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Is the Digital Future Sustainable?

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Abstract

It is predicted that in 2030, the energy consumption of the ICT sector will be 21% of the world’s energy consumption, but will resources be enough to carry out all the digital technology development trends at the same time? Trends, such as the transition to the ecommerce, the transition of mobile services to the fifth-generation network, video streaming, online gaming and the rise of electric cars, all increase the need for both storage and computing capacity and energy as well. More broadly, the geographical location of digital resources and infrastructures has implications to country’s security of supply, for example in systems of systems development of smart traffic. The ecological effects of digitalization should also be explored through the lens of digital ecology and sustainability.

Tiivistelmä

Onko digitaalinen tulevaisuus kestävällä pohjalla?

On ennustettu, että vuonna 2030 ICT-alan energiankulutus tulee olemaan 21 prosenttia koko maailman energiankulutuksesta, mutta riittävätkö resurssit kaikkien digitaalisten kehitystrendien samanaikaiseen toteuttamiseen? Digitalisaation kehitystrendit, esimerkiksi kaupan siirtyminen internetiin, mobiilipalveluiden siirtyminen 5G-verkkoon, videoiden suoratoisto, online-pelaaminen ja sähköautoilun yleistyminen, lisäävät merkittävästi sekä tallennus- ja laskentakapasiteetin että energian tarvetta. Laajemmin ajateltuna digitaalisten resurssien ja infrastruktuurien maantieteellisellä sijainnilla on vaikutuksia maan huoltovarmuuteen, kuten älykkään liikenteen systeeminen kehitys. Digitalisaation ekologiset vaikutukset tulisi myös laajemmin selvittää, jota varten esittelemme täysin uuden termin, digitaalinen ekologia, tarkastelemaan digitaalisten teknologioiden kestävyysvaikutuksia.

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Key words: ICT, Energy Efficiency, Computing Capacity, Emissions trading, Security of Supply

Avainsanat: Tietotekniikka, Energiatehokkuus, Laskentakapasiteetti, Päästökauppa, Huoltovarmuus

JEL: O3, O33, Q4, Q5

Digital ecology – a fresh perspective to resource efficiencies of ICT

In today's society, information and communication technology (ICT) is widely accepted as one of the main drivers of technological advancement. Ever since the 1980s, evaluating the productivity of ICT and respective systems by their operating costs and resource efficiency has not been at the center of attention (Hukkinen et al., 2019).

This, of course, is unsurprising. ICT resourcing has become increasingly outsourced, consumerized and readily available as a service, while at the same time, the related business models have become increasingly all-encompassing and obscure. Thus, the resource efficiency of handling information has been perceived as a trivial externality, readily sacrificed in the face of increased capabilities, strategic benefits, and competitive advantage (Hukkinen et al., 2019).

In recent years, however, several simultaneous digital technology trends have surfaced, creating overlapping ripples which may just yet rock the boat of ICT-related resource abundance.

ICT-related activities have had significant environmental impacts due to rare raw materials required to build new hardware as well as energy to power the digital infrastructure. Hence, it has become questionable whether the contemporary ICT-related resource abundance is sustainable.

The digital infrastructures of the future require a new way of thinking in the society. We must take a meticulous attention to resources and cost efficiencies from the larger perspective. We call this digital ecology. This perspective focuses our attention on sustainability in the use of natural resources for information processing. Research of the digital ecology produces an evolving framework which specifically examines the impact of digital technologies on a biophysical environment. In our considerations a biophysical environment can vary in scale from micro to global to digital in extent. (for more on industrial ecology see e.g. Erkman, 1997; Korhonen, 2004; Rajala et al., 2018)

Digital transformation is here, but how do we exploit our resources?

It is generally expected that digital transformation will play a major role in transitions across different industrial and public sectors. It is evident that the digital transformation will change how we think about consumables, non-consumables and capital goods related business models. There are many excellent examples of these transformations such as switching physical storefronts to ecommerce.

