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Digitalisation and the UN Sustainable development Goals: What role for design

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Abstract. This paper investigates the relation between digitalisation and the Sustainable Development Goals (SDGs). Digitalisation is often presented as a transformative power, changing the way we live and work. The SDGs describe digitalisation technologies such as ICTs as enablers of sustainable development. The unsustainability of these technologies themselves may actually undermine the gains made in digitalisation. This becomes clear when we locate the discussion of digitalisation and the SDGs in a discussion of the Planetary Boundaries framework. The example of one of the most emblematic digital technologies of our time, the smartphone, shows the negative impact of its production and consumption on the biosphere, the basis for all life on our planet, and on many of the social aspects of the SDGs, such as poverty, child labour, decent work, and peace. But rather than promoting sustainable digitalisation, this paper proposes the notion of sustainment as a foundational principle for the sustainability of digitalisation. While sustainability has become a mean to an end, sustainment is about sustaining life itself. With sustainment, digitalisation and its design can strengthen our ability to respond to the challenges of living on a finite planet.

Keywords: Digital economy, ICTs, Planetary boundaries, Regeneration, Smartphone, Sustainable design, Sustainability, Sustainment, Transition.

1 Introduction

The notion of digitalisation covers the use of digital information and communication technologies, including the interconnectivity and networking of these technologies. Digitalisation differs from digitisation; the latter refers to the process of making something digital. Digitalisation is then about the processing and networking of what has become digital data. Big data, artificial intelligence (AI), platform technologies, crypto-currencies, blockchain technology, Internet of Things (IoT), and 3D and 4D printing are some of the technologies associated with digitalisation.

Digitalisation is often used in the context of the digital economy. While both terms, are not new, e.g., [1], they are increasingly used in the literature as a result of new services, new business models, industry 4.0, etc. [2–5]. The term digitalisation is also used in a broader sense, such as in "digital public sector" or e-Government [6].

This paper is concerned with the role of digitalisation in sustainable development.[1] Digitalisation is not necessarily sustainable. As will be discussed in this paper, the

[1] The discussion on ICTs and the Sustainable Development Goals (Section 2 and Table 1 and 2) is published in an earlier version of this paper, which has been presented at 13th IFIP TC9 International Conference on Human Choice and Computers, Poznan, Poland, 19 – 21 September, 2018 [7].

unsustainability of the technologies that enable digitalisation may also undermine claims made about the positive role of digitalisation for sustainable development. While the popular and policy literature highlights the transformative nature of digitalisation, e.g., [8–12], it is still a question how, when, and where digitalisation can contribute to sustainability.

In this paper, sustainability is defined as *securing the social foundation for people everywhere now and in the future, while staying within planetary boundaries*. This is the definition used in the Sustainable Market Actors for Responsible Trade (SMART) project.[2] In SMART, we study the barriers and drivers for the contribution of market actors (companies, public procurers, consumers) to the UN Sustainable Development Goals (SDGs), with the aim of achieving policy coherence for development. The mobile phone is one of our two research case studies.

This paper will look closer to the role of digitalisation technology as a barrier to or driver for sustainable development. In the next section, I will explore the SDGs in order to find out how they describe the relation between digitalisation and sustainability.[3] In section three, I will situate the discussion of the SDGs in the Planetary Boundaries framework [14, 15], which identifies the "critical, interacting processes on Earth that contribute to the stability and resilience of the Earth system as a whole" [16]. A new illustration of the SDGs by the Stockholm Resilience Centre, showing the centrality of the biosphere to all life on the planet, visualises the importance of the SDG framework to engage with the environmental sustainability of digitalisation technologies.

In section four, I will present an example of one of the emblematic technologies of digitalisation, the smartphone. Research shows that the smartphone has a significant impact on the biosphere, the global ecological system integrating all living beings and their relationships [17]. This case in particular indicates that the unsustainability of digitalisation may undermine the gains of digitalisation. Secondly, this unsustainability is often externalised, contributing to social and environmental unsustainability in low-income countries and regions; the same ones that are often presented as the main beneficiaries of sustainable development.

