triple bottom line concept: economic, social, and environmental, should be considered holistically in order to achieve the overall goal of sustainable development. Additionally, the spiritual dimension which is always considered as a foreign area should be added to these three dimensions [10].

Agenda 3: Theories to Link DT and SD

Existing studies show a few examples of theories that can be applied to explore the link between DT and SD. However, the operationalization of such theories is still a challenge. There is still lack of theories that explain the link between DT and SD. Existing theories such as dynamic capabilities, or resource-based view are mainly focused on addressing the economic and human values of an organization [2, 4]. These theories are still useful, but to understand the complex relation between DT and SD there is a need for better theories or a combination of theories. DFID (Department for International Development) sustainable livelihood framework is a holistic framework that takes the essence of sustainable development. However, the framework does not

consider digitalization explicitly [35]. Digitalization or sustainable development, both require actionable information. The digitalization process generates big data that can be converted into actionable information [8], which can be later mapped to SDG indicators. The theory of affordances originated from ecological psychology can be a useful lens in this regard [20, 36, 37]. The Affordance theory states that we perceive objects in terms of action possibilities (what I can do with the object), i.e., affordances rather than their properties. For example, in the DT and SD context, we can say people do not care about big data but the action possibilities by which they can solve their economic, social, or environmental challenges. However, what kind of facilitating conditions should be arranged to make the affordances perceivable needs further exploration. Because, just perceiving affordances, does not lead to actualization due to various socio-cultural and institutional challenges [36]. Therefore, to understand the actualization process we can combine other theories such as institutional theory, structuration, or Actor-Network theory to name a few [38]. It also calls for a grounded approach to develop new theories instead of borrowing theories that were not meant to study the link between DT and SD.

Agenda 4: Role of Social Enterprises in linking DT and SD

One of the areas that we identify in our analysis is social enterprises, aiming to contribute to sustainable development[39], that are mainly dealing with both digitalization and sustainable development. Unlike profit-making enterprises, the motive of social enterprises (SE) is to address societal and environmental challenges in addition to meet the economic goal [20]. Because of their focus on solving problems in all three dimensions [39], SE is an important sector in finding the link between DT and SD. Therefore, it is important to study the role of SEs in attaining sustainable development grounding the principle of the triple bottom line. The role of such enterprises in developing countries' context becomes more vital. There are several examples of emerging social enterprises (formal and informal) that are adopting the digital platform to excel innovations and address societal challenges [18, 20, 40]. However, it is important for the stakeholders involving in social enterprises to perceive the action possibilities of digitalization that may lead to sustainable development, especially, in terms of addressing the intertwined nature of economic, social, and environmental dimensions of sustainable development. Hence, there is a need for studies that explore how social enterprises in developing countries design, implement and evaluate the digitalization process to attain sustainable development.

5 Conclusion

The purpose of this paper was to conduct a selective literature review to explore how the existing research explains the phenomena of digitalization and sustainable development; furthermore, how these two areas are interlinked. In doing so, we scrutinized 45 journal papers from the business management and information systems disciplines. Our review showed that the concept of digitalization and sustainable development are not

used consistently in the literature and need further theorization. So far, these topics have been mostly studied independently, and there is a lack of studies that investigate the link between digitalization and sustainable development. To illustrate, we selected five papers as examples that partially show the relationship between DT and SD. Finally, based on the overall analysis of the literature, we propose four research agendas as future research avenues.

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