Is digitalization a problem solver or a fire accelerator? Situating digital technologies in sustainability discourses

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Abstract
Starting from the framework of the ‘futures of sustainability’ this article asks whether or not digital technologies are discursively framed in such a way that they can offer a solution to socio-ecological problems. The initial observation is that the mediation and interactions of digitalization and sustainability have recently been the subject of political debates. Using the mapping procedure of situational analysis, the discourses around digital technologies as they emerge in the ideal-typical paths of sustainability – modernization, transformation and control – are identified and presented. The results show that similar technologies provoke varying discourses in the three possibility spaces of future sustainability, which can also be attributed to different normative foundations.

Keywords
control, digitalization, futures of sustainability, modernization, transformation

Résumé
En partant du cadre donné par les « futurs du développement durable », cet article pose la question suivante : les technologies numériques sont-elles définies dans le champ discursif de manière à ce qu’elles puissent offrir une solution aux problèmes socio-écologiques ? En premier lieu, j’ai observé que la médiation et les interactions existant entre la numérisation et le développement durable ont fait récemment l’objet de débats politiques. A partir de la méthode cartographique de l’analyse situationnelle, j’ai identifié et présenté les discours entourant les technologies numériques, en tant qu’ils émergent au sein des trois routes idéal-typiques menant vers un futur durable : celles de
la modernisation, de la transformation et du contrôle. Les résultats obtenus montrent que des technologies similaires engendrent des discours divers dans les trois espaces possibles pour définir un futur durable, ce qui peut aussi être le signe de fondements théoriques différents.

Mots-clés
contrôle, futurs du développement durable, modernisation, numérisation, transformation

Introduction: Prospects and concerns about digitalization and sustainability

Both technological progress generated by digitalization and sustainability appear to be necessary developments and thus ‘grand challenges’ (Ferraro et al., 2015) to which contemporary societies must respond. Changing societies in a more sustainable way is necessary because the consumption of fossil resources, the loss of biodiversity and the threats posed by climate change, due to the great acceleration, must be faced (Steffen et al., 2015). Sustainability is thus a future-oriented project of development and a mode of action that is intended to correct past failures of industrial modernity and to curb the further use of natural and human resources (Neckel, 2018: 12). It broadly raises the question of how present needs may not be realized at the expense of future generations economically, socially and ecologically (WCED, 1987). In this context, organizations, institutions, and everyday life are permeated by partly varying sustainability values and norms. The formulation of 17 Sustainable Development Goals by the United Nations General Assembly in 2015 is one instantiation that illustrates the significance of sustainability as a leitmotif for political measures all over the globe. The complexity of interests and goals associated with the concept of sustainability provokes conflicts and incompatibilities even down to the organizational level (Ametowobla et al., 2020). Consequently, sustainability is not a solution, but a problem to which social actors react in different ways (Neckel, 2018). The concept of ‘futures of sustainability’ aims to examine the imaginaries, practices and structures that societies rely on when striving to realize sustainability (Adloff and Neckel, 2019a, 2019b).

Digitalization, however, can be seen as a main requirement for innovation that tends to infuse all areas of society (Lupton, 2014b). The term refers to the multiple processes that organize social life through and around digital technologies (Leonardi and Treem, 2020). This includes not only the translation of analogue formats into digital values, but also so-called practices of datafication, which turn activities, behavior or processes into ‘meaningful data’ (Prietl and Houben, 2018). In the social sciences, digitalization is commonly regarded as part of a transformation towards ‘digital capitalism’ (Schiller, 2000; Staab, 2019), which is characterized by the adaptation of the digitalization paradigm to all economic and social spheres as in the automotive industry (Elder-Vass, 2016), public service sectors (Zhao et al., 2015), or the healthcare system (Lenz, 2020, 2021). In the case of digitalization, especially economic and political actors are confronted with global competition and the need to ensure economic wealth. This is also linked to visions of a
fairer world fulfilled through digital technologies, for example when it comes to identifying better solutions and making better decisions.

This article proceeds from the observation that the discourses on digitalization and sustainability have long run parallel to each other, but have increasingly become overlapping and are discussed critically. Against this background, digitalization and sustainability need to be considered not only as two currently dominant processes of social change, but also discussed sociologically in terms of their interconnectedness. Neither a future without digital technologies is imaginable, nor is a future in which discourses about sustainability disappear. It is much more likely that these two strands of discourses and the normative requirements which are interwoven within them will be brought into dialogue with each other. Political decision-makers are already addressing this challenge. For example, in the report ‘Towards our Common Digital Future’ (WBGU, 2019), the German Advisory Council on Global Change (WBGU) clearly called on German and European Union policy-makers to integrate digitalization into policy objectives. This was also supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) which called for an ‘environmental digital agenda’ in the same year. The aim is to develop a digitalization strategy that brings together wealth and environmental protection. Thus, at its meeting in late 2019, the State Secretaries’ Committee for Sustainable Development confirmed that ‘digitalization and sustainable development must be consistently addressed together’ (Bundesregierung, 2019).

