POLICY **BRIEF** 2022:35

Perspectives into topical issues in society and ways to support political decision making.

This publication is part of the implementation of the 2021 Government plan for analysis, assessment and research (**tietokayttoon.fi/en**). The producers of the information are responsible for its content and it does not necessarily represent the views of the Government.

Assessment of environmental impacts caused by digitalization in public sector services

Minna Tuominen-Thuesen, Riikka Sievänen, Heikki Saarinen, Merja Tiira, Lauri Lenni-Taattola, Terhi Lehmuskoski, Helinä Melkas, Satu Pekkarinen, Riika Saurio, Lea Hennala, Jyri Seppälä, Janne Pesu, Jáchym Judl

For the assessment of climate and environmental impacts of digitalization, which needs more research, it was possible to prepare general-level theoretical principles and a practical assessment method, the use of which can be promoted through policy actions. Central to the assessment is the consideration of sector and case-specific differences as well as the consideration of qualitative social and societal impacts.

Sustainability as part of all activities

Taking sustainability into account in the operations of organizations is becoming increasingly important. Among other things, Finland is committed to the Paris Climate Agreement and the Sustainable Development Goals. In order to keep these commitments, it is essential that both the public and private sectors consider sustainability as part of their own operational guidelines, practical operations, measurement and reporting.

Digitalization of public sector services is seen as one option to reduce the environmental impacts of public service production. Digital services can reduce greenhouse gas emissions and other negative environmental impacts, for example by reducing the need for movement and heating as well as paper consumption.

However, the assessment of climate and environmental impacts of digitalization has been difficult to outline. For this reason, there was a need to examine climate and environmental impacts of digitalization of public sector services, as well as methods for assessing them. Social and healthcare services were selected for case studies. The topic is particularly timely, as digitalization is expected to play a central role in the development of operations in this field. To support the implementation of these actions, there has been a need to obtain concrete practical tools for assessing climate and environmental impacts of digitalization.

The goal of the project was to work on a reference framework based on research data that supports the assessment of environmental impacts caused by digitalization of public services. The goal was also to create a practical operating model based on the reference framework development for assessing climate and environmental impacts of digitalization in the public sector in connection with the production and use of services.

In order to create a practical operating model, the project investigated the climate and environmental impacts of digitalization of public sector services with the help of two case studies and mapped out methods for assessing and predicting them. Social and societal impacts were also examined in the case studies. The goal was that by utilizing the methods mapped as a result of the work, it would be possible to form a comprehensive operating model based on measured data, including perspectives that should be taken into account when assessing climate and environmental impacts of digital public services.

Research material and methods

The project started with background work, the aim of which was to find out the current state and practices of environmental and climate impact assessment with the help of literature and empirical research.

Literature analysis, interviews and surveys conducted with the owners and producers of digital services, and workshops were the methods used in the initial phase of the project to gather information about the current status and practices of climate and environmental impact assessment regarding digitalization. At the same time, with their help, it was possible to find out the most common application areas of digitalization used in connection with public services, including devices and infrastructures, as well as the practices and user experiences related to their procurement.

After this background phase, the project started developing the reference framework for climate and environmental impacts. The work progressed to testing the preliminary framework with two case studies in the social and healthcare services. This was carried out by interviewing service staff (professionals responsible for developing and managing services as well as professional caregivers) and technology suppliers. In addition, background material was collected, such as statistics. Based on the data, both a quantitative assessment and a qualitative assessment were made. The latter also included social and societal impacts. The selected cases were the following:

- **Case 1:** Home care services of Päijät-Häme Joint Authority for Health and Wellbeing, unit for elderly care services and rehabilitation, especially **a) video call and b) medicine dispenser services**

- **Case 2: Remote appointments** in South Karelia Social and Health Care District, especially in three units: a) dental care, b) nutritional care, and c) mental health and substance abuse services for children and youth

Results and conclusions

The first key output of the project was a reference framework based on life cycle thinking. It was possible to draw a conclusion from the previous research and the questionnaire and interview studies carried out in the initial phase of the project, that climate change is the only environmental impact category for which some baseline data was available. For this reason, the calculation regarding the case studies was limited exclusively to the assessment of climate impacts.

The most important results obtained in the case studies are divided into quantitative and qualitative assessment results below.

Quantitative assessment results

The climate impacts of all selected cases could be calculated with reasonable effort and reliability. The magnitude of climate impacts depends on the number of devices needed to deliver the service and their allocation to the service, the length of the devices' life cycle, and the data intensity of the service. However, the data required for the calculation had to be obtained from several sources and was partly concluded on the basis of insufficient information.