Section five addresses the question if the SDGs will result in a sustainable smartphone. The example of the Fairphone, considered the most ethical mobile phone on the market, shows that it is not just about having less impact on people and planet, but about taking responsibility for what we design. In section six, the notion of sustainment is discussed in the context of digitalisation and design. Not sustainable design, but design as sustainment should inform design approaches. Digital sustainment thus becomes about digitalisation and its technologies that generate life and can regenerate the planet.

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[2] Sustainable Market Actors for Responsible Trade (SMART) is a Horizon2020-financed research project based at the University of Oslo, see https://www.smart.uio.no/

[3] The SDGs don't mention the term digitalisation, but refer to Information and Communication Technology (ICTs). The SDGs were published in 2015, just before the term digitalisation received new impetus, with the widespread application of blockchain technology, cryptocurrency, AI, etc. A quick search on the scholarly site scopus.com showed that the number of academic publications with the term digitalisation or digitalization, increased from on average 28 titles to 101 titles in 2016 and 204 titles in 2017. The SDGs and their preamble and declaration only use the term digital, and then only once, to refer to the digital divide [13].

2 The Sustainable Development Goals

“Transforming our world: the 2030 Agenda for Sustainable Development” is the United Nations agenda for sustainable development. Adopted in 2015 by the UN General Assembly, it consists of a Declaration and a set of Sustainable Development Goals (SDGs). The Declaration refers to the contribution of ICT to sustainable development: “The spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies […]” [13].

Fig. 1. United Nations Sustainable Development Goals

The SDGs are a collection of 17 goals (see Fig. 1), with 169 associated targets and 304 indicators [13]. The SDGs are perceived as global and universal, promoting sustainable development in all countries. Its definition of sustainable development is based on the Brundtland report from 1987: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [18].

ICTs are specifically mentioned in SDGs 4, 5, 9, and 17 (see Table 1). SDG 4 addresses quality education, which, according to target 4b, includes training in the use of ICTs. SDG 5 is about gender equality and target 5b mentions ICTs as an enabling technology for women’s empowerment. SDG 9 is about industry, innovation, and infrastructure, and in target 9c, access to ICTs and affordable Internet access are seen as enabling this goal. SDG 17 is about partnerships for the SDGs and target 17.8 is about enhancing the use of enabling technologies, in particular ICTs.

Table 1. ICT and the Sustainable Development Goals

Goal	Targets and Indicators
SDG 4. Quality Education: *Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*	*Target 4.b.* By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and **information and communications technology**, technical, engineering and scientific programmes, in developed countries and other developing countries *Indicator 4.4.1.* Proportion of youth and adults with **information and communications technology (ICT)** skills, by type of skill
SDG 5. Gender Equality: *Achieve gender equality and empower all women and girls*	*Target 5.b.* Enhance the use of enabling technology, in particular **information and communications technology**, to promote the empowerment of women
SDG 9. Industry, Innovation, and Infrastructure: *Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*	*Target 9.c.* Significantly increase access to information and communications technology and strive to provide universal and affordable **access to the Internet** in least developed countries by 2020
SDG 17. Partnerships for the Goals: *Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development*	*Target 17.8.* Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular **information and communication technology**

The four SDGs that specifically mention ICTs stress the enabling and empowering role of ICTs. ICTs are presented as universal technology for sustainable development. There is no mentioning of the technologies themselves in terms of the sustainability of their life cycle, i.e., the resources used to produce the ICTs, the manufacturing, transport, and use of ICTs, and lastly, the end-of-life of ICTs, when they are no longer in use. For example, in 2015, ICTs formed 18% of all merchandise imports in the world [19]. More concretely, from 2012 – 2017, more than 7 billion mobile phones were sold worldwide and in 2018, another 1.5 billion mobile phones will be sold [20]. On this scale, the sustainability of the production and consumption of ICTs is an important challenge to sustainable development.

