6-18-2022

It's a Big Question – Researchers' Discourses on Sustainable Technology Development and Use

Fanny Vainionpää
University of Oulu, fanny.vainionpaa@oulu.fi

Marianne Kinnula
University of Oulu, marianne.kinnula@oulu.fi

IT'S A BIG QUESTION – RESEARCHERS' DISCOURSES ON SUSTAINABLE TECHNOLOGY DEVELOPMENT AND USE

Research Paper

Fanny Vainionpää, University of Oulu, Oulu, Finland, fanny.vainionpaa@oulu.fi

Marianne Kinnula, University of Oulu, Oulu, Finland, marianne.kinnula@oulu.fi

Abstract

Sustainability is a major theme in today's discourses across disciplines, including Information Systems (IS). Creating a more sustainable world is considered an interdisciplinary effort and IS an inherently interdisciplinary field. Working with complex problems benefits from deeper disciplinary understanding than can be obtained by researchers operating within one field. We interviewed 30 researchers from different fields on sustainable technology development and use, analysing their discourses and reflecting those with the Quintuple Helix Innovation Model that aims for sustainable development of innovations. Our findings show power is woven into sustainability: education can empower us to make sustainable choices, politicians must be vigilant of developments in the industry to protect us as companies follow business interests, and we must all be conscious of the impact technology can have on us and our environments. We contribute with insights on the role of researchers in these discourses, and propose an IS research agenda.

Keywords: Sustainability, Discourse analysis, Researchers, Technology development, Technology use, Quintuple helix innovation model.

1 Introduction

Since the 2030 Agenda for Sustainable Development[1] was adopted by all countries of United Nations in 2015, the call for all researchers to consider how to create a better world for all of us is even stronger than before. The Information Systems (IS) community has reacted to the call by establishing the AIS Sustainability Task Force in 2019 (see e.g. Watson et al., 2021), and by accumulating research on how IS can answer the call for a more sustainable future long before that (Chasin, 2014). In this study, we focus on sustainability of technology itself – what does it mean when we develop and use technology in a sustainable way, which we argue is a central question for IS scholars to ponder. In line with the Brundtland Commission, we maintain that IS researchers should always consider whether their actions are sustainable in the sense that they meet "the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987).

Information and communication technology (ICT) solutions are envisioned by IS researchers to improve several types of sustainability. For example, Ziemba (2019) mentions the ecological aspects of sustainability (conserving the use of natural resources, avoiding pollution, and using renewable resources (Moldan et al., 2012)), aspects embedded in our socio-cultural environment, related to our shared practices and understanding of the world (Khan, 2016; Missimer et al., 2017), and economic aspects (using sustainable practices and models in the competition (Guillemette and Paré, 2012)). Technology has been identified by IS researchers as one of the established tools to help in tackling the climate change (Watson et al., 2021). It can also help in transforming societies to deliver more equal

[1] https://www.un.org/sustainabledevelopment/development-agenda/

and effective public services, such as healthcare and education; and it can help in getting better insight for the basis of decision making, thus opening the possibility for "making the right decisions and taking meaningful actions" (Watson et al., 2021). However, technology has been also seen as a source for further harm in environmental sustainability due to its resource needs (Watson et al., 2021).

IS can influence sustainability through developing and innovating new, sustainable technology (e.g. Corbett, 2013; Melville, 2010), which may for example guide sustainable consumption (Hilty and Aebischer, 2015). IS design can also consider human values (Winkler and Spiekermann, 2019), and how using IS can support collaboration in sustainability efforts (Elliot and Webster, 2017). The use of IS can influence behaviour to be more sustainable (Bengtsson and Ågerfalk, 2011), and business intelligence systems can support sustainable supply chain management practices (de Camargo Fiorini and Jabbour, 2017). Despite this variety of contexts for sustainability research in IS, it seems that the meaning of sustainability is still somewhat elusive and Watson et al. (2021) argue in their action agenda that IS researchers' concrete successful actions for more sustainable world are still scarce.

It has been widely acknowledged – also by IS researchers – that 'grand problems', such as creating a more sustainable society, need to be approached through multiple perspectives (Hovorka and Corbett, 2012). IS is already an interdisciplinary field and often studies topics situated in the crossroads of disciplines (Galliers, 2003; Merali and McKelvey, 2006), but we argue that working with complex problems requires deeper disciplinary understanding than can be obtained by researchers who operate within one field, i.e., IS. Thus, inspired by the United Nations Sustainable Development Goals (United Nations, 2015) and the action agenda that calls IS scholars to devote a portion of their time to study sustainability related topics (Watson et al. 2021), we wanted to explore what researchers in different fields think about sustainable technology development and use and what IS research can learn from that. As our research question we ask, "*What are researchers' discourses on sustainable technology development and use?*" To answer this question, we interviewed 30 researchers from various disciplines, and analysed their discourses on sustainability, reflecting them on the Quintuple Helix Innovation Model (Carayannis et al., 2012) as our analytical framework. Discourses have power to construct and shape our shared understanding of the world (Foucault 1998). Researchers are central actors in both building a new world as well as creating understanding of the current one, shaping their own research fields and as experts also having certain credibility and authority in public discussions. We think listening to researchers of different fields and understanding their discourses on sustainable technology development and use can strengthen the conscious working for sustainability, hopefully ending in a situation where sustainability is a natural part of research ethics.

Next, we discuss IS literature on sustainability and present our theoretical lens, the Quintuple Helix Innovation Model. Then, we present the research methods utilized in this study, followed by our findings. Finally, we discuss our results and their implications and present our related research agenda.

2 Background

2.1 Sustainability in Information Systems

A decade ago, Watson et al. (2012) wrote that the logic by which we organize companies or societies activities is moving from customer service dominant logic toward sustainability dominant logic. The argument has also been made that IS professionals should be concerned about sustainability because the field has contributed to an increase of productivity (Gholami et al., 2016), with various consequences. There has indeed been research interest and varying definitions of sustainability in IS (Chasin, 2014). Green IS is a prominent perspective, where IS is utilized for environmental objectives, involving implementation of IS, people, processes, software, and technologies (Dedrick, 2010; Watson et al., 2010; Ziemba, 2019). Environmental Informatics, Green ICT, and sustainable human-computer interaction (Hilty et al., 2011) are examples of approaches using ICT for sustainability. ICT solutions can improve energy efficiency of buildings, transportation, supply chains, etc., but manufacturing and use of ICT has a negative impact on energy consumption (Dedrick, 2010). We see both technology development and use as important perspectives in sustainability.

Technology development can affect sustainability for example through IS innovations (Hilty and Aebischer, 2015; Melville, 2010), and persuasive systems design (Corbett, 2013). In organizations, IS use can influence behaviour dictated by sustainability initiatives (Bengtsson and Ågerfalk, 2011), and sustainability efforts can be supported by IS enabling collaboration between businesses, governments, and societies (Elliot and Webster, 2017), or IS supporting innovations (Hanelt et al., 2017) and business intelligence management in organizations (de Camargo Fiorini and Jabbour, 2017; Petrini and Pozzebon, 2009). IS has also provided a sustainability framework (Dao et al., 2011) and a green response model (Hedman and Henningsson, 2016). Ultimately, ICT solutions have potential to change patterns of production and consumption, affecting sustainability broadly (Bieser and Hilty, 2018).

