DIGITAL SUSTAINABILITY PRACTICES: A RESEARCH AGENDA

IRENE R. JONKERS, XIAO PENG,
WILLEMIJN VAN HAEFTEN
University of Applied Sciences Utrecht, Utrecht, Netherland
irene.jonkers@hu.nl, xiao.peng@hu.nl, willemijn.vanhaeften@hu.nl

Expectations are high for digital technologies to address sustainability related challenges. While research into such applications and the twin transformation is growing rapidly, insights in the actual daily practices of digital sustainability within organizations is lacking. This is problematic as the contributions of digital tools to sustainability goals gain shape in organizational practices. To bridge this gap, we develop a theoretical perspective on digital sustainability practices based on practice theory, with an emphasis on the concept of sociomateriality. We argue that connecting meanings related to sustainability with digital technologies is essential to establish beneficial practices. Next, we contend that the meaning of sustainability is context-specific, which calls for a local meaning making process. Based on our theoretical exploration we develop an empirical research agenda.

Keywords:
digital sustainability, twin transformation, practice theory, sociomateriality, sustainability, digital technologies

University of Maribor Press
DOI https://doi.org/10.18690/um.fov.4.2024.21
ISBN 978-961-286-871-0

1 Introduction

As reflected in a frequently cited statement of Dutch transition scientist Rotmans "we aren't living in an era of change, but in a change of era"[1], it is broadly recognized that our societies are quickly evolving due to several major trends. Two of those trends concern the rapid advancement of digital technologies, and the growing acknowledgment of the urgency of the sustainability agenda. Both trends trigger transformation of organizations and societies at large. In academia, the concept of 'twin transformation' (e.g. Fouquet & Hippe, 2022; Graf-Drasch et al., 2023) or 'dual transformation' (e.g. Kürpick, Kühn, et al., 2023; Kürpick, Rasor, et al., 2023) is gaining ground, denoting an intertwined connection between the digital and sustainability transformation. Whilst the label attached to the concept implies that there are two transformation processes that develop simultaneously, it is often used to refer to one organizational transformation process in which digital technologies are implemented to advance the sustainability agenda (e.g., Graf-Drasch et al., 2023). Or, in other words, a process in which the enabling properties of the digital technologies are connected to the meanings and goals of the sustainability agenda (Kürpick, Rasor, et al., 2023). Alternately, the term '*digital sustainability'* is applied, which refers to "the organizational activities that seek to advance the sustainable development goals through creative deployment of technologies that create, use, transmit, or source electronic data" (George et al., 2021, p. 1000). To emphasize the intended outcome of the organizational change process, in this paper we prefer the latter term.

In digital sustainability on the one hand digital technologies are employed to help a transformation towards a sustainable organization and societies (e.g., Chatzistamoulou, 2023; Feroz et al., 2021), and on the other hand the value driven sustainability agenda can help move to a more human driven digitalization (e.g., Nahavandi, 2019). In the upcoming literature, attention is mostly paid to possible applications of digital tools for sustainability (Carvalho & da Silva, 2021). However, knowing what tools can do to advance sustainability, does not suffice to understand if and how connections with sustainability are meaningfully made in daily organizational practices. To understand digital sustainability in organizations, we therefore call for research from a practice approach. Practice theory refers to a range

[1] See: https://janrotmans.nl/, statement translated from Dutch by authors. [last accessed 6 May 2024]

of sociological theoretical perspectives that give ontological primacy to everyday sayings and doings of people, by zooming in on the interconnections between agents, rules and expectations (explicit and implicit), and material elements. In this paper we relate primarily to the perspective of Shove et al. (2012), in which they present an analytical framework of the building blocks of practices: competences, tools, and meanings. Further emphasizing the inseparable relationships between practitioners and digital technologies, we relate to the concept of 'sociomateriality' which emphasizes that technologies gain shape in practices (Orlikowski & Scott, 2008).

In this paper we argue that a deeper understanding of the connections between practitioners, sustainability related meanings, and digital technologies in organizational practices is a starting point to understand the potential synergy between reactions to the mega two trends. The overall aim is to propel further research in this area. Without disregarding the relevance of developing digital sustainability competences to form digital sustainability practices, here we focus on the connection of digital technologies and sustainability related meanings. After elaborating on practice theory and sociomateriality, we advance our argument by demonstrating the lack of a uniform understanding of the concept of sustainability. We distill starting points available in literature, and finally claim that the meaning of sustainability should be context specific, which calls for local meaning making processes. We develop our ideas theoretically and end with a research agenda for empirical substantiation.