The SDGs address the need for sustainable ICT indirectly, in SDG 8 and 12 (see Table 2). SDG 8, about decent work and economic growth, mentions global resource efficiency in consumption and production as part of the effort to decouple economic growth from environmental degradation. This aspect of the SDGs has received the most critique, as decoupling assumes the possibility of economic growth without environmental degradation, e.g., [21, 22]. SDG 12 is about sustainable production and consumption, but the overall economic paradigm is based on the idea that "net welfare gains from economic activities can increase by reducing resource use, degradation and pollution along the whole life cycle, while increasing quality of life" [13]. This is another way of describing decoupling. For example, 3D printing is presented as one of the technologies that promises sustainable production through reduced resource use and thus "contains the (theoretical) potential to absolutely decouple energy and CO_2 emission from economic activity" [23].

Table 2. Sustainability of ICT

Goal	Target
SDG 8. Decent Work and Economic Growth: *Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*	*Target 8.4.* Improve progressively, through 2030, **global resource efficiency in consumption and production** and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead.
SDG 12. Responsible consumption and production:	*Target 12.2.* By 2030, achieve the **sustainable management and efficient use of natural resources**
	Target 12.4. By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly **reduce their release to air, water and soil** in order to minimize their adverse impacts on human health and the environment.
	Target 12.5. By 2030, substantially **reduce waste generation** through prevention, reduction, recycling and reuse

While the SDGs are presented as an holistic framework, the practical implementation can result in some SDGs constraining or cancelling out the positive impacts of others [24]. The SDGs are also less clear when it comes to environmental sustainability [25, 26]. Raworth notes:

> *Some are absolute and time-bound: end overfishing and halt deforestation by 2020. But two key ambitions – to halt biodiversity loss and combat climate change – lack target dates. And for others, the measure of success is unclear. What would it mean to 'significantly reduce' nutrient pollution by 2025? To 'minimize the release of' hazardous chemicals by 2030? Or to 'minimize the impacts of' ocean acidification (by no set date)?* [25].

While the SDGs are based on the understanding that the survival of the biological support systems of the planet is at risk, they don't explore the consequences of the fact that we live on a finite planet. The SDGs thus lack a planetary-wide framework that can guide human activity towards sustainable development. In the next section, the Planetary Boundaries framework is presented as providing the scaffolding needed for the implementation of the Sustainable Development Goals.

3 The Planetary Boundaries Framework

The Planetary Boundaries framework [14, 15] identifies the "the critical, interacting processes on Earth that contribute to the stability and resilience of the Earth system as a whole" [16]. The nine processes were identified by a group of 29 scholars, under leadership of Johan Rockström of the Stockholm Resilience Centre [14] and research is on-going, e.g., [15].

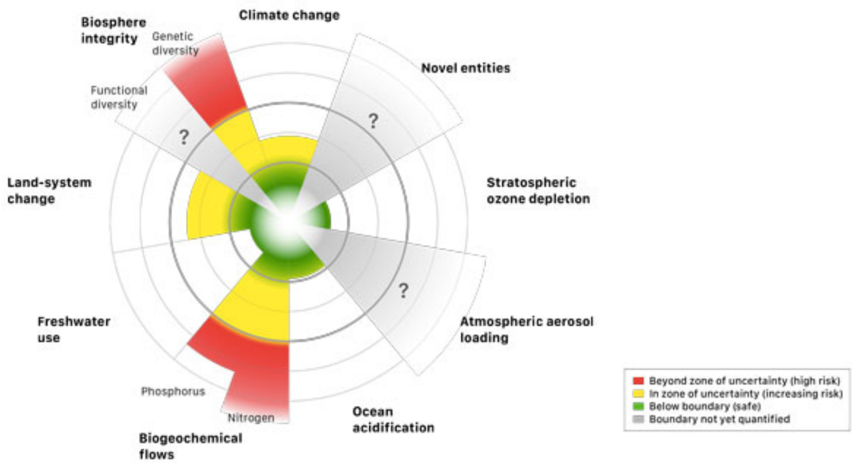

Fig. 2. Planetary Boundaries [27]

The framework is developed around the understanding that we live on a finite planet, and consists of an integrated system of processes that make up the nine planetary boundaries (PBs): Climate change, Novel entities, Stratospheric ozone depletion, Atmospheric aerosol loading, Ocean acidification, Biochemical flows (phosphorous and nitrogen), Freshwater use, Land-system change, and Biosphere integrity. At the moment, four of the PBs have overshot their boundary (see Fig. 2). The area in green presents the "safe operating space for humanity" [14].