While energy consumption is often a central factor in sustainability discussions, the issues are societal and involve social, economic, political, and technical aspects (Ketter et al., 2016). There is a concept of social sustainability, which is difficult to define due to its subjective nature. It has been approached for example as a question of social acceptance of technology, i.e., related to sustainable use of technology (Assefa and Frostell, 2007). Moreover, in technology development, IS research has paid attention to human values in IS design (Winkler and Spiekermann, 2019), utilizing ISs for managing sustainable and socially responsible practices in organizations (Petrini and Pozzebon, 2009), and using technological solutions to address societal challenges related to inequalities in wealth distribution (Tim et al., 2021). Economic growth benefiting few people has been framed as social injustice and a sustainability issue (Saravanamuthu, 2002). As companies and academics develop new technology, it is interesting to see how researchers view social sustainability and their role in it.

Sustainability as we see it may also be discussed without using the term itself, for example in articles concerned with ethics (Mingers and Walsham, 2010), social inclusion (Iivari et al., 2018), and politics of technology (Carsten Stahl, 2011). While sustainability may refer to activity that is compatible with the welfare of humans and nature (Hilty et al., 2005, pp. vii), it can also refer to simply sustaining something so it can keep going. Such somethings can be e.g. collaboration (Kumar and van Dissel, 1996), a project (Chengalur-Smith et al., 2010), a digital platform (de Reuver et al., 2018), or virtual communities (Bock et al., 2015). Our interest is on the sustainability that aims for common good, although these perspectives are not necessarily in conflict.

Urban development and smart cities are a prominent topic in IS sustainability research. The work on smart cities has also been connected to the UN sustainable development goals (Ismagilova et al., 2019). While ICT use can be disruptive and impact urban development and sustainability (Bibri and Krogstie, 2017), and the concept of smart cities can have varying forms, smart cities involve sustainability and technology (Bibri, 2019). Sustainability can be considered as a governmental responsibility, but IS can have a role in building the smart city (Corbett and Mellouli, 2017). Smart governance, technology-based collaboration of citizens and governments is one aspect in this research (Tomor et al., 2019). Since governing and collaboration are strongly linked to sustainability and it is an area where IS can have impact, politics is an important area to discuss.

In IS education, the competency area of 'ethics, impacts, and sustainability' has been envisioned to provide graduates capabilities in applying sustainable approaches in technology development, ensuring safety, privacy and integrity, interpreting and complying with regulations and standards in IT, and understanding culture and ethics in compliance behaviour (Topi et al., 2017). Furthermore, there has been interest in interdisciplinary courses with IS and engineering to work on sustainability challenges (Watson et al., 2012). In tackling the challenges of IS student recruitment, researchers found high schoolers interested in sustainability issues and making the world a better place, but also concerned over the future of technological developments (Vainionpää et al., 2020). Riekki and Mämmelä (2021) state that universities can contribute to creating a smart and sustainable world through new knowledge and educating experts. They suggest, among other things, considering performance criteria, system models, research problems, and education content to find common goals and education curricula for creating a sustainable world. The authors call for inter- and transdisciplinary efforts (particularly with social and human sciences) to cover a wide area of expertise and to improve the quality of research through broad education. (Riekki and Mämmelä, 2021).

Regarding sustainability in practice, the term 'green washing' has been used to describe superficial ethical and sustainable positioning, that does not stand deeper scrutiny (see Meyers and Bittner, 2012). Media technologies enable individuals as well as organizations to take part in public discourses via the internet and make identity claims through discursive practices (Vaast et al., 2013), i.e., communicating who they are. Organizations need to communicate about their stance on sustainability (Bengtsson and Ågerfalk, 2011), which would be a type of identity claim. Wagner (2018) wrote of a notion that something must be done, and companies presenting ethics as a solution to improve technologies, with no need of regulation from the government – leaving the industry to self-regulate. Interestingly, a study found the ACM code of ethics has no observable influence on ethical decision-making (McNamara et al., 2018). This question of what sustainability discourse aims to do is an interesting angle, as it leads us to consider why researchers may engage in the discourses and what positions they may take as individuals and while representing their organizations and fields.

2.2 Theoretical Lens

We use as our theoretical lens the Quintuple Helix Innovation Model, presented by Carayannis et al., (2012), which has not been previously applied in IS research on sustainability. This model aims for supporting sustainable development of new innovations, with a win-win situation between innovation, knowledge, and ecology. An innovation is seen to emerge as a result of cooperation of five helices (subsystems): **Education system** contains all levels of education, produced education, and research, and humans either go through the system (students) or work within it (teachers, researchers etc.). The **economic system** comprises the economic structures, such as industries, companies, banks, and institutions, with their production processes, resources, money etc. **Natural environment** refers to the nature itself and the resources it provides, such as minerals, metals, living organisms, water, air etc. The **civil society** helix, sometimes called 'media-based and culture-based public,' is a combination of information and media related assets such as different media and information sharing networks, and also cultural issues such as art, traditions, values, and life-styles. The **political system**'s assets are political and legal capital. Political capital refers to the accumulation of resources and power to the politicians, parties, and other stakeholders, and legal capital is understood as the legal system and laws and regulations. (Carayannis et al., 2012). Knowledge and know-how circulate between the helices, acting as a basis for new knowledge and know-how and eventually leading to sustainable innovations. The interconnected nature of the helices aims to make visible that creating innovations sustainably is a complex task and requires effort and knowledge and know-how created in many different fronts. The model builds on the Triple Helix model (Etzkowitz and Leydesdorff, 2000), which brings forth the significance of cooperation of industry, academia, and governments when developing innovations, and the Quadruple Helix model (Carayannis and Campbell, 2009), which adds civil society as a new helix, stressing that knowledge economy and knowledge society need to go hand in hand. In the Quintuple Helix model, natural environment is seen as a necessary element to consider when developing sustainable innovations, both as a resource but also as a source for knowledge that needs to be taken into account in the development (Carayannis and Campbell, 2010). The different helix models have been used widely for understanding and guiding development of knowledge economy (see e.g. Powell and Snellman, 2004), for example, in many European Union funded projects. We see that the innovation perspective in relation to sustainability fits well with IS field, which has for long been interested in innovations and their capacity to change the world. The Quintuple Helix model has been suggested supporting inter- and transdisciplinary analysis and understanding of sustainable development (Carayannis and Campbell, 2010). With our focus on sustainable development and use of technology, we find the Quintuple Helix model an inspiring and useful analytical framework to examine how researchers of different fields situate their understanding of sustainability.

3 Methods

Data collection. This study is part of an effort that aims for strengthening human capabilities in the digital era and combines human-centric understanding and ICT. In this study, we look at that from a

sustainability perspective. In this spirit, we conducted interviews with researchers from different disciplines within a Finnish university, where the effort is one of the university strategic profiling areas. A common denominator for all the interviewees is that they are somehow interested in ICT – either it is their research area, or they see that their own research can be or should be linked with ICT. We started from researchers who clearly worked with technology: researchers from telecommunications and information systems, then widening to humanities in different fields, finding new interviewees based on recommendations of our interviewees. The researchers from humanities had some link to technology through their work, for example interaction researchers saw that technology had become a part of our everyday lives and as such it is unavoidable in their research. For them, technology is not the main focus in research but a part of their research contexts, nonetheless. To protect our interviewees' privacy, we present the demographics only to the following detail: The field of each interviewee presented in Figure 1 is their primary field, but many had multidisciplinary backgrounds; for example, several IS researchers had backgrounds in humanities, two humanists had been involved with education, 'tech' people were ICT engineers and two of them were also involved in industry. Nationalities included 24 Finns, 4 Europeans, 1 South American, and 1 African, all living in Finland. 15 interviewees were men, 14 women, and one nonbinary person. All interviewees were experienced researchers regardless of their position, which can be roughly divided as half of the interviewees in a professor position and rest something else.