These demands relate to the awareness that digitalization could have ambivalent effects on sustainability in the future. Moreover, the processes of digitalization are difficult to assess or evaluate in terms of their impact on sustainability (Wendt et al., 2018: 10). On the one hand, supporters emphasize that digital technologies could promote climate protection through smart homes, automated decision-making systems, or virtual reality applications (Schieweck et al., 2018). With the help of artificial intelligence (AI), specific monitoring techniques for climate change or warning and forecasting systems are also being developed, which may contribute to achieving the Sustainability Goals (Nishant et al., 2020). While governments consider digitalization as an asset in developing sustainable strategies, internationally operating tech companies like Microsoft and Apple are hoping to sell climate-friendly AI applications that contribute to securing the standard of living of future generations. Both have then a great interest in making the public aware of the benefits of digital technologies in questions of sustainability (Espinoza and Aronczyk, 2021). In this sense, digitalization is seen as ‘problem solver’ for climate change (Bieser et al., 2020). On the other hand, sceptics refer to the negative consequences of an increasing monopolization of international tech companies and the power consumption of the digital infrastructure both of which are discussed as unsustainable (Lange and Santarius, 2018). The latter is already partly observable at present when global infrastructure requires high amounts of power (Hilty, 2012). Digital infrastructures and devices such as blockchain or smartphones not only require large amounts of energy but also of natural resources (digital waste), counteracting the goals of an environmentally sustainable development. Accordingly, there is a growing concern that these technologies will exacerbate the environmental consequences and serve as ‘fire accelerators’ (WBGU, 2019). Hans Joachim Schellnhuber, Director of the Potsdam Institute for Climate Impact Research, points this out when he
states that ‘we cannot leave digitalization to Silicon Valley alone, because artificial intelligence could destroy our civilization faster than climate change’ (Potsdam Institute for Climate Impact Research, 2018).

Against this background, digitalization and sustainability are seen as two dominant development concepts that are both shaping and addressing the future. Here, both are understood as discourses or ‘universes of discourse’ (Clarke, 2012: 95) about future developments that are debated, negotiated, criticized and legitimized by different actors and against the background of varying positions, experiences and expectations. Accordingly, digitalization and sustainability are two ‘social worlds’ (Clarke, 2012: 106; Strauss, 1982) that become increasingly interconnected and critically negotiated in social and political reality – the so-called ‘sites of hyperprojectivity’ (Mische, 2014).

It is this controversial impact that digital technologies could have on a sustainable future that is the focus of this article, which asks whether or not digital technologies are discursively framed in such a way that they can offer a solution to socio-ecological problems. In doing so, I am not interested in examining or assessing the actual impact of digital technologies on sustainability, but rather in identifying the discourses and the resulting controversies that unfold at the intersections of digitalization and sustainability. Moreover, this is a genuinely sociological perspective, not one of the ecological economy, which asks much more about the real political implications and governance requirements (Santarius et al., 2021). Accordingly, claims made by protagonists are taken for exactly what they are: the legitimate assumptions of reality in these ‘worlds’ (Berger and Luckmann, 1972). To approach this question, I will present a preliminary mapping (Clarke, 2012: 121–183) of the discourses around digitalization and of the ideas using digital technologies in the context of sustainability. I draw on the recent work on ‘futures of sustainability’ (Adloff and Neckel, 2019a, 2019b), according to which sustainability itself is highly contested. Here, sustainability is conceived as a category of observation that can shed light on the socio-economic transformation that is taking place and on the lines of conflict, inequalities and hierarchies that are emerging as contemporary societies increasingly integrate criteria of sustainability into their institutions, functions and value patterns (Neckel, 2018: 13). Analytically, Frank Adloff and Sighard Neckel distinguish between three ideal-typical development paths in which sustainability is based either on modernization, transformation or control. Each of these trajectories is interlinked with distinctive discourses on digitalization and its impact on sustainability.

In the next section, I will put the complexity of sustainability to analytical use by referring to the concept of ‘futures of sustainability’. By defining discourses from a situational analysis perspective, I will then examine the discourses around digital technologies and digitalization processes in the three possible pathways of future sustainability. In the last part, I will discuss these findings and draw an outlook of necessary further research.

**Futures of sustainability and digitalization**

In line with the research program ‘Futures of Sustainability’ (Adloff and Neckel, 2019a), I consider sustainability to be a very broad concept that is open to interpretation. Currently being negotiated controversially in almost all areas of society, it is given concrete but
often multi-layered action-guiding meanings in various economic and political areas as well as in everyday life. Encompassed and framed by the famous definition of the 1987 Brundtland Report, according to which present needs must not be realized at the expense of the needs of future generations, the norm of sustainability guides very different strategies, processes, and actions. In recent decades, the concept of sustainability has been highly differentiated and at the same time has become the subject of everyday political-administrative and corporate actions (Görgen and Wendt, 2015; Kraemer, 2008; Schachtschneider, 1999), so that the term and the multiple concepts surrounding it are even criticized as being useless and meaningless (Finke, 2012). Moreover, some authors note that in the sustainability discourses of the 1980s, economic and natural science ideas predominated, which left out the social dimension of sustainability, i.e. the questions of poverty, inequality and war (Görgen and Wendt, 2015: 6; Steurer, 2001). The latter proclaim that this reduction provides an insufficient basis for a genuine discourse on sustainability (Ott et al., 2011: 15; Ott and Döring, 2008).