Of the nine planetary boundaries, *climate change* is the most mentioned in the SDG framework and is the topic of SDG 13: Take urgent action to combat climate change and its impacts. SDG 13 has, however, no targets, even though climate change is one of the processes that has crossed its boundary.

In order to visualise the centrality of planetary processes to life on our planet, Folke et al. [28] reorganised the SDGs from a linear to a 'wedding cake' perspective (see Fig. 3).

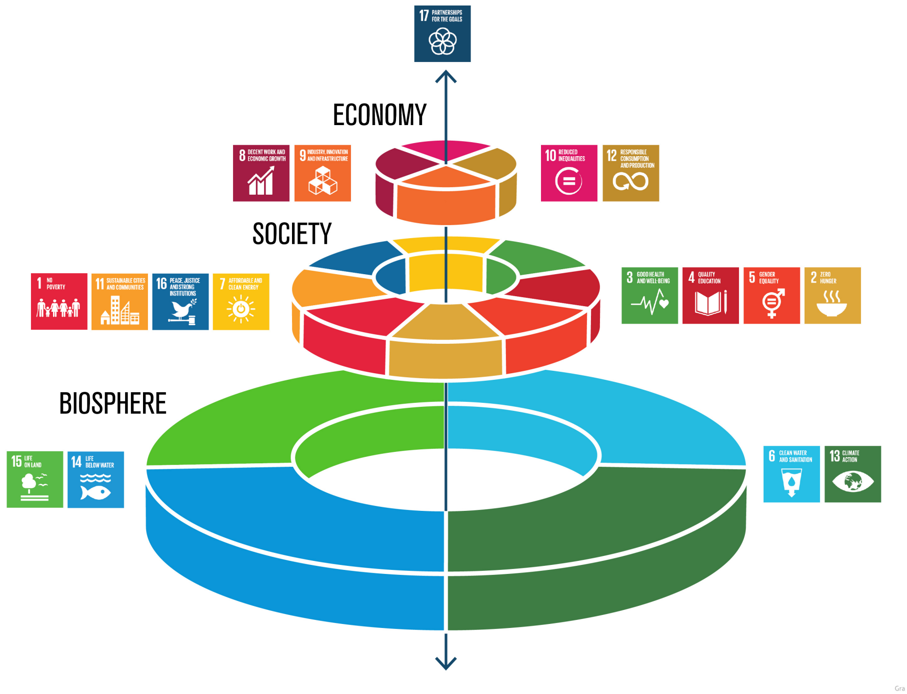

Fig. 3. Credit: Azote Images for Stockholm Resilience Centre

This perspective makes clear that digitalisation and its technologies may contribute to sustainable development, if they take place within the safe operating place for humanity. In other words, in order to be sustainable, digitalisation needs, in addition to enabling SDGs of the societal and economic spheres, also enable the SDGs of the biosphere. As discussed in the previous section, ICTs are only explicitly mentioned as enabling technologies in SDGs 4,5, 9, and 17.

4 A Sustainable Smartphone?

The smartphone is one of the emblematic technologies of digitalisation, but at the same time it is one of the most unsustainable digitalisation technologies. The smartphone has contributed significantly to achievements in the social and economic sphere. It enabled improved access to information, more reliable communication, effective data collection in rural healthcare; it facilitated banking in remote areas, and much more. In the SMART project, we investigated the sustainability impacts in the life cycle of mobile phones. This study was limited to the social and environmental risks in the different phases of the mobile phone life cycle: extraction of its resources, manufacturing, transport, use, and end-of-life. We found significant impacts, so-called hotspots, in three of the phases: resource extraction, manufacturing, and end-of-life, affecting all nine planetary boundaries [29]. The lack of decent work, child labour, health risks, exposure to hazardous materials, unsafe work, food chain pollution, etc. showed that the lack of sustainable production and consumption of mobile phones affects workers, children, and communities in relation to all SDGs.