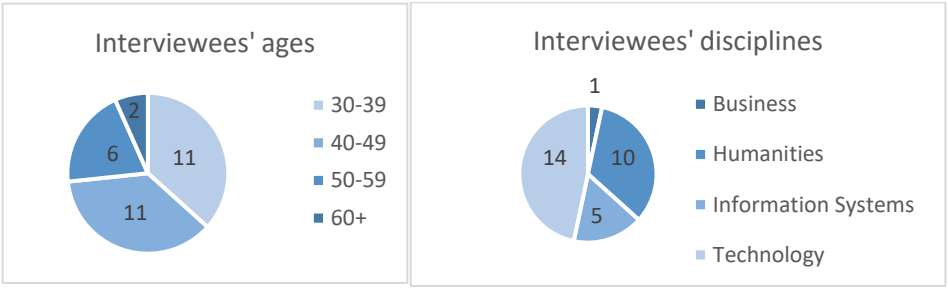

Figure 1. Demographics of the interviewees: age and discipline.

The interviews (~80 min duration on average) were conducted via Zoom, audio recorded, and transcribed. Six of them were conducted in English, the rest in Finnish. Mostly, there were two interviewers present, but when one researcher was well acquainted with the interviewee, the interview was done by the other one alone. We began the interviews with a description of our interests and motivation for the research, stating that we consider sustainability a broad concept and aim to collect different researchers' points of view. Our interview themes included the following: the researchers' background; their experience and competence with technology; their views on technology in people's everyday life; what they think about (sustainable) technology development and use; what type of technology they think is useful, necessary, or acceptable; and technology regulation. In this paper, we focused on the interviewees' views about sustainable technology development and use.

Data analysis. In the data analysis, we focused on how sustainability of technology was constructed in the researchers' discourses. Inspired by the Foucauldian discourse lens, we focused our attention on the ways interviewees were speaking about the topic (see Foucault, 1972, 1980). Foucault (1972) states that discourses systematically form objects as they are spoken of, which establishes certain understandings of the world. Individuals are also offered subject positions they must take for participating in the discourses (Foucault, 1972, 1980; Weedon, 1987). The speakers' subjectivity, their sense of self and understanding of their position in the world (Weedon, 1987) is constituted in discourses (Foucault, 1972, 1980; Weedon, 1987). With the discourse lens comes a notion of people being persuaded to become subjects in discourses; there may be several competing discourses and subject positions to choose from, and some may be available to a limited set of people. People can also challenge and negotiate discourses and subject positions (Foucault, 1972; Weedon, 1987). With this understanding, we examined from our data what the interviewees talked about when discussing sustainable technology development and use, how they talked about it, and from which subject positions, and identified the most germane discourses in their talk. As we had existing understanding

on the Quintuple Helix model, that surely focused our thinking on certain directions. However, the discourses emerged from the data and were not identified based on the model. In the next phase, we reflected the identified discourses with the helices of the Quintuple Helix model and found that they fitted very well together, as the interviewees had spontaneously brought up in their talk education, politics, business, natural environment, and civil society related issues as central in their discourses.

4 Findings

The interviewees began unravelling the question of sustainable technology development and use from five different angles: manufacturing of technology, involving mining of materials and its impact on the environment and people; the purpose of technology manufacturing and use; impact of technology use on people and environments; technology lifecycle, including the path from mining of materials to recycling discarded devices; and technology in political power relations, the question of who has the power or responsibility to make decisions on what technology we create and how. Five central discourses were identifiable in how the interviewees constructed sustainability in their talk: 1) We need technology education and transparency in technologies to empower people to act in sustainable ways; 2) politics and governing are needed to regulate technology development and use to ensure sustainability; 3) business is driving technology development, often towards an unsustainable direction; 4) natural environment is threatened by impact of technology development and use; and 5) we must talk about sustainability, but it is a complex topic. The power is in the hands of those developing the technology (companies), while governments are meant to control what happens, educators need to empower people, the nature is a victim, and individuals can make choices in their everyday lives – but to be sustainable everything needs to work together. Next, we present our findings, identifying the interviewees with their field and a number: Biz = Business; Hum = Humanities; Tech = Technology; IS = Information Systems.

4.1 Education – Empowering the People

In the 'empowerment discourse,' the interviewees constructed informing and educating people as something necessary for people to make sustainable choices, but also so that people can trust and see potential in technology. Digital literacy was constructed as important for everyone, and transparency in technology as necessary, as lack of knowledge means individuals must make their choices with a limited understanding. In this discourse, the interviewees take a position where doing the right thing feels good, and information is key in doing that. "*I think that in general the society is not trusting the governments it's not trusting the technology because technology of course can be used for bad but many times it's because they don't understand the possibilities of technology or what is involved so, I think that, again, the important thing is educating people..."* (Tech11) Technology was constructed in this discourse as an enabler, something that can inform our actions based on data, a tool to empower us through information and resources. Possibilities were identified in making sustainable choices in general, considering environmental sustainability as well as ethics and fairness. On another level, for example telecommunication networks covering remote areas were brought up in this discourse to provide people equal access and opportunities, related to education and healthcare. "*Well, maybe it would mean that we would have good applications for example for informing people of how they could behave sustainably. For example, if technology would provide information about the products we use or our consumption habits or lifestyles and such things..."* (Hum4) Moreover, technology was constructed in this discourse as a tool that can shape our actions and ideas of what is the 'right thing' to do: changing technology changes us. As an example, information is filtered for us by algorithms. It was considered a problem that people may not understand how and what our data is collected for and how it can be used to alter us. *"I think sustainability is related to that, that we must create environments where we discuss what the goals are, so we do not do something by accident... When we change the environment, we also change the human. And we should have some type of value conversations, about what basis are we working on."* (IS5)

4.2 Politics – Wielding Power and Responsibility

We linked with the political helix the following aspects of sustainability that emerged from the data: social and societal issues, inclusion, ethics, and international power relations. In the 'regulation discourse' that demanded more effective regulation for technology development and use, sustainability was constructed by the interviewees as a social question where people shape each other. For example, by negotiating our everyday practices and habits at home, such as loading the dishwasher. Politics comes into the equation here through decision-making and governing society, as these affect people's behaviour. This discourse positions governments as responsible to people. There was concern over maintaining an understanding over technological developments in the fast-paced industry, which is needed for decision making. *"You need to trust governments, and you need to demand governments that the money that you pay in your taxes are going to be used for improving, this is the problem, well, society is not educated, and society doesn't trust the people, doesn't trust the government, so these are the two main things."* (Tech11) Individual choice was foregrounded, while common efforts were thought necessary for larger change or impact: motivated people can create change, but we also need regulation and people in charge of sustainability. However, political systems and will for change were questioned. Sustainability or was constructed as politically on the left or requiring a total revolution of our systems. "*Every person can do things of course, every day you can make choices, but maybe it's difficult for one person to change the big things. I think that we need many kinds of regulation and drawing lines to make big changes fast."* (Hum2) Technology itself was not constructed in this discourse as negative or positive, but how it is used defines the verdict. As an example, social media was seen to influence politics, social relationships, and mental wellbeing in both positive and negative ways. Use and ownership of data, however, were identified as a significant risk: who can use it and for what purpose – companies, governments, or individuals themselves. Technology related decision making was constructed as a question of power and responsibility. "*One threat is this control of information, which is also very real in marketing now with these big actors that collect huge amounts of information. All the while they collect the information, they grow their power. The worst dystopia is of course that us individual tech users have no grasp of how the technology is used. The power is with those who know everything about us.*" (Biz1)