2 Twin transformation

Focusing on digital technologies and sustainability, we interact with the terms 'twin transformation' and 'twin transition'. These originate from the policy domain (Diodato et al., 2023), and more specifically from the EU at which level the requirement of digitalization to achieve the decarbonization goals was acknowledged (Fouquet & Hippe, 2022). Guandalini (2022) concluded that manifest attention to the topic in the management literature is lacking, which is surprising as it is acknowledged that both the sustainability transformation (ST) (e.g., Millar et al., 2012; Sancak, 2023) and the digital transformation (DT) require fundamental organizational changes (e.g., Gong & Ribiere, 2020; Hanelt et al., 2021). Combining the DT with ST, Graf-Drasch et al. (2023) define twin transformation as: "a

fundamental organisational change process that enables organisations to address digital and societal challenges synergistically by harnessing the power of DT to enable ST and leveraging ST to redesign DT" (p. 4). The focus in this definition is on the way that digital and sustainability related changes are addressed simultaneously and synergistically on the organizational level. The required knowledge for the twin transformation hence goes far beyond examples of application of specific technological tools for sustainability, and rather requires insights in the embedding of such solutions in organizational practices, as well as the competences needed for this embedding process.

To establish alignment to existing and ongoing work, in this paper we do accord to the term 'twin transformation' to refer to the change process that is involved in applying digital technologies to address sustainability related issues. We prefer the term transformation over transition due to underlying notions of the two terms. From an etymological perspective transition relates to the process of moving from one state to another. Transformation, on the other hand, means a change in shape (Hölscher et al., 2018). We hold the perspective that we find ourselves in fundamental changes in organizations, economies and societies at large of which the 'new' is still 'becoming', and use the term transformation to refer to this process of deep change "that requires new ways of thinking and behaving, (..) is major in scope, discontinuous with the past and generally irreversible" (Quinn, 1996, p.3).

In what follows, we dive into the concepts of 'digital sustainability' and 'practices of digital sustainability'. Looking in more detail on *how* DT and ST (can) complement each other, our thesis in this paper aligns with the argument of Lock and Seele (2017) that sustainability should form the normative core of digitalization efforts. According to a study of Kürpick et al. (2023) business leaders also tend to perceive DT from an 'enabler perspective', as opposed to the ST which is perceived from a 'target perspective'. To further elaborate this connection, we continue with introducing our theoretical perspective.

3 Conceptualizing digital sustainability

3.1 Relational approach to understand people and technology

We relate to theories of practice to conceptualize the linkage between digital developments and the sustainability agenda. Theories of practice are based on a relational ontology and consider social reality being made up of 'a bundle of practices' (Schatzki, 2012). Practices can be defined as "shared, routinized, ordinary ways of doings and sayings, enacted by knowledgeable and capable human agents who – while interacting with the material elements that co-constitute the practice – know what to do next in a non-discursive, practical manner" (Spaargaren et al., 2019, p. 8). Practice theories in general consider actions performed by people as inherently social, or as culturally and historically embedded (Reckwitz, 2002). People that are part of a 'community' hold shared understandings and norms regarding what sayings and doings are expected in a given setting. Based on these, actions (sayings and/or doings) are (repeatedly) performed in interaction, to achieve a certain outcome. So, practices are goal-oriented. And, the knowledge that practitioners have available regarding the practice is not considered from a cognitive stance, but is of a practical or embodied nature. Practice theory "connects 'knowing' with 'doing'" (Gherardi, 2001, p. 136).

Where the earlier theories of practice focused mostly on connecting doings to shared norms and meanings, interest in the role of materiality rose later (Shove et al., 2012). The concept of 'sociomateriality' indicates that the social and material are not separate entities but rather that the relations between humans and materials are enacted in practice (Orlikowski & Scott, 2008). Looking at digital developments, new technologies should not be considered as an exogenous force that impact societies. Rather, following Orlikowski's reasoning, they gain their relevance and meaning when they are employed and become part of our daily doings. Applying the sociomateriality lens to working with data, Mathiassen et al. (2023) call for a deeper understanding of how distributed organizational actors use digital tools to transfer and consume information. Data are not neutral, rather actors translate information to meanings, and then transform those into action. This involves complex processes of producing, transferring and consuming information; processes which are embedded in practices. Based on a similar framing, Bähr and Fliaster (2023) illustrate that certain digital technological frames lead to more sustainable value propositions.