The unsustainability of the mobile phone is most often externalised, that is, the costs of this unsustainability is not incorporated in the pricing structure of the mobile phone. That is because important and major parts of the resource extraction, manufacturing, and end-of-life phases of the mobile phone take place in low income countries and/or in countries with weak regulation when it comes to human rights, labour rights, and environmental protection. Countries such as Ghana, DRC Kongo, Indonesia, are known for unsustainable resource extraction, resulting in child labour, slave labour, unsafe work, foodchain pollution, environmental degradation, etc. [29–34]. The manufacturing of mobile phones takes mainly place in low-income countries in Asia, where labour rights and environmental protection are weak, such as Vietnam, Indonesia, Taiwan, and China [35–38]. Many used mobile phones from high income countries are sold to low income countries, where they stay after they are discarded. These countries lack electronic waste regulation and/or sustainable electronic waste recycling facilities, e.g. Nigeria, China, and Ghana [39–45].

While people and communities in low-income countries and regions carry most of these costs, they are also perceived as the main beneficiaries of sustainable development. The lack of policy coherence plays a major role in the continuation of these practices. For example, in the case of toxic materials, corporations fulfil all requirements, so they can sell smartphones on the strictly regulated European market; but they continue the use of toxic materials in resource extraction and production processes in countries without strict regulation of the use of hazardous materials.

When it comes to toxicity in the mobile phone life cycle, important changes have taken place. Most major brands stopped the use of particular toxins in their phones, such as PVC, brominated flame retardants, and phthalates. At the same time, a 2018 report by the United Nations Human Rights Council estimates that one worker dies every 15 seconds from toxic exposure at work [46]. Several of the cases mentioned in the report are related to the mobile phone life cycle, such as children mining cobalt for use in mobile phone batteries in DR Congo, women using mercury in artisan gold mining, and workers in the electronics manufacturing industry [47].

A rather 'invisible' impact of smartphone use is energy consumption. Digitalisation creates increasing interconnectivity and networking of data produced by smartphones. The communication and storage of data, often on multiple sites in the cloud, is increasing exponentially. The amount of data in the world is almost doubling every year [48, 49]. While the energy efficiency and use of renewable energy of networks and data centres is increasing, e.g. the Open Compute Centre initiative [50] and national initiatives, such as the Green Data Center Platform in the Netherlands [51], the question is if these energy gains are cancelled out by the increase in data production. A report on data centres by environmental organisation Greenpeace [52] mentions that "[w]hile important progress has been made in driving renewable energy investment in several markets, the dramatic increase in the number of data centres in markets such as Virginia, dominated by utilities that have little to no renewable energy, is driving a similarly dramatic increase in the consumption of coal and natural gas". The report also mentions that East-Asian Internet giants, such as Alibaba and Baidu, are looking into expanding globally, but lack access to renewable energy resources.

Although the global production and consumption of phones is flattening out, each year more than 1.5 billion phones entered the market [20]. For example, in Norway, a country of five million people and a mobile phone density of 97% (ages between 16 and 65), two million new mobile phones were sold in 2016 and again 1.9 million in 2017 [53]. Increasing production, even of more sustainable mobile phones, puts even more pressure on natural resources and puts more workers at risks. We are also still far away from the sustainable recycling of considerable amounts of mobile phones. In terms of sustainability, the challenge thus becomes one of longevity: how to do more, and longer, with the phones we already have. Repair, maintenance, and care are in this context the first choice in the range of options for a sustainable mobile phone life cycle [54–57].

5 Another Design is Possible

Will the SDGs result in a sustainable mobile phone life cycle? There are several causes for the short lifespan of mobile phones, in particular smartphones. Recently, large smartphone producers, such as Apple and Samsung, have introduced schemes to promote trade-in or trade-up of their smartphone for the latest model. National mobile phone services providers offer similar schemes, enabling consumers to trade-in their smartphone every year. Limited warranty and lack of consumer rights, combined with a smartphone design that make repairs difficult and expensive, also encourages a fast turnover of mobile phones.