In addition, we are moving towards the next technological breakthrough, moving from the 4G network towards the 5G network. The number of base stations for the upcoming 5G network will be multiple compared to the 4G network. This challenges energy efficiency. (Katsigiannis, 2016; Ge et al., 2017)

Companies are using more energy consuming algorithms in their operations. The use of machine vision and learning, natural language recognition tools, but also deep learning is being used when augmenting humans as part of their daily tasks and duties. Especially deep learning has been considered to have an extensive size of a carbon footprint (Strubel et al., 2019)

On the consumer side, the use of various streaming services and online gaming are increasing and moving images are being transmitted with increasingly accurate resolution. The use of Netflix and other streaming services is constantly increasing. The Google Stadia reportedly uses one terabyte of data for every 65 hours for 4K streaming (Madan, 2019).

The moving image is always transmitted at an increasingly accurate resolution level (from Full HD to 4K resolution and in the future to an 8K image). This not only increases data traffic, but also increases the need for storage capacity. Thus, new large data center centers are being built continuously that uses our energy sources (Avgerinou et al., 2017).

Additionally, the demand for energy and computing capacity will also increase in other ways. For example, as electric cars become more commonplace, they require a share of electricity production, before cars have mostly operated on fossil fuels.

The developing autonomous functions of cars also increase the need for recording and computing capacity, which is again reflected in the growing need for energy in cars.

Independent control of one robot car requires the computing capacity and power consumption of dozens of laptops using current technology. Using the automatic driving feature can reduce the electric vehicle's range by up to 30%. (Bloomberg, 2017; Tesla, 2019; Teraki, 2019)

It has been predicted that in 2030, the energy consumption of the ICT sector will be 21% of the world's energy consumption, but will our societal resources be sufficient to carry out all activities simultaneously? (Andrea & Edler, 2015; Jones, 2018).

The current development of digitalization raises the question of the sufficiency of storage and computing capacity and electricity production. Can all these development trends be realized at the same time, or do the capacities of storage, computing power and power generation become constraints? A digital transformation requires simply more storage and computational capacity, but also more energy.

The ecological effects of digitalization and ICT technologies need to be clarified. In the field, we need a completely new term, digital ecology, to look at these effects of the future resource ICT-efficiencies. Is our digital future a sustainable future?

Questions for decision makers in policy

The increase in energy demand and computing capacity does not serve the industry but consumers and Internet waste: most of the streaming and online gaming services are free, and thus the economy does not benefit from producing any of these services, but to some extent. The ecological effects of digital transformation have also not been clarified. The digital future is said to be sustainable, but the results are missing. The aim is to explore these effects with digital ecology. As defined earlier digital ecology means an evolving framework that examines the impact of digital technologies on the biophysical environment. The impact of digitalism on the existing industrial ecology has not been studied, but digital ecology specifically examines these.

As digitalization progresses, no attention has been paid to what digital resources really cost and who will eventually pay for those services. But also, because of the platform business models we dare to ask the following questions[1]. Do Finnish industries and public sector pay 80% to 90% of the fixed costs associated with maintaining storage and computing capacity and electricity used? What about the carbon footprint of ICT? Who is really paying for the emissions trading cost of ICT-resources if any? A good set of questions that will require further clarifications.

As the core activities of the society are digitized, Finland's security of digital supply also raises questions. The questions are also aroused by organizing Finland's digital security of supply on a sustainable basis. At present, 1.54%[2] of the storage and counting capacity at European level for volume data centers is in Finland. When storage capacity is currently outside the Finnish borders and at the same time digitizing the core functions of society, we need to consider how to ensure that we have capacity in the event of a disruption. And it is not only about the storage and computing capacity, but where is all critical software programs being located? However, should capacity be built here to ensure security of supply for critical digital infrastructure and software programs?

Endnotes

1 In platform business models the different sides of the marketplace are being under and over changed. For more information on platforms see Kenney et al., 2019.

2 Etla calculations; Source: https://cloudscene.com/datacenters-in-europe (information retrieved 9.5.2019).

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