In response to this analytical ambiguity, from a practical-philosophical and an environmental and economic perspective, the distinction between ‘weak’ and ‘strong’ sustainability is proposed (Ott et al., 2011; Steurer, 2001). Weak sustainability is characterized by the idea that the limit of natural resources can be exceeded through social, economic and ecological innovations, but without exposing the ecosystem to collapse (Kraemer, 2008). In a nutshell, weak sustainability is the neoclassical answer to the growth critique (Steurer, 2001: 551). The three-pillar model, where ecology is equated with the economy and the social, consolidates this idea (Brand, 2011: 61). However, equating economy, ecology and social issues could lead to the following result: only the aspects that are economically profitable are considered sustainable (Lenz and Neckel, 2019). Strong sustainability, conversely, goes beyond the original normative framework of ecological protection measures and resource conservation and instead refers to the need to correct current economic and political growth dynamics as the only solution (Görgen and Wendt, 2015: 6; Ott and Döring, 2008: 320ff; Sarkar, 2001). Concepts of strong sustainability thus take the social dimension seriously and challenge profit-driven systems that have a devastating impact on natural as well as human resources.

In a similar way, however inspired by cultural sociology and praxeology, the concept of the ‘futures of sustainability’ (Adloff and Neckel, 2019a) also refers to the meaning of sustainability as a leading concept of current social change. By explicitly turning the argument about strong and weak sustainability to social theory, Adloff and Neckel describe modernization, transformation and control as ideal-typical orientations that institutions, organizations and actors can take in their efforts to achieve sustainability. Sustainability as modernization, transformation or control then mark the possible trajectories of a social change, which give quite different and even contradictory answers to the ecological question (Adloff and Neckel, 2020: 8).

**Sustainability as modernization**

Characteristic of the trajectory ‘sustainability as modernization’ is that the principles of the capitalist market economy, individual consumer orientation, and the striving for financial prosperity remain untouched. Those who aim at sustainable or ecological
modernization search for possibilities to mediate environmental demands with economic growth. In coping with environmental problems, imaginations and practices of ecological modernization refer to market structures and are oriented towards progressive-optimistic solution strategies based on weak sustainability in order to meet environmental and resource problems (Streurer, 2001: 539). At their core, these orientations are economistic, as environmental problems are reduced to efficient management and allocation (Kraemer, 2008: 33). Current research shows that sustainability as ecological modernization has long ceased to be merely an obstacle or a requirement that CEOs and other economic actors should or even ‘must’ fulfil in order to maintain their legitimacy vis-à-vis their stakeholders. On the contrary, climate change and the corresponding sustainability strategies are increasingly considered not just as challenges, but as opportunities for corporate action (Wright and Nyberg, 2012: 1572). Sustainability is becoming an essential criterion of economic and corporate efficiency and competitiveness, which is even anchored in the emotional culture or ‘emotionologies’ (Fineman, 2002; Wright and Nyberg, 2012) of business enterprises. At the macro level and in organizational settings, this is reflected in concepts such as ‘green capitalism’ (Mol et al., 2016), ‘ecocapitalism’ (Hawken et al., 1999) or ‘ethical finance’ (Lenz, 2018; Lenz and Neckel, 2019) that place sustainability at the heart of the renewal of capitalist economies and merely serve to adapt to changing conditions, such as climate change.

**Sustainability as transformation**

In contrast, discourses that refer to ‘sustainability as transformation’ are increasingly critical of this continued growth-based orientation and the consequences this has for nature (Acosta, 2015). Modernization is considered insufficient, for which reason supporters of transformative movements claim for a ‘great transformation’ built on a global non-competitive and non-growth-based social order (strong sustainability). This position is represented by degrowth movements (Latouche, 2015) and can be found in the concepts of post-capitalism (Mason, 2016). From this perspective, the constraint of economic growth must be renounced (Kallis et al., 2015). Actors in the trajectory of transformation do not simply draw on scientific knowledge or traditional economic practices, but explicitly transcend the given normative framework (Beling et al., 2018), which is why this notion can be located in the context of strong sustainability (Biesecker and Hofmeister, 2009; Döring, 2009). According to the degrowth paradigm, a sustainable transformation cannot be achieved by limiting bad growth (diesel cars) and promoting good growth (green energy). They call for a complete institutional and value-based transformation not only of the economic system, but of all social, cultural and political activities (Kallis et al., 2018). These demands are based on fundamental cultural change and turn away from the relentless desire for more consumption and the belief that infinite growth will redirect society in a way that allows everyone to live a good life (Kallis et al., 2020: 19).