Technology manufacturing is a business which involves people and politics internationally. Post-colonialist technology development, where we 'help' other countries without asking what is needed or wanted, was brought up in this discourse. Many interviewees considered the impact of technology manufacturing on the workers and brought up child labour as an unethical example. Related to this, mining for rare minerals and metals needed for technology was considered a political issue as this is done across borders. Political choices affect where telecommunication networks are built, and accessibility was considered as one aspect of sustainability that can be governed with regulative actions when there is a weak financial incentive for companies. Those working on telecommunications connected this to the UN sustainability goals. In addition to network availability, some recognized that technology such as sustainable Internet of Things solutions are made for those with money to buy and skills and opportunities to use them and exclude many differently abled from using technology. When it comes to technology politics, Artificial Intelligence and data were connected by the interviewees with ownership and international power relations where China, Europe, and the US apply different strategies. The argument was made, that people must demand our governments to be active in technology development and use because we cannot let companies decide for us. The key to all these points about responsibility, accessibility and inclusion was a need for regulation. "*We talk about who owns the data and does it just happen or do we have the chance to affect your data or opt out. […] What happens in Europe, America and China are three entirely different things with data. In China you must opt in, and then you have no say, there the society and systems take you and your data. […] And in the US, we know they have all the largest platform companies, not just telecommunications but IT companies, cloud companies, data companies, and platform companies form a large convergence. […] And in Europe, I just read a good tweet, that Europe regulates [laughs] and we hope to have this 'MyData' or to be somehow better in this, but we are in danger of being crushed."* (Tech4)

4.3 Economy – Business Decides What Technology is Developed

Considering technology development from an economic point of view, making money was constructed in the 'business as a driver discourse' as something opposed to sustainability. For example, inclusive technology and solutions to the digital divide were constructed as sustainable but not necessarily profitable. Financial drivers were seen in this discourse as a problem that creates a pressure to innovate and create more technology, while an increasing number of technological devices was considered a sustainability problem in terms of energy consumption and materials used for building them, and the waste from discarded devices. Consumer society and constant replacement of our technological devices were constructed in this discourse as a sustainability issue. 'Planned obsolescence' was considered a major flaw in the business model. In this discourse the interviewees positioned those who make money on sustainability as not actually caring about sustainability, only about profits. "*I was quite an idealist, I thought it's enough to do good, that it's the right thing to do… but it must have a business logic behind it. And this would be the ideal that we have the technology, economy, and societal in a neat triangle, benefiting each other."* (Tech4) The interviewees identified factors involved in sustainable technology development: the people (workers and consumers), and the entire lifecycle of technology, including mined materials, manufacturing devices, selling, using, and recycling the devices. The researchers were worried about excessive technology use as something common and posing a problem for human wellbeing. This linked to a concern over how much technology businesses are deciding about our everyday lives for us; we use technology in our free time, and our work can demand us to use it, particularly during the pandemic and distance work. The negative aspects of technology use, such as unhelpful or burdening IS were mentioned to negatively affect workers' wellbeing. This is a question of when we can opt out, at work or in our everyday lives. "*At least our information systems do not increase wellbeing of workers (laughs)."* (Tech8)

4.4 Natural Environment – We Need to Consume Consciously

'The impact discourse' focusing on the impact of technology development and use on the natural environment originates mostly from the researchers working in more technical areas. This may stem from a focus on resource use, as researchers working on telecommunications emphasized the need for energy efficiency due to the increasing amount of technology. Another consideration was that the technology around us keeps getting more complex and requires more resources. "*This energy efficiency is very important. We are always getting more technology, always more devices, etc. At the same time, we need to manage energy efficiency, because otherwise it will get far out of hand."* (Tech1) Even though this discourse was coloured by examples of how to save resources, it was still surprisingly unquestioning, constructing new technology as a solution to environmental sustainability. The researchers were able to see a conflict with this technology solutionism, though, as data, algorithms, and use of AI were said to be "power hungry," i.e., consuming copious amounts of energy while helping us optimize energy consumption. Additionally, they pointed out the environmental impact of mining raw materials for the technology and discarding obsolete devices. On the other hand, rural area networks can reduce the need to travel or build local infrastructure for societal services, such as healthcare or education, which can to some extent be provided digitally. "*If I consider these telecommunication networks and sustainability, it's a very multifaceted and versatile thing. It involves all the raw materials, their recycling, what materials and parts are used, how they are produced, […] and how they are acquired. […] the people who do the mining and all the rest. So, it has many... the environmental point of view, the people point of view, and all the recycling issues. So just these devices, their lifecycle and how they are made should be on a whole different level than they are now. And another thing is the vast infrastructure, the base stations, servers, and the rest. They use large amounts of energy.*" (Tech3) The interviewees' thoughts on how to strive for environmental sustainability involved the whole technology lifecycle, from mining minerals to discarding old devices, focusing e.g. on carbon emissions, using local resources, and knowledge sharing. One interviewee also criticised software development, where we develop one product, use it for some time and discontinue it, and another project is begun from scratch. Many considered making technology for

a purpose the key and called for careful consideration of this. There were clear calls for slowing down from most interviewees: constant production of new things is not sustainable.

4.5 Civil Society – Sustainability is a Big Question, What is Our Power?

We linked with the civil society helix 'the complexity discourse' where the interviewees saw the need to talk about sustainability but saw it also as an extremely complex question. Researchers take part in societal discourses through their research communities and various other chosen media, such as Twitter. In this discourse, the interviewees drew on societal discourses as well as anecdotes from their personal lives, and constructed sustainability as a buzzword that has become fashionable though its frequent use in media. On the other hand, sustainability was also constructed as something we must strive for because it is good, and because otherwise "*everything will collapse"* (Tech14). It is a discourse we must engage; we must think and talk about it. *"I know this sustainability thing has been made a buzzword, that involves basically everything in this world that aims for something good."* (IS1) The question of sustainability evoked statements that it is abstract, a difficult and big question encompassing a general aim of doing good, needing resiliency and ability to adapt to new situations. Yet, good was noted to be subjective *"Sometimes what you think is good is actually bad for somebody else*" (Tech14). The interviewees saw a need to define more carefully the focus of sustainability as the issue was considered context specific, similarly to the values and goals that are driving us. One interviewee pointed out that this is an issue discussed in technology philosophy and technology critique. In this discourse, technology was constructed as something that is meant to improve sustainability, for example through information and optimization, but interviewees called for consideration of what we need. *"Sustainability is such an abstract concept that it's difficult, but we should always consider that when we make changes, for sustainability, what does it mean to people. […] I think sustainability is related to that we must create environments where we discuss what the goals are, so we do not do something by accident."* (IS5)

While sustainability was constructed as a 'we' question, the researchers also considered their own position. Many said they do not need to think about sustainability in their work, whereas others positioned researchers as responsible for producing answers on sustainability in their applications. Interestingly, this came mostly from those in technical fields. They need to promise sustainability efforts in project proposals but have difficulties linking them in the real work. *"I was huffing to my wife a few nights ago, that I was reading the UN sustainability goals and thought about impact this past week. I told her that you have to build quite a long bridge from electromagnetics to this, saving the world. But you have to come up with something, and with enough steps you can get there... Technology is an enabler."* (Tech13) Although researchers have arguably gained deep knowledge in their respective areas, several began unravelling the question of what sustainability could be in the context of technology with disclaimers that their expertise does not lie directly in sustainability. This provokes the question of what qualifies us to make statements on sustainability: *"I'm not an expert in this area. Although I do supervise doctoral theses that relate to sustainability."* (IS1)

