






Green ICT Adoption and Challenges: Evidence from the Finnish ICT Sector

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Abstract. For better or worse, information, communication, and technology (ICT) is taking over most part of our lives. During the past few years, organizations, industries, and educational and health institutions that could utilize the power of ICT and digitalization maintained high productivity, efficiency, economic and social resilience. Yet, at the same time, the trend towards digital transformation is contributing its fair share to increased energy consumption, e-waste, and carbon emissions. The challenge is how to ensure that organizations successfully embark on their digital strategy with sustainability at the center of the digital transformation. In this study, we aim to understand the motivations and needs of organizations towards adopting green ICT as a response to the sustainable development agenda. Through an exploratory and qualitative study, we surveyed ICT-related organizations to understand their motivations and challenges to adopting green ICT. Our findings show a lack of green ICT awareness and a vague corporate strategy for green ICT adoption. This study provides a foundation for practitioners and policymakers to develop strategies and support systems to enhance the organizational green ICT transformation agenda.

Keywords: ICT ecosystem · Sustainability awareness · Green ICT · Sustainable ICT business development · Motivations · Challenges

1 Introduction

The climate crisis poses an unprecedented risk to humanity and our common planet. As result, many countries are making commitment towards achieving carbon neutrality by 2050, as agreed upon during the UN Climate Change Conference in Glasgow (COP26), and the demand for zero-carbon goods and services is set to grow correspondingly. At the same time, the digital transformation trend is becoming pervasive, and organizations are racing towards it. As companies race to innovate and roll out their digital transformation strategies, there is the need to ensure that these transformations are done with sustainability in mind. Digital technologies which was once an enabler to sustainable development is now also contributing its fair share to the environmental and climate change problem. As such, Finland is setting the pace in developing an ambitious climate target for the information, communication, and technology (ICT) sector to reach carbon neutrality

by 2035 [1]. Hence, how organizations adopt green ICT practices towards sustainable digital transformation becomes pertinent to achieving Finland's 2035 carbon neutrality target. To this end, our study set out to understand the motivation and challenges of organizations in adopting green ICT practices in their digital transformation journey. The findings in this study becomes an initial step towards building a green ICT ecosystem in the Uusimaa region, a research project focused on boosting the competitiveness and sustainability of ICT and software related businesses in Finland.

2 Background and Green ICT Related Studies

The green ICT concept is gaining popularity among scholars and practitioners whether to save the planet, improve energy efficiency, promote sustainable development, or increase information systems' reliability [2]. The term often refers to either greening the ICT sector itself or using ICT to green other industries. Despite evidence of the role of ICT in responding to grand global challenges [3], a handful of studies have empirically investigated the motivations and challenges to developing and adopting green ICT initiatives in organizations. In the study of Thabit and Yaser [4], the authors posited that factors such as costs, political and social pressure, government legislation, environmental responsibilities, enlightened self-interest, and new opportunities in the market were the six drivers for developing green ICT in developing economies. Hernandez [5] also identified factors such as individual attitude, managerial support, and budget availability as the internal success factors for green ICT adoption in organizations. Regarding the external factors, Hernandez argued that availability and accessibility of IT infrastructure, industry pressure, and government support significantly facilitate Green IT adoption among SMEs.

The green ICT aims to encourage stakeholders engaged ICT and software business to consider environmental problems and find solutions to them [6]. Thus, green ICT adoption in organizations concerns not only ICT's energy efficiency or the environment, it includes various organizational processes and socio-technical, economic, and managerial practices related to ICT [7]. For instance, Radu [8] identified and classified the main motivating factors for green ICT adoption in organizations such as the quest for competitiveness, organization strategies and policies towards sustainability, as well as social and environmental responsibility commitment are the key motivations for organizations to adopt green ICT principles. Despite the motivation from business stakeholders towards green ICT, many organizations have challenges in adopting green ICT principles in their business operation. For example, a recent study [9] identified factors such as lack of technical human resource and training programs, lack of budget allocation for green ICT implementation and the lack of government strict regulations as the main barriers to green ICT implementation in organizations.

As Finland happens to be one of the first countries to set ambitious climate strategy for the ICT sector, the contribution of our study provides a better understanding to whether having government policy on sustainable ICT is enough for organizations to adopt green ICT practices in their operations. Thus, the study identifies the state-of-the-art on green ICT adoption challenges and discusses the findings in relation to organizations' digital transformation agenda. The result of this study will serve as a basis to orchestrate a green

ICT ecosystem in the southern part of Finland where stakeholders involve in ICT and software business come together to share green ICT best practice as well as produce and source ICT products and services.