The carbon footprint of one customer's annual use of home care services was equivalent to driving a car for hundreds of kilometers. For some customers, greenhouse gas emissions increased due to the effect of these services, but for those living further away, the emissions clearly decreased. The single most significant factor in the carbon footprint of these services was the emissions from the manufacturing of the devices taken to customers' homes. Another significant factor was the data intensity of the service. Due to these two factors, the emissions of the video call service were about three times higher than those of the automated medicine dispenser service.

In the carbon footprint of an individual remote appointment, the manufacturing and energy consumption of the equipment used to provide the service was highlighted, but overall the climate impact was estimated to be minor and remote appointments were generally a greener option.

Qualitative assessment results

In the digitalization of social and healthcare services, positive and negative climate and environmental impacts as well as positive and negative social and societal impacts could be identified based on the qualitative assessment of the selected cases. The social and societal impacts were divided into impacts on customers, on employees, and on service organizations and society. Positive climate and environmental impacts were observed, for example, a reduction in customer and employee travel and a reduction in the need for caregivers' protective equipment. Negative climate and environmental impacts were revealed, among other things, from telecommunication connections, data transfer, servers, memory capacity, and equipment manufacturing and materials.

Positive social and societal impacts were, for example, preservation of customers' activity and independence, regional equality regardless of place of residence, rationalization of employees' work, increased work flexibility due to a decrease in commute time, and more reasonable allocation of society's resources. Among other things, issues related to customer inequality (digital skills and financial opportunities, or the service in question being unsuitable for the customer and the resulting problems), the workload of employees while learning a new way of working, and the increase in management challenges and complexity were identified as negative social and societal impacts. The detailed impacts depend on the type of service and technology.

Environmental impacts have not been the central driver of the digitalization of social and healthcare services. The qualitative assessment clearly showed the multidirectionality and interconnectedness of the impacts of digitalization, as well as their connections to people and people's actions and ways of doing things. This emphasizes the need for multi-method assessment and for contextual understanding enabled by qualitative assessment when making assessments. The assessment results showed, among other things, that it is important to adequately assess the suitability of the digital service or the technology used in it for the customer or patient and to familiarize all parties involved carefully so that use is safe and successful. This, in turn, contributes to the planning and foresight of the work and thus the functionality of the whole, in which case the possibilities of positive environmental impacts increase. The knowledge provided by qualitative assessment is typically in-depth by nature and related to people's actions and ways of doing things. It is the kind of knowledge that service organizations and the service system are able to utilize in development activities.

Next, based on the results of the project, a simple assessment method was prepared for assessing the climate impacts of digitalization of public sector services. An online service has also been developed to illustrate the assessment method, which can be found at laskurit.hiilineutraalisuomi.fi/verkkopalvelu/. The method is based on both qualitative and quantitative assessment.

The main stages of the assessment method are shown in Figure 1. In the first stage, the aim is to use the questions on the checklist to identify whether the digital service has significant negative or positive climate impacts. In the second stage, the aim is to assess the amount of climate impacts. For some services, the actual calculation can be done with the simple calculator developed in this connection. However, for more complex services, a separate life cycle calculation performed by an expert is still required. A qualitative assessment of the improvement potential is also part of the assessment method. This third step is also implemented in the form of a checklist.

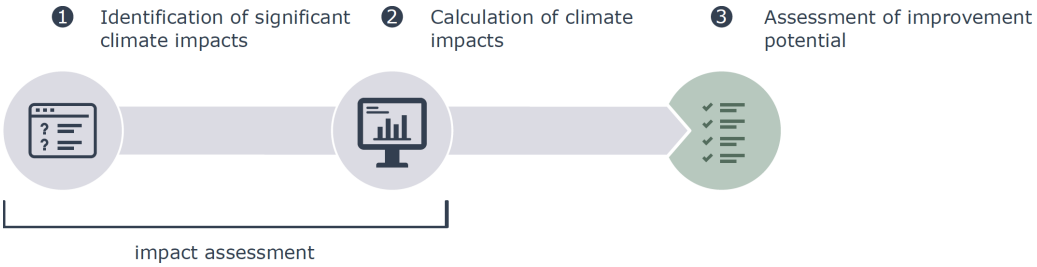

Figure 1. Steps of the assessment method

The following recommendations summarize the results of the project:

- It was possible to draw up general-level theoretical principles and the assessment method described above for the climate and environmental impacts of digitalization. Sectoral and case-specific differences require a case-by-case review.