In reference to work of Orlikowski and Gash (1994), the authors argue for a distinction between three domains of frames: the nature of the technology ('what is it?'), the technology strategy ('why should it be implemented?'), and technology in use ('how it is used on a daily base?').

To be able to research how practices arise, develop and dissolve, Shove et al. (2012) propose an analytical model that highlights three core elements of practices: (shared) meanings, tools and/or materials, and competencies (the practical know-how to perform a practice). Only when these three elements are meaningfully and iteratively interlinked by practitioners, a practice is formed and sustained. The availability of new digital tools and technologies from this reasoning is not a sufficient condition, but does open possibilities for practices of digital sustainability arising.

To conclude, we focus on the question how new technologies and digital tools can be integrated in our daily activities in a way that helps to advance goals related to the sustainability agenda. This is essential to alter the ways things are done and give shape to the transformation. Combining elements of definitions of practice theory (Spaargaren et al., 2019) and digital sustainability (George et al., 2021), we propose the following working definition of *digital sustainability practices* in turn as: 'the daily shared, routinized and ordinary ways of interacting of practitioners with digital technologies that seek to advance a transformation towards a system which is both ecologically and socially sustainable in the long term'. We further elaborate on this definition in the upcoming sections.

3.2 Sustainability related meanings

Schatzki (2001) talks about the teleoaffective structure which is central to the organizing of practices, indicating that practices are performed to achieve something. In cultural historical activity theory this goal is referred to as the 'outcome' of a practice (Engeström, 1987/2019). For Shove et al. (2012) this element is captured in the category 'meanings' which refers to a broad category of "symbolic meanings, ideas and aspirations" (p. 14). The authors hold that practices exist when meanings are connected to materials and competences. Existing meanings can be connected to new tools, and meanings are "extended or eroded as a result of dynamic processes of association" (p. 55). When considering digital sustainability

practices, it hence is important to further dive into the meanings associated with sustainability.

The term sustainability originates from the policy domain (Kuhlman & Farrington, 2010) in which attention was drawn to intergenerational equity and a focus on welfare. In the often cited Club of Rome report 'Limits to growth' (Meadows et al., 1972) five major global trends are investigated (i.e., accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment), and the conclusion is drawn that with no action the limits of growth will be reached within the century, leading to "a rather sudden and uncontrollable decline in both population and industrial capacity" (p. 23). The authors call upon people to prepare for "the transition from growth to global equilibrium" (p. 24). This equilibrium denotes a condition of ecological and economic stability which is *sustainable* into the far future. Within this equilibrium "the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential" (p. 24). In this sense sustainable means transforming the system for long-term maintenance. Next, it is associated with issues like equality and realizing human potential. In 1987 a UN report (Brundtland, 1987) follows in which *sustainable* development is depicted as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (section 3, no. 27). Again, the term sustainable by itself refers to a state that can be maintained; factors that endanger this state (or present limits to growth) are a downward spiral of poverty, environmental degradation, and inequality. From these foundational reports, we take that sustainability refers to a transformation to reach 'a state that can be maintained on the long term, both environmentally and socially'.

As the term 'sustainability' got traction in the academic debate (Salas-Zapata & Ortiz-Muñoz, 2019), the policy domain (Leach et al., 2010), and business domains, its meaning diffused. A range of thematic guidelines have been developed to assist organizations in their ST (e.g., the Sustainable Development Goals, the Global Reporting Initiative, the European Sustainability Reporting Standards). Whilst helpful in translating an abstract idea to organizational practice, there are downsides of a thematic approach. With an almost infinite list of issues to 'pick and choose' from, the original focus on a fundamental transformation towards a sustainable state is not integrated in all understandings of sustainability (cf., Johnson et al., 2018).

Elkington came to a similar conclusion. In 1994 his triple bottom line brought sustainability to the business world. His framework examines a company's social, environmental, and economic impact. Elkington (2018) afterwards retracted his framework as he noted that it reverted into an accounting tool based on a trade-off mentality. This, while with his framework he intended to "provoke deeper thinking about capitalism and its future" (p. 2). Similarly Leach et al. (2010) observe that also institutions often view sustainability conservatively, focusing on maintenance rather than transformation.