5 Discussion

As many of our interviewees stated, sustainability is a big question, the more so when taking an all-encompassing perspective to sustainability, but also when we narrow it down and examine sustainable technology development and use only, as in this study. That shows both in the numerous angles taken in the previous IS research to examine sustainability (Ziemba, 2019), as well as in our interviewees' sometimes frustrated or helpless ponderings on what possibilities they have to affect sustainable technology development and use, and do they even understand what it means. We contribute with this study by making visible multi/interdisciplinary views on sustainability of technology use and development. This has been suggested as a useful approach for grand problems (Hovorka and Corbett, 2012), and within the interdisciplinary IS field (Galliers, 2003; Merali and McKelvey, 2006) researchers are in a great position to advance such inclusion of expertise. We provide the perspectives

from researchers who are advancing technology, and from those whose research links to technology as it permeates across our lived experiences. With this approach, we have made visible a broad picture of sustainability, which also revealed how researchers position themselves in sustainability discourses in various ways. Another key contribution is bringing the Quintuple Helix Innovation Model (Carayannis et al., 2012) into IS sustainability research as a useful framework. While the model has been intended for sustainable development of innovations (Carayannis et al., 2012), and IS research has already considered innovations and sustainability (Hanelt et al., 2017; Hilty and Aebischer, 2015; Melville, 2010), the framework has not been utilized in IS so far even though it fits there very well. The Quintuple Helix model guided us to reflect our interviewees' discourses on sustainable technology development and use against the five helices of education, politics, economy/industry, nature/environment, and civil society (see Fig. 2 as a summary of our findings) and helped make visible the complex ecosystem of stakeholders needed for sustainability efforts. Next, we reflect our findings with previous IS research, discuss their implications to IS research and education and related research agenda for future IS research on sustainable technology development and use.

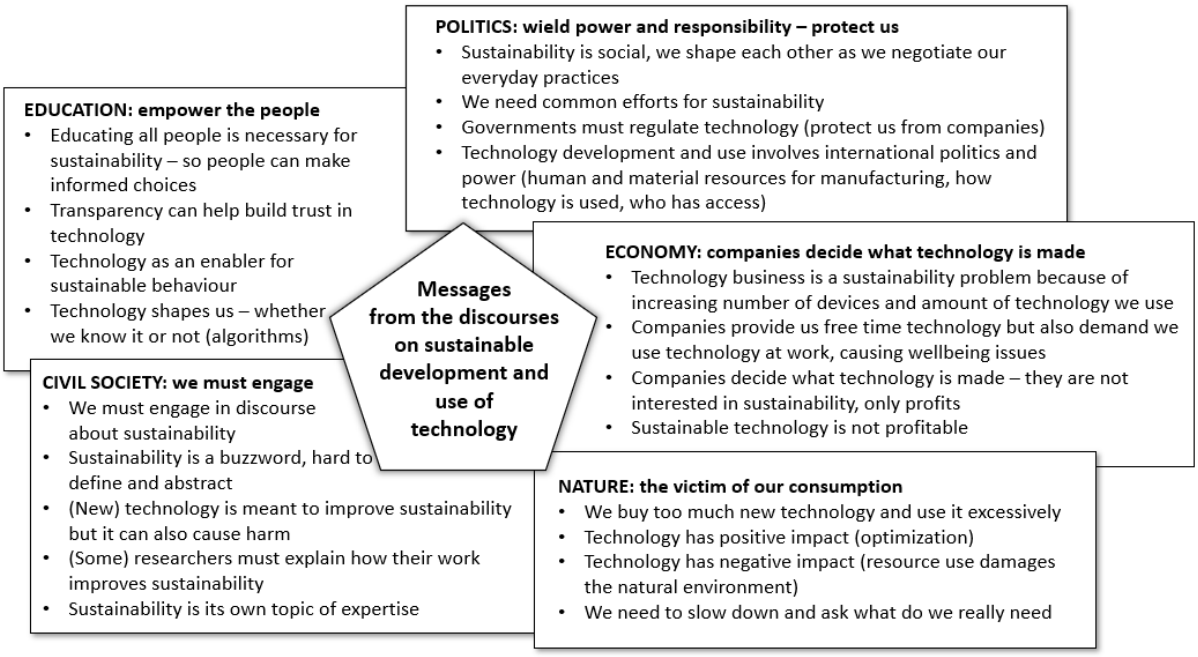

Figure 2. Messages from the researchers' discourses.

In the education helix, the interviewees called for empowerment and agency of all people. IS researchers have considered how ICT can support and persuade us to make sustainable choices (Corbett, 2013; de Camargo Fiorini and Jabbour, 2017; Hilty and Aebischer, 2015; Petrini and Pozzebon, 2009), and we also found this optimism in our data. The interviewees emphasised empowering people through information. However, the possibility of technology shaping us caused concern, e.g., when algorithms filter information for us and shape our ideas without us realizing it. This type of problems are about transparency in technology development and use, which is important for society as well as individuals to evaluate new technology and its acceptability. Our interviewees also recognized the challenge of being widely enough informed to make consistently sustainable choices in our everyday lives. Technology education for everyone**,** not only for professionals working in technological fields, was considered vital for sustainability efforts. IS education has already considered sustainability competencies for future IS professionals (Topi et al., 2017). As there is a need for an increasing number of IS professionals and young generations are not necessarily interested in this career choice, sustainability topics and how IS can help address them could offer opportunities in raising interest in IS (Vainionpää et al., 2020). Riekki and Mämmelä (2021) wrote that universities can contribute to a sustainability through new knowledge and educating experts through inter- and

transdisciplinary efforts. We found interdisciplinary interests in our data, but also how researchers from other fields have a real link and contributions to technology development and use. Based on this, we call for further IS research on the cross-section of IS/ICT education and sustainability education, taking particular focus on consciously created inter- and transdisciplinary education efforts (see e.g. Kuure et al., 2016) and using the lens of transdisciplinarity to support the work (see e.g. Choi and Pak, 2006; Godemann, 2008; Nicolescu, 2012; Wickson et al., 2006).

In the politics helix, the interviewees called for regulation to protect us all. They saw sustainability as a societal issue that requires common efforts. IS literature talks of supporting collaboration (Elliot and Webster 2017) and has acknowledged the social nature of sustainability issues (Ketter et al 2016; Petrini et al., 2009; Tim et al 2021). Smart cities, which involve governing, technology, and collaboration of citizens and governments (Tomor et al., 2019), are prominent in IS research on sustainability. They were not mentioned as such by our interviewees, who talked about individual technology use, companies, rural areas, and societal consumption of technology. This may simply suggest that smart cities do not concern our researchers as they are not a visible reality in our lives yet. Our interviewees pondered the digital divide and considered equal access to technology important: where we build networks that support other technological solutions such as remote education; who has money to buy the technology; and who has skills and opportunities to use it.