- There are usually several reasons for the digitalization of a service, and digitalization is generally considered a positive measure for the environment. However, it is good to remember that every digitalization action also causes negative climate impacts.

- The planning and implementation of digitalization affect its climate impacts significantly. At least in connection with larger digitalization projects, climate impacts should also be assessed. Project designers' improved understanding of climate impacts of different implementation options has a potentially significant influence on energy consumption and greenhouse gas emissions.

- Policy measures could essentially speed up wider use of climate impact assessments of digitalization, for example by requiring a report on climate impacts in connection with the largest development projects and their procurements. Such policy actions would be a clear example of the necessity of climate impact assessment in connection with digitalization.

- The general-level guidelines resulting from this project need further research. Sustainable development, including climate and environmental impacts, is becoming more and more important for various actors. Integrating their consideration into everything the public sector does is key.

- In addition to the quantitative assessment method – and to help interpret it – qualitative understanding of digitalization and its impacts is needed. This is especially important when access to numerical data is limited. We also need

systemic understanding that "everything affects everything." Qualitative assessment gives, for example, in-depth knowledge related to people's actions and ways of doing things, which can be responded to with the necessary development measures.

- It is essential to widely promote a way of thinking that recognizes the importance of multi-perspective and multi-method impact assessment in different sectors and industries.

Further reading

laskurit.hiilineutraalisuomi.fi/verkkopalvelu/

References

Euroopan komissio, 2010. International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. https://doi.org/10.2788/38479

Euroopan komissio, 2021. Commission Recommendation (EU) 2021/2279 of 15 De-cember 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations. Official Journal of the European Union , L 471/1 (December 2021), 396. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=OJ:L:2013:124:TOC

European Commission. 2019. ASSESSING THE IMPACT OF DIGITAL TRANSFORMATION OF HEALTH SERVICES. Report of the Expert Panel on effective ways of investing in Health (EXPH). https://ec.europa.eu/health/sites/health/files/expert_panel/docs/022_digitaltransformation_en.pdf

International Energy Agency, 2019. Global Energy and CO2 Status Report https://iea.blob.core.windows.net/assets/23f9eb39-7493-4722-aced-61433cbffe10/Global_Energy_and_CO2_Status_Report_2018.pdf (Accessed 13.5.2022)

ISO, 2006a. SFS-EN ISO 14040 Environmental Management. Life Cycle Assessment. Principles and Framework (ISO 14040:2006).

ISO, 2006b. SFS-EN ISO 14044 Environmental management. Life Cycle Assessment. Requirements and Guidelines (ISO 14044:2006).

Kansallinen ikäohjelma vuoteen 2030. Tavoitteena ikäkyvykäs Suomi. Periaatepäätös. Luonnos. https://www.lausuntopalvelu.fi/FI/Proposal/Participation?proposalId=71e4473d-b849-42ac-b118-4903f3b9943a (17.10.2022)

LVM. 2020. Ekologisesti kestävällä digitalisaatiolla ilmasto- ja ympäristötavoitteisiin. ICT-alan ilmasto- ja ympäristöstrategiaa valmistelevan työryhmän loppuraportti. Liikenne- ja viestintäministeriön julkaisuja 2020:19. https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162562/LVM_2020_19.pdf?sequence=1&isAllowed=y

Melkas, H. 2011. Effective gerontechnology use in elderly care work: from potholes to innovation opportunities. In F. Kohlbacher & C. Herstatt (eds.), The Silver Market Phenomenon. Springer, Berlin.

Melkas, H., Hennala, L., Pekkarinen, S. & Kyrki, V. 2020. Impacts of robot implementation on care personnel and clients in elderly-care institutions. International Journal of Medical Informatics, 134. https://doi.org/10.1016/j.ijmedinf.2019.104041.

Nelimarkka, K. & Kauppinen, T. 2007. Ihmisiin kohdistuvien vaikutusten arvioiminen. Oppaita 68. Stakes, Helsinki.

Niemelä, M., Heikkinen, S., Koistinen, P., Laakso, K., Melkas, H., & Kyrki, V. (eds.). 2021. Robots and the Future of Welfare Services – Finnish Roadmap. Aalto University publication series CROSSOVER, 4/2021. http://urn.fi/URN:ISBN:978-952-64-0323-6.