3 Methodology

This study aims to understand needs of stakeholders in the ICT and software business in implementing green ICT practices, which then serves as a foundation for building a green ICT ecosystem. As such, this study employed a survey-based investigation methodology to collect data and gain insights on why organizations are interested in green ICT and the barriers to green ICT adoption so that support systems can be provided for these organizations towards realizing Finland's 2035 carbon-neutrality ambition. For this reason, we used an explorative and qualitative research method [10] focusing on the motivations and challenges of Finnish-based organizations to adopt green ICT practices. We chose the qualitative approach because of the size of respondents and since generalization of the findings was not the focus. We designed a semi-structured questionnaire to collect data from 36 respondents. The primary data was collected in Finnish language from employees of different sizes of ICT and software related organizations through Webropol, an online survey tool, between September and October 2021¹. We adopted a non-probabilistic convenience sampling and snowballing strategy [11], to reach as many potential respondents as possible based on the following criteria:

(i) the respondents' organizations must be stakeholders in the ICT and software business, (ii) the respondents' organizations must be Finnish-based and (iii), the organizations must be conducting business or have presence in the Uusimaa region.

The rationale for meeting these criteria was because the results of this study will form the basis to orchestrating a green ICT ecosystem in the Uusimaa region of Finland. Based on the set criteria, we sent the link to the survey questionnaire to 1850 separate emails out of which 36 people completed the survey.

Among the 36 respondents, only 16 preferred to mention their gender, roles and company of affiliation which consisted of 4 Top level managers (all male), 9 Middle-level managers (4 females) and 3 Specialists (2 females). These 16 respondents represented 3 state-owned organizations, 5 public enterprises and 8 private businesses. Finally, two of the authors who are native Finns translated the answers and compared them with the text in Finnish to ensure that we retained the original meaning and content. Miro board and NVivo software were employed to code and analyze the survey responses based on the research questions. We formulated the following two research questions to help fulfill the research aim:

RQ1: What factors drive ICT firms towards adopting green ICT practices?

RQ2: What are the barriers to green ICT adoption among organizations during digital transformation?

¹ Research data available at <http://lnnk.in/driy>.

4 Results

Under this section, we present the survey responses considering the research questions.

RQ1: Organizations' Motivations in Adopting the Green ICT

Although the questions in our survey did not directly ask respondents about their motivations for adopting green ICT, motivation as a theme emerged through our exploratory analysis. For example, when asked whether the organizations were interested in acquiring green ICT products and services, 29 out of 36, thus, almost 81% of organizations who responded to this question showed their motivation to procure green ICT products and services. Either *“at approximately the same price range or more expensive”*. Similarly, we asked respondents to choose what kind of green ICT products or services their organizations are interested in purchasing of which *“carbon neutral products and services”*, *“recycled equipment”*, *“equipment made from recycled materials”*, or *“services and products that reduce the carbon footprint of our business”*. Overall, we observed that respondents' motivation towards green ICT revolved around carbon-neutrality commitment, climate and environmental responsibility, CSR fulfillment, energy efficiency, and optimizing premise usage.

RQ 2: Organizations Support Needs in Implementing Green ICT Initiatives

The results revealed the lack organizational policy and strategy on green ICT as one of the main challenges of adopting green ICT in organization as summarized in Fig. 1. We asked respondents whether their organizations have tried to procure Green ICT services or products but have not found supply in the market? 75% of the respondents answered, *“we have not attempted to acquire green ICT services or products so far.”* On the other hand, 6 respondents answered that *“we have tried to find Green ICT services, but we have not found them...”*. Another interesting result from the survey worth noticing is the issue of monitoring energy consumption and emission. When asked whether the organizations monitor the energy consumption of their information and communication technologies, **19 out of 36, representing 53% of the organizations, said they do not monitor their energy consumption.**

Similarly, 18 respondents mentioned that *“the principles of reducing emissions are not taken into account in tenders and procurement.”* Furthermore, the results show that the lack of trained sustainability experts in organizations is also a challenge in adopting green ICT as 77% of the respondents. Finally, when asked whether employees in their organizations are trained in using equipment following Green ICT principles said, *“we do not train our staff in the use of equipment in accordance with Green ICT”*. Finally, we identified the lack of budget allocation for Green ICT transformation as another challenge when 86% of the respondents stated that *“we do not take Green ICT into account when budgeting”*.