In our data, technology was seen as political and linked to global issues, a part of international power relations, and sustainability was considered to be politically on the 'left'. The questions remain, who is technology made for, how, how is it used, and who has a say – and how the political order is related to those. Our interviewees were concerned over ownership and use of data, involving technologies we use in our everyday lives. This relates to challenges of maintaining an overall understanding of fast technological developments, to make informed decisions. This concerns everyone, not only IS professionals. The role of governments and regulation was fore fronted in our data, for guarding us from the actions of companies. Rather than expecting accountability and responsibility from companies, our interviewees' thought regulation is needed for sustainable technology development and use, implying, and outright stating distrust in companies being responsible. Earlier studies have suggested that ethical guidelines may have little effect (McNamara et al., 2018), but companies may use them to avoid government regulation (Wagner, 2018). Related to this, some researchers stated that sustainability is discussed widely, but that sustainability in practice is another matter. We interpreted this as a criticism of ethics- or green washing (Meyers and Bittner, 2012), where organizations are making identity claims on sustainability (cf. Vaast et al. 2013; Bengtsson and Åkerfalk, 2011). This means that we discuss sustainability because we must, but it does not have to extend to our actions in practice. Organizations taking stances on sustainability (Bengtsson and Ågerfalk, 2011) is visible in researchers' realities in some aspects, manifesting e.g. in funding proposals, but there were no explicit mentions of researchers taking a sustainability stance for example in social media (Vaast et al., 2013). We call for further research on power laden issues in relation to sustainability: from digital divide perspective, particularly focusing on what is socially sustainable development and use of technology, and how that can create or lessen the digital divide, and who has a say; the role and power of governments and regulation in sustainable development and use of ICT; and how (social) media has a power to shape our views of sustainable technology development and use. Suitable theoretical lenses include for example discoursive lens (e.g. Foucault), power asymmetry (e.g. Saam, 2007) and any lens that helps make sense of motivations and drivers of the involved stakeholders and actors, such as stakeholder theory (see e.g. Bailur, 2006; Jones and Wicks, 1999), value co-creation (Vainionpää et al., 2020; Vargo and Lusch, 2016), resource dependence theory (see e.g. Hillman et al., 2009), or nexus analysis (Scollon and Scollon, 2004).

In the economic helix, the interviewees brought up the business as a driver for new technology. Sustainable technology business was considered to involve different people, the economy, and technology lifecycles. There was hope that our governments protect us from companies, while companies were considered to work in an economy where sustainability is not profitable. In IS, researchers have discussed how IS can enable businesses to be more sustainable (Petrini and Pozzebon, 2009; Elliot and Webster, 2017; Corbett, 2013). Several of our interviewees' view was that

business drives technological developments, and it is a problem for sustainability due to the need to profit, the increasing amount of technology, fast pace of replacing devices with the newest model, excessive use of technology, the energy consumption, and ethical questions in vast amounts of data being processed. The researchers called for slowing down, and consciousness in what we are doing and whether we need all the new technology. Here, we see a potential for researchers to study this phenomenon, for example by scrutinizing whether business really is in conflict with sustainability and inquiring how conscious our technology developers are when they create new things.

In the nature helix, impact of technology development and use was the worry. Here, researchers were concerned about carbon emissions, electricity use, and the impact of mining materials and discarding devices. These are not the most common topics to ponder for IS researchers who often focus on organizations, but maybe that is something IS should care about, too. Nature was essentially considered a victim of our consumption habits, although technology solutionism was also present as new technology was thought to be better for the world than what we currently have. Particularly the technical researchers considered sustainability as related to ecology – resources and the environment – as they aim to improve energy efficiency of our technologies. As mentioned by Dedrick (2010), our researchers also noted how technology can have positive effects through energy efficiency and optimization. In addition, efficiency in building networks rather than physical places appeared as another perspective in our data. Furthermore, the discourses involved the need for smart use of resources, not just through optimization but recycling and using devices and software until they stop working, and then only making new ones for a real need - so we can slow down the pace of consumption. This idea was also extended to reusing code in software development projects. The Quintuple Helix Innovation Model might give new perspective for IS researchers studying this topic.

In the civil society helix, researchers called for engagement but hesitated with positioning one's own role in relation to sustainability. This encompasses the researchers' discourses on sustainability itself. We found evidence of people being persuaded to become subjects in sustainability discourses (Foucault, 1972); they were considered something we must engage. We are left with interesting questions on the researchers' role in sustainability issues. Foucault (1972) discusses how certain discourses may be available to only a limited set of people. Indeed, the researchers in our data questioned their own authority in speaking of sustainability despite extensive knowledge in their respective fields. This goes further, as a question of the researchers' role in taking part in sustainability discourses. Riekki and Mämmelä (2021) saw researchers as academics and teachers who have a significant role in creating a more sustainable world through their research and teaching. However, it seems that being experts in our own fields is not enough, and that sustainability expertise is considered an arena of its own that one must first engage and learn about before taking on a role of a speaker. We could try to find ways to support researchers in this within our organizations. Some of our interviewees saw little link between their work and sustainability and grumbled about having to spend time on 'inventing' connections to sustainability in research proposals. This is one way researchers can challenge and negotiate discourses and subject positions (Foucault, 1972; Weedon, 1987). The question is then whether the funding application processes force us to truly consider sustainability in our work, or if the words are merely performative – a form of ethics washing (Meyers and Bittner, 2012; Wagner, 2018). UN sustainability goals, which are one form of code of ethics (McNamara et al., 2018) were often mentioned related to sustainability and research work. We cannot say how much they affect practice, but they are used in communicating about the research work. The researchers seemed to position companies as creators of technology, rather than themselves – the researchers only enable others to build the 'real world' using the research they have conducted.

Some of our interviewees saw sustainability as a continuity similarly to some IS scholars (Chengalur-Smith et al., 2010; de Reuver et al., 2018), and most thought of sustainability as aiming for common good (in line with Hilty et al., 2005). The subjectivity of good was stated by many, notably regarding social sustainability (Assefa and Frostell, 2007). Is environmental sustainability more based on numbers and thus considered more objective? Assefa and Frostell (2007) approached social sustainability from an acceptability angle. To better understand this, we see a need to take the 'all encompassing' lens as we used in the current study and propose thus as part of our research agenda the

following: inquiring different actors on what type of technology is considered useful, necessary, or acceptable, with a viewpoint of sustainability as a subjective, value-laden question of what is 'good'. We argue there is a need for both taking a deep look into e.g. energy efficiency, child labour, or use of data, but also for building 'the big picture', as in the current study. We propose that sustainability is a complex interdisciplinary aim where views from different disciplines can contribute to the discourses -- IS can understand and include the technical and the humanities alike. Finally, we propose utilising the Quintuple Helix Innovation Model (Carayannis et al., 2012) in IS research on sustainability as it highlights the social systems and helps make visible how they are intertwined.

6 Conclusions

Our paper title states that sustainability is a big question, as we found from our interviews. The discourses of the 30 researchers draw a picture that highlights the need to see sustainability as a complex, interdisciplinary aim where combined efforts from all helices are needed. As the amount of technology in our everyday life increases and new intelligent technologies penetrate it, we need to consider all facets of sustainability in ICT development and use, not only ecological sustainability. We need to ask: When is technology sustainable and what kind of world are we creating for future generations? We found power an integral part of sustainability – a question of who has a voice. In our dataset, researchers called for education to empower all people so they can have agency to critically reflect their own habits; for all of us to demand our politicians to remain vigilant on what is happening in the tech industry as companies follow profits; and for all of us to be more conscious of the impact we have on nature and consider what happens 'behind the scenes' of technology development and use. Finally, we saw consideration of researchers' role in performatively writing sustainability into funding proposals, and lacking confidence to speak of it from their perspectives as experts in their own fields. We see this lack of agency to discuss sustainability as a practical problem, possibly originating from a view of sustainability as a separate field of research, requiring distinctive expertise, instead of being an integral part of every field of research. We propose that researchers should approach sustainability as a natural part their research, regardless of the field: We should see sustainability as something we naturally consider in all our research efforts, in a position similar to research ethics. For this purpose, it is helpful to take a wide view to sustainability and consider not only use of resources, such as energy or raw materials or human labor, but also social sustainability of the solutions.