Design plays a central role in the lifespan of mobile phones. Designed obsolescence is still a common characteristic of the mobile phone industry. By, for example, discontinuing software upgrades for older models, they can no longer be used or their batteries start slowing down the phone [58]. Most smartphones have batteries that can't be replaced easily by the owner. The increased use of glue is a feature that hinders the repair of smartphones, because it impedes the easy opening of smartphones or the replacement of glued batteries [59].

Several design approaches have been presented to address unsustainability in the mobile phone life cycle, such as design for the environment, design for recycling, sustainable design, and eco-design. After more than three decades of discussing and promoting sustainability in digital technologies, we have now arrived at a stage in which replacing or trading up, rather than repair and maintenance, have become the standard rationality in the design and use of mobile phones and other digital technologies. Rather than dematerialisation, the use of less materials and less energy in digital technologies, we use more [60]. Thus, while the weight and size of a mobile phone has been reduced remarkably, its material footprint has not. The average material footprint of a smartphone is 70 kilo, of which two-thirds is found in the resource extraction phase [61]. The average smartphone consists of 70 different materials, each with their own extraction and production processes using energy and producing waste [62, 63]

Is another design possible? The Fairphone is often mentioned in discussions of a more ethical or sustainable mobile phone design, e.g., [64–67]. Fairphone claims it sources raw materials and manufactures its phone in an ethical manner; its design is focused on longevity and transparency; it offers a 5-year warranty, which enables the owner to repair the phone by offering spare parts and repair manuals online; and it uses recycled materials from old mobile phones [68–71]. The battery and the screen of the Fairphone 2 can be replaced without the use of tools [72].

The Fairphone website gives an overview of how Fairphone addresses the social and environmental risks in the mobile phone life cycle [73–75]. They engage directly with the involved communities and workers on the ground (e.g., in mining areas, at manufacturing locations, at informal recycling sites, etc.)[4]. The case of Fairphone

[4] In September 2017, I followed two representatives of Fairphone during their visit to Ghana, where they met with informal recyclers in Abogbloshie, mobile phone repairers at the Circle, discarded mobile phone collectors in two villages, and a visit to the Environmental Protection Agency. Fairphone's aim was to facilitate the export of discarded mobile phones in Ghana to a recycling facility in Europe.

exemplifies that such an ethical perspective on design includes responding to the different challenges and tensions of living on a finite planet; it includes engaging with the humans and nonhumans involved or affected by the designed. Fairphone's statement "You shouldn't have to choose between a great phone and a fair supply chain" [76] exemplifies this responsibility of both the designer/producer and the consumer.

Design as the ability to sustain life on our finite planet is something different than sustainable design. Designer and design philosopher Tony Fry argued that sustainability is about "reforming business as usual". Sustainability has thus become about less impact, often in a fragment and inconsistent manner, rather than a systemic understanding and approach to sustaining life on a finite planet. Fry thus calls for a Sustainment as "overcoming business as usual" and as overcoming the "dominance of defuturing" [77, 78]. What if we take sustainment as the foundational principle for our thinking and doing in digitalisation and design.

6 Digital Sustainment

Two lines of investigation can be found in the growing body of literature addressing sustainable digitalisation[5]: digitalisation for sustainability and the sustainability of digitalisation processes. This paper has focused on the first line of inquiry and argued that digitalisation for sustainability fails to address the sustainability of digitalisation technologies.

Research on the sustainability of the digitalisation processes may be another venue in which the discussion on the sustainability of digitalisation technologies could take place. However, this line of inquiry focuses, amongst others, on the interoperability and long-term maintenance of digital systems [79, 80], the importance of openness, in terms of maximising access through open access, open content, open data, and open source hardware and software [81], the longevity of the digital data [82] or the governance strategies for sustainable digitalisation [83]. In a literature review of sustainability in eGovernment research, Larsson and Grönlund [84] found that the sustainability of the eGov project itself was one of the most important themes. Also this literature doesn't address the sustainability of the technologies used in the digitalisation processes.