**Sustainability as control**

Adloff and Neckel (2019b: 175) describe the trajectory of sustainability as control as a dystopian option for the future of sustainability, which is characterized by authoritarian measures and state-directed control. The focus is not – as in the case of
transformation – on changing existing societal, political, and social structures, but on adapting these structures to the ecological emergency through building resilience (Zebrowski, 2017). In this trajectory of sustainability, it seems that hope for sustainability has been extinguished in view of the inevitability of the impending collapse of the earth system (Kaplan, 2016) as well as the continuous crossing of so-called ‘tipping points’ (Leggewie and Welzer, 2009; Servigne and Stevens, 2015). Accordingly, this discourse of control is based on a radicalized assumption of weak sustainability, which might even imply, under certain circumstances, to suspend democratic principles (Adloff and Neckel, 2019b: 175). Dystopian futures, such as the idea of ‘climate emergency’ (Spratt and Sutton, 2008), which requires a completely new action in the present and the continuation of the control imperative, as condensed in the sociotechnical imaginaries (Jasanoff and Kim, 2015) of geoengineering (Bellamy, 2016), are central normative reference points of ‘sustainability as control’.

Each trajectory refers to a particular set of imaginations of the future and of what sustainability means in the first place. At these interfaces, new paradoxes, new challenges, and new inequalities arise. Specific indications of future conflicts can be inferred by looking at how exactly societies attempt to integrate digitalization and sustainability, i.e., at their action-guiding imaginatations, the practices based on them, and their manifestations in social and infrastructural settings. Discourses and implicated imaginations, expressed as visions or expectations, form the basis for everyday actions at the micro level, as well as for global processes of change (Appadurai, 1996: 31). The three development trajectories of potential future sustainability constitute normative spaces of possibility and orders of justification (Boltanski and Thévenot, 2006) for societies striving to realize sustainability. Thus, the different trajectories are characterized by imaginaries in which different, partly contradictory ideas of justice and ‘rightness’ appear (Castoriadis, 1975: 278; Jasanoff and Kim, 2015: 4). This moral-discursive dimension has a decisive influence on how digital technological innovations are evaluated in the context of sustainability, since they always contain fundamental self-descriptions of society and desirable futures (Kaiser, 2012). In terms of digitalization processes and sustainability, this means that the material properties of so-called ‘technologies of rationality’ open up both possibilities (affordances) and limitations of use (Jarzabkowski and Kaplan, 2015). They acquire their moral meaning only through the attribution of certain properties and functions and in the digital practices themselves (Weizenbaum, 1987). This does not mean, however, that the initiating imagination or idea is not already charged with normative meaning. For example, the development of digital health technologies is shaped by the developers’ ideas of justice and follows their claims (Lenz, 2021). Still, since digital technologies are used or are intended to be used in a wide variety of sectors, their normative impact depends on the overriding demands and discourses of the area in which they are applied – even though they often end up not having the originally intended effect in their concrete application. Generally, it can be observed that the same technologies lead to varying discussions in different areas and are thus in need of negotiation based on the respective recognized norms. Digitalization is also discussed controversially in the context of possible future sustainability developments. In the following, I will address the question of how digital technologies and the related processes of digitalization are subject to discursive negotiation in the context of modernization, transformation and control as possible pathways to future sustainability.
Digitalization between strong, weak and no sustainability

In order to illustrate how digital technologies are negotiated and discussed in the three trajectories of sustainability, I use a mapping method that builds on situational analysis as proposed by Adele Clarke (2012). This procedure also makes it possible to identify actors, their positions and the resulting contradictions, heterogeneities, ambivalences and insignificances (Clarke, 2012: 31). In order to comprehensively assess the complexity of the social, the main focus is not on the actor-centered processuality of social actions (basic social processes) and their dependence on specific contextual conditions, but on the analysis of the relationality of social actions in their situatedness (Clarke, 2012: 108). Situations, from this perspective, are not static or fixed entities, but fluid human and non-human relational structures (Knorr Cetina and Bruegger, 2002) that capture everything that is made relevant or irrelevant in interaction (Clarke, 2012: 17). Following Strauss’ key metaphor, situational analysis distinguishes analytically between ‘social worlds’ and ‘arenas’. Social worlds are accordingly understood as shared activities and goals, but which are characterized by a constant dynamic of change, of new formations and disappearances. At their interfaces, conflicts of action and interpretation occur comparatively regularly, which can provoke crises if no compromises are found (Strauss, 1993). These arenas are considered as sites of confrontation or ‘hyperprojectivity’ (Mische, 2014) in which different social worlds confront each other. As ‘universes of discourse’, arenas are a product of specific social worlds and the conflicts and contradictions that take place in them (Clarke, 2012: 198). This is where those interactions are located, in which certain issues are debated, fought out, negotiated, manipulated, maintained or even enforced (Strauss, 1993: 226). Consequently, what can be said and by whom is constituted in social worlds and arenas; they form the basis for social coordination and organization and provide information about collective action (Clarke, 2012: 199).

From the perspective of situational analysis, the negotiations around digitalization in the context of sustainabilitles take place in specific social worlds that relate to the respective values, principles and action-guiding orientations of the three trajectories. In these processes of negotiation, certain types of representation, discourses and interpretations are produced and can assert themselves as legitimate interpretations of social order. In other words, such discursive negotiations point to which social worlds are empowered to enforce certain ideas. In order to find out how digital technologies are discussed in the three paths and what status they have in the respective social worlds, I take examples from business, politics and science.