As for the limitations of our study, we interviewed researchers representing many disciplines, with an uneven distribution. We began with researchers in technology and expanded based on suggestions of our interviewees. As many of our interviewees were doing interdisciplinary research, we think this combination opens an interesting window to researchers' perspectives to sustainability. Our participants included 24 Finnish researchers, and all 30 interviewed researchers worked in a Finnish university. Thus, the cultural context has some weight on the results. To conclude, IS can be considered an interdisciplinary field, and we argue that IS researchers should consider how to foster multi/interdisciplinary work on sustainable ICT, to enrich our understanding. As IS is positioned between the 'hard tech' and the 'humanists', it provides a unique possibility to understand, include, and influence 'both sides' in the discussion, hopefully leading to novel visions and sustainable solutions.

Acknowledgements

This research is connected to the GenZ project, a strategic profiling project in human sciences at the University of Oulu. The project is supported by the Academy of Finland (grant agreement No. 318930, Profi4) and the University of Oulu.

References

Assefa, G., and Frostell, B. (2007). "Social sustainability and social acceptance in technology assessment: A case study of energy technologies." *Technology in Society*, 29(1), 63–78.

Bailur, S. (2006). "Using Stakeholder Theory to Analyze Telecenter Projects." *Information Technologies and International Development*, *3*(3), 61–80.

Bengtsson, F., and Ågerfalk, P. J. (2011). "Information technology as a change actant in sustainability innovation: Insights from Uppsala." *The Journal of Strategic Information Systems*, 20(1), 96–112.

Bibri, S. E. (2019). "On the sustainability of smart and smarter cities in the era of big data: An interdisciplinary and transdisciplinary literature review.*" Journal of Big Data*, 6(1), 25.

Bibri, S. E., and Krogstie, J. (2017). "Smart sustainable cities of the future: An extensive interdisciplinary literature review." *Sustainable Cities and Society*, 31, 183–212.

Bieser, J., and Hilty, L. M. (2018). "Assessing Indirect Environmental Effects of Information and Communication Technology (ICT): A Systematic Literature Review." *Sustainability*, 10(8), 2662.

Bock, G.-W., Ahuja, M., Suh, A., and Yap, L. X. (2015). "Sustainability of a Virtual Community: Integrating Individual and Structural Dynamics." *Journal of the Association for Information Systems*, 16(6), 418–447.

Carayannis, E. G., Barth, T. D., and Campbell, D. F. (2012). "The Quintuple Helix innovation model: Global warming as a challenge and driver for innovation." *Journal of Innovation and Entrepreneurship*, 1(1), 1-12.

Carayannis, E. G., and Campbell, D. F. J. (2009). ""Mode 3" and "Quadruple Helix": Toward a 21st century fractal innovation ecosystem." *International Journal of Technology Management*, 46(3/4), 201.

Carayannis, E. G., and Campbell, D. F. J. (2010). "Triple helix, Quadruple helix and Quintuple helix and how do Knowledge, Innovation and the Environment relate To Each other? A Proposed Framework for a Trans-disciplinary analysis of Sustainable development and Social Ecology." *International Journal of Social Ecology and Sustainable Development*, 1(1), 41–69

Carsten Stahl, B. (2011). "IT for a better future: How to integrate ethics, politics and innovation." *Journal of Information, Communication and Ethics in Society*, 9(3), 140–156.

Chasin, F. (2014). Sustainability: Are We All Talking About the Same Thing State-of-the-Art and Proposals for an Integrative Definition of Sustainability in Information Systems. *ICT for Sustainability 2014 (ICT4S-14)*, Stockholm, Sweden.

Chengalur-Smith, I., Sidorova, A., and Daniel, S. (2010). "Sustainability of Free/Libre Open Source Projects: A Longitudinal Study." *Journal of the Association for Information Systems*, 11(11), 657–683.

Choi, B. C. K., and Pak, A. W. P. (2006). "Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness." *Clinical and Investigative Medicine*, *29*(6), 351–364.

Corbett, J. (2013). "Designing and Using Carbon Management Systems to Promote Ecologically Responsible Behaviors." *Journal of the Association for Information Systems*, 14(7), 339–378.

Corbett, J., and Mellouli, S. (2017). "Winning the SDG battle in cities: How an integrated information ecosystem can contribute to the achievement of the 2030 sustainable development goals." *Information Systems Journal*, 27(4), 427–461.

Dao, V., Langella, I., and Carbo, J. (2011). "From green to sustainability: Information Technology and an integrated sustainability framework." *The Journal of Strategic Information Systems*, 20(1), 63–79.

de Camargo Fiorini, P., and Jabbour, C. J. C. (2017). "Information systems and sustainable supply chain management towards a more sustainable society: Where we are and where we are going." *International Journal of Information Management*, 37(4), 241–249.

de Reuver, M., Sørensen, C., and Basole, R. C. (2018). "The Digital Platform: A Research Agenda." *Journal of Information Technology*, 33(2), 124–135.

Dedrick, J. (2010). "Green IS: Concepts and Issues for Information Systems Research." *Communications of the Association for Information Systems*, 27, Article 11.

Elliot, S., and Webster, J. (2017). "Editorial: Special issue on empirical research on information systems addressing the challenges of environmental sustainability: An imperative for urgent action*." Information Systems Journal*, 27(4), 367–378.

Etzkowitz, H., and Leydesdorff, L. (2000). "The dynamics of innovation: From National Systems and "Mode 2" to a Triple Helix of university–industry–government relations." *Research Policy*, 29(2), 109–123.

Foucault, M. (1972). *The archaeology of knowledge and the discourse on language*. Pantheon Books.

Foucault, M. (1980). *The history of sexuality. Volume one: An introduction.* Vintage Books.

Galliers, R. (2003). "Change as Crisis or Growth? Toward a Trans-disciplinary View of Information Systems as a Field of Study: A Response to Benbasat and Zmud's Call for Returning to the IT Artifact." *Journal of the Association for Information Systems*, 4(1), 337–352.

Gholami, R., Watson, R., University of Georgia, Hasan, H., Molla, A., and Bjorn-Andersen, N. (2016). "Information Systems Solutions for Environmental Sustainability: How Can We Do More?" *Journal of the Association for Information Systems*, 17(8), 521–536.

Godemann, J. (2008). "Knowledge integration: A key challenge for transdisciplinary cooperation." *Environmental Education Research*, *14*(6), 625–641.

Guillemette, M. G., and Paré, G. (2012). "Transformation of the Information Technology Function in Organizations: A Case Study in the Manufacturing Sector." *Canadian Journal of Administrative Sciences*, 29(2), 177–190.

Hanelt, A., Busse, S., and Kolbe, L. M. (2017). "Driving business transformation toward sustainability: Exploring the impact of supporting IS on the performance contribution of eco-innovations*." Information Systems Journal*, 27(4), 463–502.

Hedman, J., and Henningsson, S. (2016). "Developing ecological sustainability: A green IS response model." *Information Systems Journal*, 26(3), 259–287.

Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). "Resource dependence theory: A review." *Journal of management*, 35(6), 1404-1427.

Hilty, L. M., and Aebischer, B. (2015). "ICT for Sustainability: An Emerging Research Field." In *ICT Innovations for Sustainability* (Vol. 40). Springer, Cham.

Hilty, L. M., Lohmann, W., and Huang, E. M. (2011). "Sustainability and ICT - An overview of the field." *Notizie Di Politeia*, 27(104), 13–28.