Resilience thinking is one of the approaches that instead gives insight in underlying principles of a sustainable system. A resilient system is one that has the capacity to "absorb change and disturbances, and still retain its basic structure and function" (Walker & Salt, 2006, p. 113). It is important to not cross thresholds that shifts the current system into a next one, of which it is uncertain what services it will deliver. Walker and Salt (2006) highlight how we are all part of the system – as ecological and social systems are inextricably linked. In Western societies we tend to live in a paradigm in which humans and nature are separated, and nature is even seen as something that can be exploited (Mazzocchi, 2020). Acknowledging that nature and culture are not to be understood as two separate domains, but instead as one concept (nature/culture) divided in two parts (Latour, 2017) is crucial. As Walker and Salt (2006) further elaborate, systems are complex, consisting of many linkages and feedback-loops. It is this last point, that shows why a 'trade-off' mindset to sustainability is unwanted. One of the dangers of the current economic paradigm is a sole focus on efficiency, which reduces variety and flexibility. As Kennedy and Linnenluecke (2022) for instance argue, a sole focus on efficiency can help reduce material usage, but often also lowers costs which in turn increases sales nullifying the environmental benefits. These authors hence, point out the complexity underlying the needed transformation and the dangers of ignoring interconnections with other aspects of the system. Whilst the transference of the resilience concept from the ecological to the social domain is not uncontested (Keck & Sakdapolrak, 2013), it does resonate for instance with ideas about the importance for organizations to be embedded in strong networks of stakeholders (Busch et al., 2018). Reasoning from the original ideas of Brundtland (1987) and Meadows et al. (1972), inequality and poverty can be seen as a danger for the sustainability of a new system. Also here complexity of systems should be taken into account. For example,

removing production processes from the global south, reduces the risk of child labor, but it can have tremendous negative effects on local communities.

So where does this leave us in terms of meanings associated with sustainability? It firstly is important to keep in scope the element of transforming the current system into one that can be sustained in the long term in environmental and social terms. This means that interconnectedness, variety and flexibility need to be nurtured. However, the original policy reports (i.e., Brundtland, 1987; Meadows et al., 1972), nor resilience thinking (Walker & Salt, 2006), offer guidance of what kind of sustainable system we want; this is a normative question. The thematic guidelines available can offer guidance. But it is important to acknowledge that normative and value driven choices need to be made. And these choices are always context-bounded (Leach et al., 2010).

Moving back to our practice theory framing, it is important to acknowledge that 'meanings' are not purely cognitive concepts, but actually are established 'in use' (Ramsey, 2015, in reference to the body of work of Wittgenstein). Meanings emerge in practice (Ramsey, 2015), but can be prompted with a collective meaning making process (Jonkers, 2022). As Jonkers (2022) argues, such a meaning making process is of a reflexive and iterative nature and involves steps like specifying, diversifying, connecting to existing meanings, placing it in a broader historical and societal context, and balancing it with other practices and goals. All of this is necessary to integrate the emergent practice in the total configuration of organizational practices. Relating to the considerations above, in this meaning-making-process, reflections on the system and its interconnections would be paramount to develop practices adding up to a sustainable situation.

3.3 Digital technologies

In Shove et al.'s (2012) elemental approach of practices, 'materials' is a broad category referring to "objects, infrastructures, tools, hardware and the body itself" (p. 23). In this paper we refer to tools that are based on digital technologies. The digital landscape is quickly evolving, with technologies like Artificial Intelligence, machine learning, the Internet of Things, blockchains, cloud computing, and Augmented or Virtual Reality. Many of the new tools already impact sectors like

healthcare, finance, and transportation and are reshaping industries. Meanwhile, the pace of technological integration continues to grow.

Technologies can be used for good, but also can have dark sides (Trittin-Ulbrich et al., 2021). Nahvandi (2019) indicates that in Industry 4.0 the main focus is on creating efficiency of processes, while ignoring human costs. Efficiency itself can have a negative effect on the resilience of the system we live in (Walker & Salt, 2006). Nahavandi (2019) proposes that sustainability is embraced in the development of Industry 5.0. Karneborgen et al. (2023) emphasize that current leaders "transform their internal organizations while navigating the broader ecosystem simultaneously" (p. 78) to unlock the value of digital technology.