Modernization: Digital technologies as problem solvers

In the context of ‘sustainability as modernization’, digital technologies are discussed as means to reconcile growth and environmental concerns. This is characterized by the concept of weak sustainability, from which cost-benefit analyses and efficiency as strategic tools define what is sustainable (Döring, 2004: 5). Against the backdrop of modernization, sustainability is no longer just a disruptive factor or a threat that CEOs and other economic actors are required – or even ‘forced’ – to comply with in order to maintain their legitimacy vis-à-vis their stakeholders. On the contrary, climate change and the
corresponding sustainability strategies are increasingly considered not just as challenges, but as opportunities for corporate action (Wright and Nyberg, 2012: 1572). Some argue that sustainability is becoming an essential criterion of economic and corporate efficiency and competitiveness, which is even anchored in the emotional everyday culture of business enterprises (Fineman, 2002; Wright and Nyberg, 2012).

This resurgent appreciation of technological efficiency gains in favor of sustainable and ecological modernization partly explains the attractiveness and attraction of a ‘techno-utopia’ (Lupton, 2014a). This term refers to a scenario that leaves no sphere in which digital technologies do not promise a reconciliation between growth, efficiency, and markets on the one hand, and ecology, health, and society on the other. In ‘solutionism’ as well as in ‘internet centrisms’ (Morozov, 2013), core normative reference points corresponding to the idea of world improvement become apparent. According to these reference points, social and structural problems could be overcome through the use and development of digital technologies. Discourses about ‘disruptive agriculture’ entail promises of a more efficient production and distribution of agricultural goods. Global tech companies are the main innovators and market makers in the field of climate-friendly AI applications that are seen as instruments to secure the standard of living of future generations. As a powerful global actor, Microsoft is developing ‘Agrimetrics’, a marketplace for data that connects organizations from the food and agricultural sectors with the self-given goal of ‘creating a more productive and sustainable food system’ (Microsoft Agrimetrics, n.d.). Also, computer scientists and leading tech companies argue that the use of artificial intelligence and machine learning could provide better energy forecasts, detecting unintentional methane emissions, and speeding up materials research (Rolnick et al., 2019). And in urban areas, both e-mobility and smart-city concepts are believed to lead to a reconciliation between environment and growth. Fundamental to these orientations and discourses are the innovative capacity of technology and the enormous increase in computer capacity in recent years, which makes it highly connectable to modernization and rationalization processes.

From this perspective, then, digital technologies and the use of algorithm-based systems are seen as a decisive contribution to the achievement of climate goals and to the promotion of sustainability. This view of the positive benefits of digital technologies, based on efficiency and optimization, is particularly widespread in large parts of the economy. For example, a global association of information and communications technology (ICT) companies, the Global Enabling Sustainability Initiative (GeSI), provides information, resources, and examples of best practice with the aim of transforming social and environmental sustainability through ICT. Participating companies include Deutsche Telekom, Dell, Fujitsu, Samsung, Swisscom, and development collaborations like the German Corporation for International Cooperation GmbH (GIZ). In a video, the initiative expresses concrete statements on its visions and plans. The video is part of the report ‘Digital with Purpose: Delivering a SMARTer2030’ (GeSi, 2019), which presents the positive effects of digital technologies for achieving the Sustainable Development Goals (which are called a ‘historically unique common agenda for change’). According to GeSI, inclusion, transparency, increased efficiency, and innovation can be achieved through the capabilities of digital technologies to network, communicate, observe, monitor, analyze, optimize, expand, and automate.
In a very similar way, leading climate researchers, such as Johan Rockström, are convinced that the ICT sector and digital technologies will be able to reduce global emissions by 15% until 2030. In a co-authored report on the potential of digital technologies, Rockström argues that ‘the digital technology sector is probably the world’s most powerful influencer to accelerate action to stabilize global temperatures well below 2°C’ (Ekholm and Rockström, 2019). For the transport sector and the implementation of a politically-initiated transformation of the energy system, the use of digital technologies is seen as indispensable as well. As a German NGO puts it, ‘[t]he digitalization of the energy transition facilitates an expansion of clean energy into other sectors, so as to further reduce the demand for fossil fuels’ (Germanwatch, 2016). Industry-related research institutes likewise see artificial intelligence, the Internet of things, Big Data computing, and blockchains as innovative methods that can be applied to the energy industry and production technology (Fraunhofer, 2021).

This position on the technical containment of climate change can also be found, though in a more radical version, in the positions of the Breakthrough Institute, based in Oakland, California. In their Ecomodernist Manifesto, a group of scientists affiliated with that institute (Asafu-Adjaye et al., 2015) express a perspective very similar to ‘natural capitalism’ (Hawken et al., 1999). Sustainability as modernization through digitalization here refers to finding solutions to climate change, which include the intensification of agriculture or a more efficient design of energy production through nuclear technology. The challenge then is to completely decouple economic growth and the use of natural resources from the protection of the natural environment, in order to create space for undisturbed renaturation (Asafu-Adjaye et al., 2015). From this perspective, too, the discursively produced relationship between digitalization and sustainability is seen as a win-win situation.

Transformation: Digital technology for strong sustainability?