Nissinen, A., Savolainen, H. (eds.), 2020. Julkisten hankintojen ja kotitalouksien kulutuksen hiilijalanjälki ja luonnonvarojen käyttö - ENVIMAT-mallinnuksen tuloksia. Suomen ympäristökeskuksen raportteja 15/2019. ISBN 978-952-11-5017-3. http://hdl.handle.net/10138/300737.

Nordic Innovation. 2019. Nordic sustainable healthcare. http://norden.divaportal.org/smash/get/diva2:1346242/FULLTEXT01.pdf

Ogden, T. & Fixsen, D.L. 2014. Implementation science: a brief overview and a look ahead. Zeitschrift fur Psychologie, 222(1), 4-11.

OECD. 2022. Measuring the environmental impacts of artificial intelligence compute applications. The AI footprint. OECD Digital economy papers. No 341, November 2022. https://www.oecd-ilibrary.org/science-and-technology/measuring-the-environmental-impacts-of-artificial-intelligence-compute-and-applications_7babf571-en

Pekkarinen, S. & Melkas, H. 2019. Welfare state transition in the making: Focus on the niche-regime interaction in Finnish elderly care services. Technological Forecasting and Social Change, 145, 240-253. https://doi.org/10.1016/j.techfore.2018.09.015.

Pekkarinen, S., Tuisku, O., Hennala, L. & Melkas, H. 2019. Robotics in Finnish welfare services: dynamics in an emerging innovation ecosystem. European Planning Studies. https://doi.org/10.1080/09654313.2019.1693980.

Pohl, J., Finkbeiner, M., 2017. Digitalisation for sustainability? Challenges in environmental assessment of digital services. Lect. Notes Informatics. https://doi.org/10.18420/in2017_199

Pohl, J., L.M. Hilty, and M. Finkbeiner. 2019. How LCA contributes to the environmental assessment of higher order effects of ICT application: A review of different approaches. Journal of Cleaner Production 219: 698–712. https://doi.org/10.1016/j.jclepro.2019.02.018 .

Raappana, A., Rauma, M. & Melkas, H. 2007. Impact of safety alarm systems on care personnel. Gerontechnology, 6 (2), 112–117.

Seppälä, J., Mäenpää, I., Koskela, S., Mattila, T., Nissinen, A., Katajajuuri, JM, Härmä, Tiina., Korhonen, MR., Saarinen, M., Virtanen Y., 2009. Suomen kansantalouden materiaalivirtojen ympäristövaikutusten arviointi ENVIMAT-mallilla. Suomen ympäristö 20/2009. ISBN 978-952-11-3460-9. http://hdl.handle.net/10138/38010.

SusAF. N.d. The SusAF Taster: Sustainability awareness framework. https://www.ida.liu.se/~TDDD96/info/SusAF%20Taster%20-%20workbook%20-%20V3%20-%20english.pdf

Weigel, P.; Fischedick, M.; Viebahn, P. Holistic Evaluation of Digital Applications in the Energy Sector—Evaluation Framework Development and Application to the Use Case Smart Meter Roll-Out. Sustainability 2021, 13, 6834. https://doi.org/10.3390/su13126834.

WHO. 2015. Health central to climate change action: http://www.euro.who.int/__data/assets/pdf_file/0020/295202/Factsheet3-health-central-climate-changeaction.pdf?ua. World Health Organization, Geneva.

Yin, R.K. 2009. Case Study Research: Design and methods. Applied social research methods series. Sage Publications, Thousand Oaks.

More information:

Director Riikka Sievänen, PhD KPMG Oy Ab
Tel. +358 40 679 2632, riikka.sievanen@kpmg.fi

Professor Helinä Melkas, LUT University
Tel. +358 40 588 1400, helina.melkas@lut.fi

Professor Jyri Seppälä, Finnish Environment Institute
Tel. +358 295 251 629, jyri.seppala@syke.fi

The assessment of the environmental impacts caused by digitalization in public sector services has been carried out as part of the implementation of the 2021 Government plan for analysis, assessment and research.

Chairperson of the project's steering group:
Special expert Markus Rahkola
Ministry of Finance, markus.rahkola@gov.fi

SYKE Government's analysis, assessment and research activities

POLICY **BRIEF** is a series of articles for government analysis, assessment and research. It gives perspectives into topical issues in society and ways to support political decision-making. The articles are published on our web pages at: **tietokayttoon.fi/en**.