Threat to Validity

Construct validity refers to the extent to which the operational measures that are studied represent the researcher's objective and whether they asked the research questions correctly [12]. All three authors are part of the nine-member green ICT ecosystem project team and were involved in drafting the survey questionnaire. *Internal validity*: Internal

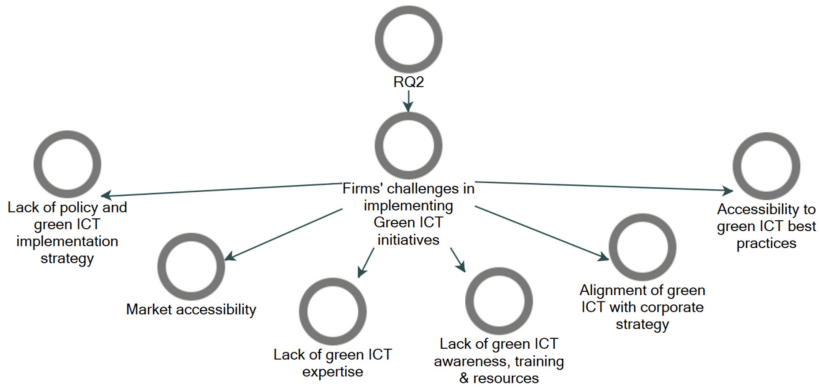


Fig. 1. Challenges of adopting Green ICT practices in organizations

validity refers to unforeseen factors that might influence the study's outcome that the researchers are unaware [12, 13]. One possible threat is the bias in interpreting and analyzing the survey findings. Hence, during the data analysis of the responses, the authors first discussed the survey questions among themselves to ensure that we did not go out of the scope of our research questions. Based on this iterative process, we are confident that the potential bias of a single author was minimized. *External validity*: This aspect of validity refers to the extent to which the findings of this study can be generalized and to what extent the findings are of interest to other people outside the investigated case [12, 13]. As with all qualitative studies, the results of this study cannot be generalized because the number of respondents is not representative of the entire ICT sector. As such, there is the possibility that had there been more responses to the survey, different themes and insights might have emerged. However, given the rigorous process that we followed, we are confident about the findings that emerged from this study.

5 Discussion and Conclusion

The results showed an interesting trend in what motivates organizations to adopt green ICT practices (**RQ1**). We noticed that most of the organizations' interests were related to the environment and social factors while and governance factors which concern the alignment of sustainable digital transformation strategies with the organization's sustainability goals, were least considered. Again, we realized that respondents did not mention economic reasons such as competitiveness or demand and supply factors as shown in [8]. Perhaps, organizations see investment in green ICT as cost-draining investment and could not promise shareholders on the return on their investment (ROI) in green ICT. Regarding **RQ2** (Challenges in adoption green ICT), we can categorize the challenges to internal and external challenges. The lack of alignment of green ICT initiatives with corporate strategy, lack of sustainability awareness, training, and resources as well as the lack of green ICT expertise and budget allocation could be addressed by management. Leaders must support their organizations' green ICT interests with solid commitments and clear corporate strategies [2]. Furthermore, organizations need support systems from

other ICT stakeholders to overcome the external challenges such as the accessibility to market and green ICT best practices. Despite Finland setting ambitious goal to achieve carbon neutral by 2035 and announcing climate strategy for the ICT sector, organizations still have challenges in adopting green ICT principles. This also comes as a surprise despite organizations expressing motivations and interest in at least environmental and social dimensions of sustainability. We envisage that, when organizations continue to face challenges in implementing their green ICT initiatives due to for instance unavailability of best practices, trained human resource, guide on how to develop green ICT initiatives that is aligned with their digital transformation strategies, overtime, motivation to adopt and implement green ICT practices will decrease and eventually abandoned. In other words, the success of green ICT implementation in organization depends not only on the motivations but also on the availability of resources, commitments from company leadership, and having an ecosystem where organizations can learn, share best practices, and source green ICT and software solutions.

Overall, this study supports the relevance of creating green ICT awareness [14] and the need to build a green ICT ecosystem where various stakeholders collaborate to co-create and co-design sustainable ICT products and services to ensure the convergence of sustainability and digital transformation. This will provide organizations better opportunities to innovate sustainably, reduce their negative environmental impact and leverage the power of co-creation and co-design of the ecosystem to remain competitive. From this study, several future research directions emerged. As our study is based on limited survey participants, another exciting avenue will be to include interviews and company annual reports to compare statements on sustainable digital transformation and actual commitments on those initiatives. Also, another avenue is to investigate the implementation of sustainable digital transformation among organizations operating in countries with climate strategy for the ICT sector and those operating in countries without government policy on sustainable ICT.

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