In contrast to ‘sustainability as modernization’, the trajectory of transformation is based on the broader concept of strong sustainability. Predominant discourses about ‘sustainability as transformation’ and its underlying visions are also linked to and highly dependent on the use of digital technologies. These are not, however, tools to support the maintenance of market-based capitalism, but to abolish and replace capitalist structures. Against the background of the social dimension of sustainability, this transformation discourse focuses on participation opportunities and inclusion, which coincide with the early assumption of 1990 that the Internet could contribute to a new, decentralized and open economy (Dolata, 2015: 507). This was seen as an opportunity to reduce income disparities and democratize global economy, as well as to build an environmentally sustainable society (Rifkin, 2014: 13). Within the debates on overcoming the capitalist economy, such as those on degrowth (Latouche, 2015) and post-capitalism (Mason, 2016), some commentators discuss whether digitalization could bring about a new form of socialism (Kelly, 2009; Morozov, 2019). A central point of reference for such imaginations of a digital utopia are the developments in the field of open source (O’Mahony and Ferraro, 2007; Schrape, 2016). Open software and application-oriented open source were meant to directly contribute to the democratization of society. Wikipedia, for
example, was created with the aim of ensuring participation in knowledge production and the democratization of access (Elder-Vass, 2016). Others – e.g., platforms like Kleiderkreisel (in Germany), Pixabay or other forms of digital commons – aim at community sharing and thus counteract commercial commerce (Kostakis et al., 2015). The initial idea of those commons-based peer production (CBPP) or ‘sharing economy’ (Vallas and Schor, 2020) was to enable ‘collaboration among large groups of individuals without relying on either market pricing or managerial hierarchies’ (Benkler and Nissenbaum, 2006: 394). Thanks to open technological infrastructures, individuals could then be empowered to communicate, organize themselves and create new non-market-based values (Bauwens and Pantazis, 2018). Structures such as the sharing economy are therefore of great importance here, as they promote engagement with sustainability (Ametowobla et al., 2020: 361). Nevertheless, the effects that socio-technical infrastructure could have on the ecological dimension has been raised only recently.

Despite the initial enthusiasm, the importance of the Internet and its democratizing and emancipating effects have been called into question over the last decades because they are provoking social, economic and ecological conflicts (Brophy and Peuter, 2015). First, despite decentralization and collaboration, it turns out that digitalization has led to increasing competition between large technology companies and thus to a concentration of power: only a handful transnational Internet companies actually benefit from open source developments (Dolata, 2015). Ultimately, not much remains of the original idea of transforming capitalist structures if the development of digital innovations is controlled by large corporations, and the knowledge, expertise, and ideas of the open source and open innovation communities only serve to increase market power (Dolata, 2015: 522; West and Lakhani, 2008). In the course of the Internet’s commercialization by large tech companies such as Google, Microsoft, and IBM, digital commons were frequently appropriated and their innovative capacity instrumentalized (Dolata, 2015: 521). Secondly, although the ecological dimension has not been rarely at the center of transformative movements, it is becoming increasingly clear that the material conditions of the digital infrastructure provoke an ‘ecological disaster’ (Sarkar, 1999: 128) or multiple ecological ‘rebound effects’ (Santarius, 2015). For example the French think tank The Shift Project concludes, that in 2018, online videos emitted 300 million tons of CO₂, which is equivalent to Spain’s annual carbon dioxide emissions and represents one percent of global emissions (Efoui-Hess, 2019). Similarly, the term ‘blood computer’ refers to the price countries and people in the global South have to pay when they mine for rare-earth minerals on behalf of large tech corporations (Caffentzis, 2019). This runs counter to an expansion of perspective – the original vision of the Internet, ICTs or platforms as a transformative power – and the motto of ‘design global, manufacture local’ (Kostakis et al., 2015). These shifts undermine the original normative approaches of transformative movements like for example degrowth and convivialism (Adloff and Heins, 2015; Vetter, 2018) and threaten the normative basis of a sustainable transformation through digitalization. However, the transformation discourse seems to focus on the ecological impacts of digital technologies just recently. The emerging discussion about convivial techniques (Vetter, 2021) and a ‘soft’ or ‘sustainable’ digitalization (Lange and Santarius, 2018) could be seen as a reaction to this incompatibility of digitalization and sustainability from a transformative perspective.
Control: Modelling and calculating ecological risks?

The third trajectory refers to authoritative and state-directed control. Here the ecological emergency is in the foreground and can be realized under certain circumstances with a suspension of democratic principles (Adloff and Neckel, 2019b: 175). A particular characteristic of the trajectory of control is that the assumptions surrounding the future sustainability are highly hypothetical; neither are the relevant technologies yet operational, nor have the social and political consequences fully materialized. It is the vision of an inherent collapse that calls for political and social reorganization, and for the concomitant focus on technological innovations as a solution to ecological problems. The discourses rest on a very weak concept of sustainability. In a sense, it is not about creating a sustainable world at all. Rather, it is about ecological disasters and the urgency to take reactive and, in the short term, proactive measures to prevent total collapse. Digital technologies are vital components of any of those strategies. In particular, methods and techniques of collecting and evaluating so-called Big Data are discussed in order to meet the challenges posed by climate change. As a significantly improved method for gaining knowledge, Big Data, as some argue (Mayer-Schönberger and Cukier, 2013), offers the basis for a more comprehensive understanding of the world and should accordingly lead to better decisions and make the future more predictable, also with regard to sustainability. Data has even been described as the 'oil of the 21st century', offering an unparalleled resource for future security (Spitz, 2017).