Both in public, policy, and academic debates the interest in technological solutions for the sustainability agenda is rising. For instance, a number of digital tools are developed by entrepreneurs to overcome managerial problems that can hinder a transformation to sustainability (George et al., 2021b). Examples of such managerial problems relate to communication towards e.g., customers of sustainable products or the costs associated with coordination across supply chains. In a conference proceeding, Kürpick, Kühn, et al. (2023) describe nine possible applications of technology for sustainability. Examples are data-based life cycle assessment, digital product passports or smart factory infrastructures. These applications are considered to have "a basically positive impact on sustainability" (p. 179). Two important requirements of applications are also addressed to prevent negative impacts of the solutions: the need for trustful and fair analytics and concerns about energy consumption and e-waste related to the technological applications.

Whilst the potential of technologies receives ample attention in the literature, insight in the actual embedding of technologies in practices of digital sustainability is still lacking. Also in other domains, there is limited research available on how data-related technologies are used in work practices (Mathiassen et al., 2023). Porto de Albuquerque et al. (2021) propose a critical research agenda regarding the generation, circulation, and usage of data specifically in the transformation towards sustainability. Questions they pose are for instance:

Who defines which data is being produced and how? Is the data generation building new capacities and critical consciousness or contributing to reduce inequalities? (…) Who defines what counts as data and which data is important? (…) What are the social and material processes for building trust in data and how this shapes decision-making in practice? (p. 160).

With formulating such questions, they argue for a more detailed understanding of how data are embedded in socio-material practices. Only from such a perspective, it becomes clear how they actually intervene in decision-making processes. We concur with this argument, and broaden the added value of a socio-material perspective to the role that digital technologies in general play in a transformation to sustainability.

4 Digital sustainability practices and a research agenda

Reflecting on the argument made above, we propose taking a practice approach to deepen our understanding of to digital sustainability, or the twin transformation. By focusing on the interrelation of actors and digital technologies (the sociomateriality) in everyday sayings and doings, we can achieve deeper insight in how technological tools gain shape in the daily organizational realities. Based on the analytical framework of Shove et al. (2012) we further examined the meanings associated with sustainability and conveyed the need of context-bounded meaning making. Additionally, we explored the potential and possible risks associated with technologies available. Based on these considerations we formulated our working definition of digital sustainability practices which focuses on the daily interplay between practitioners and digital technologies in the process of transformation towards a sustainable state. In this last section we develop a research agenda resulting from this framing, to increase our understanding of digital sustainability practices. The agenda is summarized in Table 1.

Currently, there is little empirical evidence to build upon. An exception is the study Bähr and Fliaster (2023), revealing that how digital technologies are framed shape both the business digitalization strategies at the firm level, and the contributions to the sustainability transformation. These findings support our call for further research into the association between sustainability related meanings and digital technologies. In developing our suggestions we follow the others in relating to the distinction of Orlikowski and Gash (1994) between the questions regarding the nature of the

technology ('what is it?'), the technology strategy ('why should it be implemented?'), and technology in use ('how it is used on a daily base?'). The current literature on digital sustainability/twin transformation mainly focuses on the nature of the technology or what it could do. We shift the focus to the other two levels.

We start with elaborating on the strategic aspects. This choice is made based on the limited insight in the actual connections currently made between the 'what' of digital technologies and the 'why' of sustainability. This is also a pragmatic choice. Researching the daily practices in use, would favor a methodology which includes shadowing of practitioners (e.g., Nicolini, 2012). Such studies are time-consuming and access can be challenging. To prepare for such studies, we suggest to start building the empirical base for digital sustainability practices with alternative and less invasive approaches.

We firstly suggest to investigate how organizations currently link the application of digital technologies with sustainability related meanings. Organizational documents or websites can be taken as a proxy for the connection made between digital technologies and sustainability goals. Larger companies that are committed to sustainability (e.g. B-Corps) can provide a starting point. It is most likely that the digital tools these companies use, are tied to sustainability associated meanings. While documents are not 'pure' mirrors of organizational practices, they are linguistic manifestations of discursive practices associated with strategy formation (Nicolini, 2012). By adding an intertextual lens, which ideally includes a historical perspective, deeper insights into these processes can be gained.