Hilty, L. M., Seifert, E. K., and Treibert, R. (2005). *Information systems for sustainable development*. IGI Global.

Hovorka, D. S., and Corbett, J. (2012). IS Sustainability Research: A trans-disciplinary framework for a 'grand challenge.' In *the 33rd International Conference on Information Systems*, Orlando.

Iivari, N., Kinnula, M., Molin-Juustila, T., and Kuure, L. (2018). "Exclusions in social inclusion projects: Struggles in involving children in digital technology development." *Information Systems Journal*, 28(6), 1020–1048.

Ismagilova, E., Hughes, L., Dwivedi, Y. K., and Raman, K. R. (2019). "Smart cities: Advances in research—An information systems perspective." *International Journal of Information Management*, 47, 88–100.

Jones, T. M., and Wicks, A. C. (1999). "Convergent Stakeholder Theory." *Academy of Management Review*, *24*(2), 206–221.

Ketter, W., Peters, M., Collins, J., and Gupta, A. (2016). "Competitive Benchmarking: An IS Research Approach to Address Wicked Problems with Big Data and Analytics." *MIS Quarterly*, 40(4), 1057–1080.

Khan, R. (2016). "How Frugal Innovation Promotes Social Sustainability." *Sustainability*, 8(10), 1034.

Kumar, K., and van Dissel, H. G. (1996). "Sustainable Collaboration: Managing Conflict and Cooperation in Interorganizational Systems." *MIS Quarterly*, 20(3), 279.

Kuure, L., Molin-Juustila, T., Keisanen, T., Riekki, M., Iivari, N., & Kinnula, M. (2016). "Switching perspectives: from a language teacher to a designer of language learning with new technologies." *Computer Assisted Language Learning*, 29(5), 925-941.

McNamara, A., Smith, J., and Murphy-Hill, E. (2018). Does ACM's code of ethics change ethical decision making in software development? *Proceedings of the 2018 26th ACM Joint Meeting on*

European Software Engineering Conference and Symposium on the Foundations of Software Engineering, 729–733.

Melville. (2010). "Information Systems Innovation for Environmental Sustainability." *MIS Quarterly*, 34(1), 1.

Merali, Y., and McKelvey, B. (2006). "Using Complexity Science to effect a paradigm shift in Information Systems for the 21st century." *Journal of Information Technology*, 21(4), 211–215.

Meyers, E. M., and Bittner, R. (2012). "Green washing" the digital playground: How virtual worlds support ecological intelligence...or do they? In *the 2012 IConference*, Toronto, Ontario, Canada, 608–610.

Mingers, J., and Walsham, G. (2010). "Toward ethical information systems: The contribution of discourse ethics." *MIS Quarterly*, 833–854.

Missimer, M., Robèrt, K.-H., and Broman, G. (2017). "A strategic approach to social sustainability – Part 2: A principle-based definition." *Journal of Cleaner Production*, 140, 42–52.

Moldan, B., Janoušková, S., and Hák, T. (2012). "How to understand and measure environmental sustainability: Indicators and targets." *Ecological Indicators*, 17, 4–13.

Nicolescu, B. (2012). "The Need for Transdisciplinarity in Higher Education in a Globalized World." *Transdisciplinary Journal of Engineering & Science*, *3*(December), 11–18.

Petrini, M., and Pozzebon, M. (2009). "Managing sustainability with the support of business intelligence: Integrating socio-environmental indicators and organisational context." *The Journal of Strategic Information Systems*, 18(4), 178–191

Powell, W. W., and Snellman, K. (2004). "The Knowledge Economy." *Annual Review of Sociology*, 30(1), 199–220.

Riekki, J., and Mämmelä, A. (2021). "Research and Education Towards Smart and Sustainable World*." IEEE Access*, 9, 53156–53177.

Saam, N. J. (2007). "Asymmetry in information versus asymmetry in power: Implicit assumptions of agency theory?" *The Journal of Socio-Economics*, *36*(6), 825–840.

Saravanamuthu, K. (2002). "Information Technology and Ideology." *Journal of Information Technology*, 17(2), 79–87.

Scollon, R., and Scollon, S. (2004). *Nexus analysis: Discourse and the emerging internet*. Routledge

Tim, Y., Cui, L., and Sheng, Z. (2021). "Digital resilience: How rural communities leapfrogged into sustainable development*." Information Systems Journal*, 31(2), 323–345.

Tomor, Z., Meijer, A., Michels, A., and Geertman, S. (2019). "Smart Governance For Sustainable Cities: Findings from a Systematic Literature Review*." Journal of Urban Technology*, 26(4), 3–27.

Topi, H., Brown, S. A., Donnellan, B., Tan, B. C. Y., Karsten, H., Carvalho, J. A., Shen, J., and Thouin, M. F. (2017). *Global Competency Model for Graduate Degree Programs in Information Systems, The Joint ACM/AIS MSIS 2016 Task Force*, p. 117.

United Nations. (1987). *Report of the World Commission on Environment and Development: Our Common Future*. Retrieved from https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html.

United Nations. (2015). *Transforming our World: The 2030 Agenda for Sustainable Development.* Retrieved from https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981.

Vaast, E., Davidson, E. J., and Mattson, T. (2013). "Talking about Technology: The Emergence of a New Actor Category Through New Media." *MIS Quarterly*, 37(4), 1069–1092.

Vainionpää, F., Kinnula, M., Iivari, N., and Hartikainen, H. (2020). Aiming for Resemiotisation – Meanings Making and Co-Creation of Value Around an IT Course. In *the International Conference on Information Systems 2020 Proceedings*, 17.

Vargo, S. L., and Lusch, R. F. (2016). "Institutions and axioms: An extension and update of service-dominant logic." *Journal of the Academy of Marketing Science*, *44*(1), 5–23.

Wagner, B. (2018). Ethics As An Escape From Regulation. From "Ethics-Washing" To Ethics-Shopping? In E. Bayamlioglu, I. Baraliuc, L. A. W. Janssens, and M. Hildebrandt (Eds.), *BEING*

PROFILED: COGITAS ERGO SUM: 10 Years of Profiling the European Citizen (pp. 84–89). Amsterdam University Press.

Watson, Boudreau, and Chen. (2010). "Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community." *MIS Quarterly*, 34(1), 23.

Watson, R. T., Elliot, S., Corbett, J., Farkas, D., Feizabadi, A., Gupta, A., Iyer, L., Sen, S., Sharda, R., Shin, N., Thapa, D., and Webster, J. (2021). "How the AIS can Improve its Contributions to the UN's Sustainability Development Goals: Towards A Framework for Scaling Collaborations and Evaluating Impact." *Communications of the Association for Information Systems*, 48(1), 476–502.

Watson, R. T., Lind, M., and Haraldson, S. (2012). "The Emergence of Sustainability as the New Dominant Logic: Implications for Information Systems." In *the 33rd International Conference on Information Systems*, 16.

Weedon, C. (1987). *Feminist practice & poststructuralist theory*. Blackwell Publishing.

Wickson, F., Carew, A. L., and Russell, A. W. (2006). "Transdisciplinary research: Characteristics, quandaries and quality." *Futures*, *38*(9), 1046–1059.

Winkler, T., and Spiekermann, S. (2019). "Human Values as the Basis for Sustainable Information System Design." *IEEE Technology and Society Magazine*, 38(3), 34–43.

Ziemba, E. (2019). "The Contribution of ICT Adoption to the Sustainable Information Society." *Journal of Computer Information Syste*ms, 59(2), 116–126.