Algorithm-based systems appear to offer completely new solutions to old problems. Big Data, inductive data mining, and automated decision support systems have long been promoted as marking an ‘end of theory’ (Anderson, 2008). ‘[B]ig data analytics’, Rob Kitchin explains (2014a: 2), ‘enables an entirely new epistemological approach for making sense of the world; rather than testing a theory by analyzing relevant data, new data analytics seek to gain insights ‘born from the data’.’ In other words, the attraction of these new methods is that data-driven objectivity is considered superior to human subjectivity, to human cognition and reflection. Finding the right solution no longer requires any models or theoretical assumptions; the mere amount of data and the patterns contained in it are seen as the ‘direct path to truth’ (Anderson, 2008). This ‘path’ is inscribed in the algorithms themselves. As the sum of ‘logic + control’ (Kowalski, 1979), algorithms are codes that determine what data is used and how calculations are performed (Kitchin, 2017; Kowalski, 1979). Although this imagination of knowledge generated by the computer at the push of a button has not yet materialized (boyd, 2010), it remains very powerful and inspires the idea of controlling climate change through AI and algorithms (Hampton et al., 2013; Willcock et al., 2018).

Seen from a ‘sustainability as control’ perspective, climate change has far-reaching implications for the security of populations and it has been argued that the management of all the ‘natural disasters’ we have to cope with, like floods, drought, and forest fires (Lafakis et al., 2019), is more accurate with real-time data and predictive analytics (Data. Gov, n.d.). The goal is to enable governments to develop action plans for protection against the effects of climate change based on continuously updated data. Big Data, real-time data, and predictive analytics, it is hoped, will increase the resilience of the citizens by providing information about floods or volcanic eruptions as quickly as possible. At
the very least, such information helps to raise awareness. In 2012, 2014 and 2017 the French telecommunications service Orange (former France Télécom) and a US American data innovation hub and knowledge center hosted a data development challenge with leading technology companies and data scientists to demonstrate the importance of private sector and personal data in achieving the Sustainable Development Goals (Espinoza and Aronczyk, 2021).

More concrete tools like risk zone maps, such as those generated in the ‘Surging Seas’ project, aim to show what coastal regions would look like if sea-levels were to rise by, say, 1.5 meter: for instance, large parts of Hamburg and the regions around the mouth of the German river Elbe would then be under water. Even more threatening: with a sea-level rise of 1.5 meter, almost half of the Netherlands would be under water. Another prominent example of such control-discourse is the Google Earth Engine, which compares the state of the environment over many decades and is supposed to identify, document, and forecast environmental damage around the world based on satellite images. Similarly, Microsoft is developing a global and comprehensive environmental data platform called ‘Planetary Computer’. Their aim is to use Big Data, machine learning, and AI to empower scientists, environmentalists, and governments to monitor, model, and manage complex ecosystems and environmental impacts. Biodiversity conservation, Microsoft claims, is a central concern behind its ‘AI for Earth’ program. Once again, these technologies are far from operational. Nevertheless, they refer to the vision that digital technologies can preemptively protect us against the threat of collapse.

**Discussion and conclusion**

Based on the observation that the influence of digitalization on sustainability is increasingly important within media and political discourses, I have investigated the question of how digital technologies are discursively negotiated in different notions of future sustainability (modernization, transformation or control). On the one hand, they can provide a possible solution to socio-ecological problems or, on the other, contradict the ideas of socio-ecological futures. Following situational analysis, I understand digitalization as a currently dominant, discursively negotiated development concept or ‘social world’ within which present and future are problematized and negotiated. In order to identify the different discourses around digitalization, I refer to the concept of the futures of sustainability, according to which sustainability itself is highly contested (Adloff and Neckel, 2019a). In my understanding, the three trajectories identified by Adloff and Neckel constitute universes of discourses in which digitalization is now negotiated against the backdrop of path-typical values, framings, interests and positions.

First, I observed that digital technologies fit perfectly in the trajectory of modernization and are having a partially positive effect by reconciling economic and sustainability demands. Especially in the business context, an efficiency-enhancing effect is ascribed to digital technologies, which is perceived as a win-win situation. Important actors in this field of discourse are global companies such as Deutsche Telekom, Swisscom or Dell, which emphasize the importance of increasing efficiency through ICT and the distribution of comprehensive data. This is based on concepts of weak sustainability, which consider that sustainability problems can be harmoniously solved by green growth. As
the focus is not on preserving the environment, but on increasing general welfare, digitalization is regarded positively.