Building upon this first research suggestion, it is important to acknowledge that documents also are artefacts that co-constitute practices. Documents are a result of production processes and are the starting points for consumption processes by readers (Prior, 2003). From the latter perspective, strategic documents are assumed to play a role in the technology usage (cf., Bähr & Fliaster, 2023). Research based on document analysis, can be further enriched with interviews. To zoom in on the production of the document, people involved in both the digital and the sustainability strategy can be interviewed. This could shed light on the digital sustainability strategy formation cross the boundaries of digital and sustainability departments. On the other hand, interviews with internal readers of these documents can help to understand their perception of digital sustainability and

potential calls for action they take from the document. It would be interesting to learn if and how the application of digital tools is adjusted based on strategic documents.

Studying technology in use would require sufficient time within an organization, likely resulting in case studies. Mapping the interlinked practices associated with a tool or application, could provide a starting point. Next, observing practitioners in each of the steps, while constantly asking 'why' questions would result in fine-grained data regarding the interlinkage between tools and meanings in practice. Alternatively, applying the 'instructions to the double' interview technique (Nicolini, 2009) could serve as a proxy for observing the practices while executed.

Another avenue for further research, which could fit in both categories, is looking at tools based on digital technologies that are available for organizations to adopt. This could be general tools that can be applied to achieve sustainability related goals, or tools that were developed specifically to help companies in their digital sustainability. Investigating with which meanings these tools are associated upon implementation in context-bounded organizational practices can empirically substantiate the importance of local meaning making.

We conclude this paper by relating back to Ramsey (2015) who pleas for understanding 'sustainability meanings in use' based on analysis of organizational practices. Although such empirical insights are valuable, we challenge the current depth of integration of digital technologies and sustainability related meanings. In the area of digital sustainability we therefore argue to complement more descriptive research, with a critical perspective (e.g., following Porto de Albuquerque et al., 2021). This way, we aim to ultimately encourage organizations to deepen the interconnectedness between the DT and ST.

Table 1: Overview research agenda Digital Sustainability practices

Technology strategy	**Technology in use**
Document analysis ➢ Establishing linkage between meanings and digital technologies ➢ Intertextual analysis to track evolvement of meaning and interconnections to broader discourse	Single case studies ➢ Mapping linkages between practices related to a specific tool connected to sustainability related meanings ➢ Observation of practitioners involved in the interlinked practices, complemented with probing on the 'why' of sayings and doings ➢ Alternative approach based on 'Instructions to the double' interviews
Interview study ➢ Meaning making and connection to digital technologies (across departments) ➢ Internal readers of documents: meaning consumption and impact on practices	
Comparative case study, organizations with a similar tool	

References

Bähr, K., & Fliaster, A. (2023). The twofold transition: Framing digital innovations and incumbents' value propositions for sustainability. *Business Strategy and the Environment, 32*(2), 920–935. https://doi.org/10.1002/bse.3082

Brundtland, G. H. (1987). *Our common future: Report of the World Commission on Environment and Development*. United Nations.

Busch, T., Hamprecht, J., & Waddock, S. (2018). Value(s) for whom? Creating value(s) for stakeholders. *Organization and Environment*, *31*(3), 210–222. https://doi.org/10.1177/1086026618793962/FORMAT/EPUB

Carvalho, R., & da Silva, A. R. (2021). Sustainability requirements of digital twin-based systems: A meta systematic literature review. *Applied Sciences*, *11*(12), 5519. https://doi.org/10.3390/app11125519

Chatzistamoulou, N. (2023). Is digital transformation the Deus ex Machina towards sustainability transition of the European SMEs? *Ecological Economics*, *206*. https://doi.org/10.1016/j.ecolecon.2023.107739

Diodato, D., Huergo, E., Moncada-Paternò-Castello, P., Rentocchini, F., & Timmermans, B. (2023). Introduction to the special issue on "the twin (digital and green) transition: Handling the economic and social challenges." *Industry and Innovation*, *30*(7), 755–765. https://doi.org/10.1080/13662716.2023.2254272

Elkington, J. (2018). 25 Years ago I coined the phrase "Triple Bottom Line." Here's why it's time to rethink it. *Harvard Business Review Digital Articles*, 2–5. https://search-ebscohost-

com.hu.idm.oclc.org/login.aspx?direct=true&db=buh&AN=130449047&site=ehost-live&scope=site

Engeström (1987/2019). *Learning by expanding: An activity-theoretical approach to developmental research*. Orienta-Konsultit.

