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# Environmental Innovation and Societal Transitions

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## On digitalization and sustainability transitions

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Digitalization is now ubiquitous across society. Large parts of the world's population use multiple Internet applications every day. Digital technology is further expanding into food production ('precision farming'), electricity ('smart grids'), housing ('smart homes'), healthcare ('health apps'), mobility ('smart mobility'), peer-to-peer services ('sharing economy') and banking ('online payments'). Against this background, European politicians have recently embraced the notion of a 'green digital transformation' based on the widespread use of digital technologies (Ministerial Declaration, 2021).

Rather than fostering sustainable innovation, digitalization may equally consolidate incumbents' power and unsustainable practices. Oil and gas incumbents, for instance, use digital technologies to achieve fuel efficiency and CO<sub>2</sub> reductions to claim that their oil is 'green' while continuing their unsustainable business model (Mäkitie et al., 2020). In food production, digitalization may well augment the power of food incumbents due to tighter integration of value chains (Clapp, 2021). In peer-to-peer services, the emergence of taxi and delivery apps has led to more congestion, fatalities, and substitution away from public transport (Barríos et al., 2020). What is more, sustainability scholars raised concerns about the energy and rare material use, and the rebound effects, of digital technologies (Berkhout and Hertin, 2004; Hilty and Aebischer, 2015). The prediction that digital technologies will account for 20 percent of total electricity use in 2030 (Jones, 2018) poses a huge challenge to render the digital transformation also a sustainable one.

Despite all these concerns, transition scholars devote surprisingly little attention to digitalization. Scopus (10 September 2021) contains only 21 records with title words at the nexus between transition, sustainability and digitalization (Fig. 1).

Given the relative lack of research from a transitions perspective, we call for theoretical and empirical work on digitalization in the context of sustainability transitions. We list a number of topics and questions.

As digital technology figures so prominently in people's lives, it is bound to affect social practices and consumption behaviors. Indeed, companies often use digitalization in their innovation strategy to enhance the 'convenience' of consumption and daily life, promoting smart devices and instant delivery services. This begs the question to what extent digitalization transforms social practices in a direction that yields sustainability effects, and how digital technologies can be employed to support sufficiency lifestyles with low carbon footprints. Digital technologies also foster remote working, a trend accelerated by the Corona pandemic. It remains unclear

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whether the immediate sustainability benefits arising from remote working may be more than offset as people consume more energy at home and start to live farther from their workplace (Rietveld, 2011).

Citizens and entrepreneurs also employ digital technologies in innovative new ways. One specific example is the use of block-chain technology to enable peer-to-peer electricity trading which bypasses the traditional centralized system dominated by electricity utilities and distributors. Other applications of digital technologies can be found in shared mobility, local food platform, and voluntary work (Frenken and Schor, 2017; Kolk and Ciulli, 2020), as well as cooperatives that integrate sustainability values into their operations (Foramitti et al., 2020; Vaskelainen and Münzel, 2018). We need to understand further the processes of niche creation that builds on digital technologies, and the ways such initiatives can be scaled up across communities and national boundaries.

Another focus in future research may lie on 'Big Tech' (Alibaba, Apple, Amazon, Facebook, Google, Microsoft, and Tencent) whose market valuations are measured in trillions of dollars. The market success of these digital incumbents lies not only in the specific digital technologies they deploy, but also in self-regulatory regime capacities to unilaterally impose 'terms and conditions' onto their users (Van Dijck et al., 2018). With AI technologies, they leverage the big data they generate for prediction purposes, ranging from targeted advertising and speech recognition to disease diagnosis and self-driving cars. A responsible innovation perspective could scrutinize the sustainability of digital platforms and AI across domains (Rijswijk et al., 2021), including energy use (Jones, 2018), ecosystem risks (Galaz and Centeno, 2021), ethical biases (Crawford, 2021), and loss of democratic control (Van Dijck et al., 2018).