Secondly, I observed that the connection between digitalization and sustainability in the context of the transformation path seems to be much more precarious than it is for digital-ecological modernization. This might be related to the fact that for transformative ideas it is not sufficient to refer to concepts of weak sustainability and its related cost-benefit perspective (Daly, 1999). The normative orientations and future visions of the transformation path are rather based on a more holistic perspective of strong sustainability, which contradicts the belief that environmental resources can be substituted with technical processes. Digital technologies – although their importance in connecting and mobilizing people is highlighted – oppose the normative principles of the transformative post-growth vision when they lead to a concentration of global tech companies instead of local collaboration, and when they accelerate the consumption of resources. For a long time, the discourse on transformation has been marginally concerned with the ecological side effects of sociotechnical infrastructures which are fundamental to transformative visions of openness and sharing. This is increasingly changing. With respect to so-called rebound effects, transformative movements increasingly point to the enormous power consumption of Internet-capable endpoint devices and algorithm-based systems. Although the spread of ICT is forecast to reduce electricity consumption, this is relativized by the increase in cloud services, cloud working and the growing data volumes (Andrae and Edler, 2015; Lange and Santarius, 2018: 33ff.). In the path of transformation, the use of digital technologies continues to be highly controversial. Ecological sciences, but also activists and computer scientists are involved. In Germany, in recent years, such groups came together to discuss the relationship between digitalization and sustainability and to find alternatives. Here, not only the sustainable use of ICT, but also sustainable hardware and software are central to the discussion (Höfner et al., 2019).

Thirdly, while digital technologies continue to be discussed very critically in the trajectory of transformation, Big Data and algorithm-based processes have recently fueled imaginations of sustainability as control, namely, by opening new possibilities for monitoring environmental changes and weather events and thus making climate change and its impacts more predictable. However, some problems arise with respect to such data-focused environmental policy, which are similar to those that have already being discussed for other areas of society (for example, the surveillance of individual activities as a basis for economic operations). For one thing, large, international tech companies are substantially involved here as well, a fact that, as in the case of sustainability as transformation, raises the question whether these powerful economic, social, and cultural actors should play such important roles in environmental policy. Although most of the visions and imaginations of sustainability as control have not yet been realized, such as Stefano Boeri’s Smart Forest City in Mexico (Grustat, 2019), the consequences can be assessed by considering other areas where Big Data and algorithms have already had effects. Thus, it should be acknowledged that an increasing monitoring of biodiversity or tree population, for example, may also give legitimacy to efforts of controlling other effects of climate change, not least migration (Rolnick et al., 2019). In addition, better predictions of environmental incidents and changes – relating to weather events or soil nutrient
content for instance – can offer new profit opportunities and competitive advantages to ‘old big players’. For example, a small project that was able to forecast fertilizer prices by means of open data from data.gov was bought by Monsanto, an internationally active biotech company. As I have already observed concerning smart city concepts, digital technologies do not always lead to a solution for social problems, but rather to the emergence of new management concepts and profit opportunities (Kitchin, 2014b; Söderström et al., 2014).

If Big Data one day becomes as widely available in the areas of health and lifestyle as it already is for the effects of climate change, this could also have a negative impact on the societal level, for example by fueling the emergence of an ‘evaluation society’. Screening, scorings and rankings are becoming more and more decisive for individual life chances, social positioning, or how we are perceived and treated by others (Mau, 2019: 63). As mentioned before, it appears that Big Data’s analyses are not guided by theory, but merely recognize patterns in an exorbitant amount of data, which makes it crucial to at least consider the consequences of recombining different data sources and formats, for example. In the context of the coronavirus pandemic, the links between public health and the destruction of natural habitats have become more apparent. In particular, the recombination of personal health data, possibly geospatial data, with data on biodiversity loss could exacerbate existing inequalities. In this ‘new economy of moral judgments’ (Fourcade and Healy, 2017), it would be possible to classify individuals and groups according to how their consumption and health behavior contribute to or prevent climate change. With the so-called ‘social scoring system’, the Chinese government is already pursuing the goal of encouraging desired behavior and avoiding negative behavior by awarding and withdrawing ‘points’ (Botsman, 2017; Creemers, 2016).

This analysis has shown that the discourses around digital technologies strongly depend on the underlying normative assumptions of sustainability that might subsequently legitimize or delegitimize varying practices. Future research should therefore address how digitalization and sustainability are not only discursively mediated or criticized, but also how they are implemented at the level of practical and political actions. It should be asked how the relationship between digital technological progress and ecological sustainability will continue to level off. Ultimately, how digitalization is used for sustainability or, conversely, where ecological sustainability is neglected in favor of digital-technological progress will also depend on politics. In the context of the current sanitary crisis, there is a focus, at the moment at least, on the importance of digital technologies for maintaining normality, while environmental aspects are fading into the background, at least in the media. Nevertheless, digital technologies are being discussed so that they can have a decisive influence on the design and implementation of sustainability. The use of AI for climate protection, for example, could also change the perception and evaluation of sustainability. Here, the focus should also be on the everyday practice of people who themselves critically and reflexively engage with these discourses. Further research can make a significant contribution to the theoretical conceptualization of digitalization against the backdrop of sustainability, by avoiding the risk of merely comparing claims with reality and highlighting instead the social mechanisms of its mediation.
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