Feroz, A. K., Zo, H., & Chiravuri, A. (2021). Digital transformation and environmental sustainability: A review and research agenda. *Sustainability*, *13*(3), 1530. https://doi.org/10.3390/su13031530

Fouquet, R., & Hippe, R. (2022). Twin transitions of decarbonisation and digitalisation: A historical perspective on energy and information in European economies. *Energy Research & Social Science*, *91*, 2214–6296. https://doi.org/10.1016/j.erss.2022.102736

George, G., Merrill, R. K., & Schillebeeckx, S. J. D. (2021). Digital Sustainability and Entrepreneurship: How Digital Innovations are helping tackle climate change and sustainable development. *Entrepreneurship Theory and Practice*, *45*(5), 999–1027. https://doi.org/10.1177/1042258719899425

Gherardi, S. (2001). From oganizational learning to practice-based knowing. *Human Relations*, *54*(1), 131–139. https://doi.org/10.1177/0018726701541016

Gong, C., & Ribiere, V. (2020). *Developing a unified definition of digital transformation*. https://doi.org/10.1016/j.technovation.2020.102217

Graf-Drasch, V., Kauffeld, L., Kempf, L., Maria Oberländer, A., Teuchert, A., & Maria, A. (2023). Driving twin transformation - The interplay of digital transformation and sustainability transformation. *ECIS 2023 Research Papers*, 5–11. https://aisel.aisnet.org/ecis2023_rp/255

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies*, *58*(5), 1159–1197. https://doi.org/10.1111/joms.12639

Hölscher, K., Wittmayer, J. M., & Loorbach, D. (2018). Transition versus transformation: What's the difference? *Environmental Innovation and Societal Transitions*, *27*, 1–3. https://doi.org/10.1016/j.eist.2017.10.007

Johnson, J. L., Zanotti, L., Ma, Z., Yu, D. J., Johnson, D. R., Kirkham, A., & Carothers, C. (2018). *Interplays of Sustainability, Resilience, Adaptation and Transformation* (pp. 3–25). https://doi.org/10.1007/978-3-319-67122-2_1

Jonkers, I. R. (2022*). How organizational actors socially innovate: An action learning research project in an established organization* [PhD thesis Nyenrode Business Universiteit]. Nyenrode Business Universiteit. Can be retrieved from: https://www.nyenrode.nl/docs/default-source/faculty/promoties/irene-r.-jonkers.pdf?sfvrsn=11b27813_3

Karneborgen, P., Oberländer, A. M., & Rövekamp, P. (2023). 'Unlocking digital value at the intersection of organizational digital transformation and digital business ecosystems'. In: M. K. Brohman, G. S. Dawson, & K. C. Desouza (eds.), *Digitalization and sustainability: Advancing digital value* (pp. 77-104). Edward Elgar Publishing.

Keck, M., & Sakdapolrak, P. (2013). What is social resilience? Lessons learned and ways forward. *Erdkunde*, *67*(1), 5–19. https://doi.org/10.3112/erdkunde.2013.01.02

Kennedy, S., & Linnenluecke, M. K. (2022). Circular economy and resilience: A research agenda. *Business Strategy and the Environment*, *31*(6), 2754–2765. https://doi.org/10.1002/bse.3004

Kuhlman, T., & Farrington, J. (2010). What is Sustainability? *Sustainability*, *2*(11), 3436–3448. https://doi.org/10.3390/su2113436

Kürpick, C., Kühn, A., Olszewski, L., & Dumitrescu, R. (2023). Framework for dual transformation: A systematic literature review on the interplays between digitalization and sustainability. *2023 IEEE Conference on Technologies for Sustainability (SusTech)*, 175–182. https://doi.org/10.1109/SusTech57309.2023.10129630

Kürpick, C., Rasor, A., Scholtysik, M., Kühn, A., Koldewey, C., & Dumitrescu, R. (2023). An integrative view of the transformations towards sustainability and digitalization: The case for a dual transformation. *Procedia CIRP*, *119*, 614–619. https://doi.org/10.1016/j.procir.2023.02.155

Latour, B. (2017). *Facing Gaia: Eight lectures on the new climatic regime*. Polity Press