How to overcome "business as usual", in which digitalisation can be discussed within the context of sustainability, but without the need to address the sustainability of its own technologies? The case of the mobile phone shows that design, both of the material aspects of the phone (form) and of its ecosystem (services), plays a central role in the social and environmental impacts found in its life cycle. We are not anywhere close to sustainable mobile phones; the Fairphone 2, the most ethical mobile phone available, is not yet able to prevent its impact on the biosphere [29].

How to overcome "the assumption that sustainability means less" [85] and the idea that Sustainable Design can help to restore the biosphere, rather than to destroy it [86]? With sustainability becoming a buzzword that can be put in front or behind every possible occasion [87], we need to go back to the root meaning of the world. With Fry's notion of sustainment, the biosphere becomes central to any human undertaking in the design and application of digital technologies (see Fig. 3). Rather than the sustainable design of mobile phones or sustainable digitalisation, we should start with considering what sustains life. With the overwhelming evidence of overshooting the planetary boundaries (see Fig. 2) and the overshoot of the planet's

[5] In the literature, both sustainable digitalisation and digital sustainability are used to describe the relation between digitalisation and sustainability.

annual resources to sustain life – World Overshoot Day[6] fell in 2018 on the first of August [88] – this cannot be dismissed as an utopian position, but as a necessity.

Design as sustainment is a central characteristic for design approaches such as Design for Sustainment [89], Cradle to Cradle Design [90], Regenerative Design [91], and Transition Design [92, 93]. These approaches address unsustainability as a structural problem of how we make and use things and propose to do more with the things we already have, through maintenance, repair, refurbishment, and redesign; and to upcycle [94], rather than recycle, the things we no longer use.

Similarly, we can talk about digitalisation as sustainment, the contribution of digitalisation to strengthen the sustainment of life on our finite planet. This means that digitalisation should be generative in order to contribute to development that sustains life; digitalisation as an accelerator in the effort to regenerate the biosphere, the social sphere, and the economic sphere (see Fig. 3)[7]. Digitalisation can contribute to doing more with things we already have, for example, through its role in the sharing economy, e.g., community-based cooperative platforms.[8]

7 Concluding Remarks

The discussion of digitalisation and the Sustainable Development Goals showed that digital technologies are understood as enabling and transformative in the strive towards sustainable development. The underlying assumption is that a decoupling between economic growth and environmental degradation is possible. At the same time, we see an overshoot in four of the planetary boundaries. Figures 2 and 3 visualise the vulnerability and centrality of the biosphere, the basis for all life on earth.

Situated within the Planetary Boundaries framework, it became clear that the gains of digitalisation for sustainable development can be undermined by the negative impact digitalisation can have on the biosphere, as well as on the bodies and livelihoods of people and communities involved in the resource extraction, production and end-of-life of digitalisation technologies. These impacts are often externalised, invisible for the majority of technology consumers in high-income countries, as well as absent from the pricing structure of these technologies. Lack of policy coherence and regulation facilitates the continuation of these practices.

The example of the smartphone, and the ensuing discussion of the role of design, shows that the past thirty years of sustainable design has not brought the necessary changes needed to sustain life on our finite planet. However, the example of the Fairphone 2 showed that when designers engage directly with the workers, communities, and environments that may be affected by their design, another design becomes possible.

There are no sustainable *solutions* to the enormous social and environmental challenges described in the SDGs and the Planetary Boundaries framework. To address these challenges, digitalisation and its designs, technologies, and services have to transform from minimising its negative impacts to generating life and regenerating the planet.

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[6] The World Overshoot Day 2018 is based on data from 2014. Country Overshoot Daya data can be found at https://www.overshootday.org/newsroom/country-overshoot-days/ A country's overshoot day is the date on which Earth Overshoot Day would fall if all of humanity consumed like the people in this country.

[7] Regeneration is understood here as the process of healing, renewing, restoring, and growth of biological organisms (incl. human) as well as social (sociomaterial) and economic structures and artefacts, such as communities, work, and design.

[8] See https://platform.coop/about

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