A recent development especially relevant for transition scholars is the expansion of platform companies into the energy, mobility, food, banking, education, and healthcare sectors. Google entered the electricity and mobility market with smart technologies. Amazon is becoming a giant in logistics. Apple and Google developed healthcare apps for activity tracking and self-diagnosis. Facebook aims to revolutionize banking with its own currency. These companies can leverage their resources to overcome entry barriers in other socio-technical systems, which can lead to the disruption of entrenched regimes. From a multi-system perspective (Andersen et al., 2020; Rosenbloom, 2020), one can analyze the entry of Big Tech in other domains as a co-evolutionary process with many contingencies and possible pushbacks.

In sum, digitalization will have profound effects on energy, materials and ecosystems, resulting from digital consumer products and the use of digital technology in food, energy, healthcare and mobility. It is unclear whether the increased electricity and rare material use due to digitalization will be compensated by efficiency gains and sustainable behaviors fostered by digital innovations. Currently, digital companies remain firmly rooted in a corporate logic of maximizing monopolistic rents rather than promoting sustainability, decent work, and user involvement. Moreover, the alleged sustainability benefits of digital technologies may turn out to be ill-founded, as rebound and adverse secondary effects may be substantial. Digitalization, then, might be at odds with a just transition to sustainability unless the digital regime is re-oriented towards inclusive practices, democratic governance and environmental regulation.

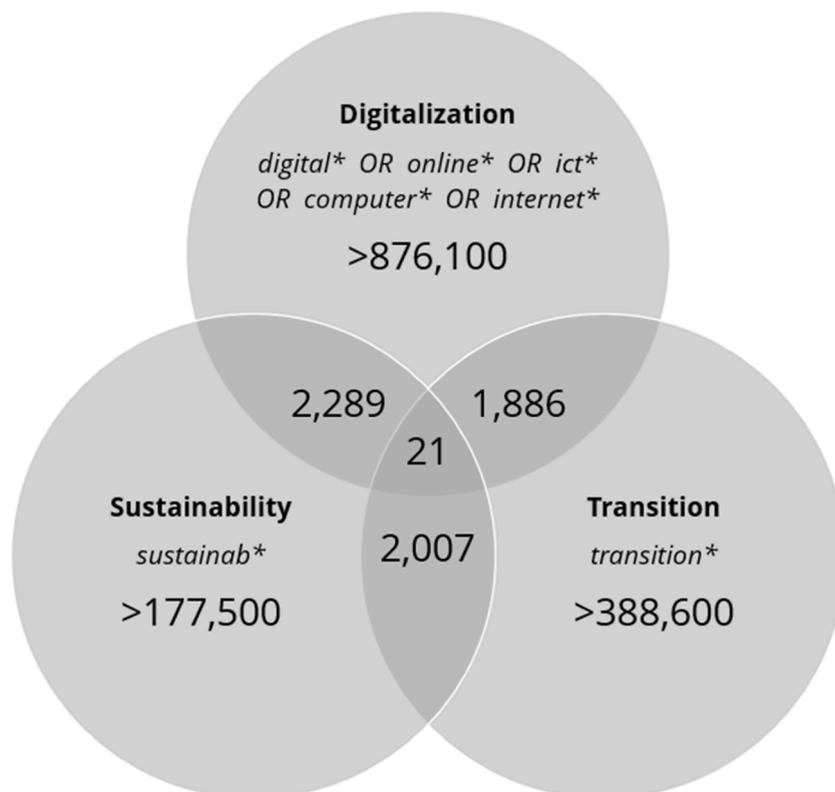


Fig. 1. Number of articles at the nexus between transition, sustainability and digitalization (Scopus, 10 September 2021).

The key question for transition research, then, holds which new digital technologies may help to speed up sustainability transitions and what institutions are required to foster such innovations. To answer these questions, we need engaged scholarship with designers, entrepreneurs, NGOs, unions, consumers, and governments. Equally, we may have to move beyond the dominant frameworks in the transition field by opening up to other disciplines such as information systems research, media studies and digital sociology as well as to new approaches including degrowth, responsible innovation, and multi-system analysis.

### Declaration of Competing Interest

I hereby declare, also on behalf of co-authors, that we have no conflict of interest in writhing the submitted paper.

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