Leach, M., Scoones, I., & Stirling, A. (2010). *Dynamic Sustainabilities*. Earthscan.
Lock, I., & Seele, P. (2017). Theorizing stakeholders of sustainability in the digital age. *Sustainability Science*, *12*(2), 235–245. https://doi.org/10.1007/s11625-016-0404-2
Mathiassen, L., Jonsson, K., & Holmstrom, J. (2023). Tensions in transfer, translation, and transformation of information: A sociomaterial perspective on heterogeneous work arrangements. *Journal of Information Technology*, *38*(3), 334–350. https://doi.org/10.1177/02683962231164426
Mazzocchi, F. (2020). A deeper meaning of sustainability: Insights from indigenous knowledge. *The Anthropocene Review*, *7*(1), 77–93. https://doi.org/10.1177/2053019619898888
Meadows, D. H., Meadows, D. L., Rgen, J. •, William, R., & Behrens Ill, W. (1972). *The limits to growth: A report for the Club of Rome's project on the predicament of mankind*. Universe Books.
Millar, C., Hind, P., & Magala, S. (2012). Sustainability and the need for change: organisational change and transformational vision. *Journal of Organizational Change Management*, *25*(4), 489–500. https://doi.org/10.1108/09534811211239272
Nahavandi, S. (2019). Industry 5.0-a human-centric solution. *Sustainability (Switzerland)*, *11*(16). https://doi.org/10.3390/su11164371
Nicolini, D. (2009). Articulating practice through the interview to the double. *Management Learning*, *40*(2), 195-212. https://doi.org/10.1177/1350507608101230
Nicolini, D. (2012). *Practice theory, work, and organization: An introduction*. Oxford university press.
Orlikowski, W. J., & Gash, D. C. (1994). Technological frames. *ACM Transactions on Information Systems*, *12*(2), 174–207. https://doi.org/10.1145/196734.196745
Orlikowski, W. J., & Scott, S. V. (2008). 10 Sociomateriality: Challenging the Separation of Technology, Work and Organization. *The Academy of Management Annals*, *2*(1), 433–474. https://doi.org/10.1080/19416520802211644
Porto de Albuquerque, J., Anderson, L., Calvillo, N., Coaffee, J., Cunha, M. A., Degrossi, L. C., Dolif, G., Horita, F., Klonner, C., Lima-Silva, F., Marchezini, V., Martins, M. H. da M., Pajarito-Grajales, D., Pitidis, V., Rudorff, C., Tkacz, N., Traijber, R., & Zipf, A. (2021). The role of data in transformations to sustainability: a critical research agenda. *Current Opinion in Environmental Sustainability*, *49*, 153–163. https://doi.org/10.1016/J.COSUST.2021.06.009
Prior, L. (2003). *Using documents in social research*. Sage Publications.
Ramsey, J. L. (2015). On not defining sustainability. *Journal of Agricultural and Environmental Ethics*, *28*(6), 1075–1087. https://doi.org/10.1007/s10806-015-9578-3
Reckwitz, A. (2002). Toward a theory of social practices. *European Journal of Social Theory*, *5*(2), 243–263. https://doi.org/10.1177/13684310222225432
Salas-Zapata, W. A., & Ortiz-Muñoz, S. M. (2019). Analysis of meanings of the concept of sustainability. *Sustainable Development*, *27*(1), 153–161. https://doi.org/10.1002/sd.1885
Sancak, I. E. (2023). Change management in sustainability transformation: A model for business organizations. *Journal of Environmental Management*, *330*, 117165. https://doi.org/10.1016/j.jenvman.2022.117165
Schatzki, T. R. (2012). A primer on practices. In J. Higgs, R. Barnett, S. Billet, M. Hutchings, & F. Trede (Eds.), *Practice-based education: Perspectives and strategies* (pp. 13-26). Sense publishers.
Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes*. Sage Publications.
Spaargaren, G., Lamers, M., & Weenink, D. (2019). Introduction: Using practice theory to research social life. In G. Spaargaren, D. Weenink, & M. Lamers (Eds.), *Practice theory and research: Exploring the dynamics of social life* (pp. 3-27). Routledge.
Trittin-Ulbrich, H., Scherer, A. G., Munro, I., & Whelan, G. (2021). Exploring the dark and unexpected sides of digitalization: Toward a critical agenda. *Organization*, *28*(1), 8–25. https://doi.org/10.1177/1350508420968184
Walker, B., & Salt, D. (2016). *Resilience thinking: Sustaining ecosystems and people in a changing world*. IslandsPress.