"We are always on, is that really necessary?" Exploring the Path to Digital Sufficiency in Flexible Work

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***Abstract*—Companies are increasingly adopting cloud-based solutions to provide their employees with tools for flexible work. The environmental consequences of this trend, although largely under-researched, are likely to be negative. In fact, by enabling integrated and easy-to-use features (document collaboration, backups, online meetings, etc.), using the cloud typically leads to a growth in data traffic and outsourced computation. At the same time, the 2022 IPCC report (Intergovernmental Panel on Climate Change) calls for *sufficiency* measures to reach net-zero emissions, i.e. actions on the *demand* side to avoid unnecessary consumption of resources. However, how much and which cloud usage is "sufficient" for flexible work?**

This exploratory study looks into this question by using qualitative research methods. We carried out three focus groups within two companies, investigating the daily use of digital technologies in flexible work. A thematic analysis using open coding was performed on the outcome. Our findings include *(i)* a list of main digital work activities and differences according to work settings, *(ii)* the perceptions of what makes certain digital activities or their cloud feature *necessary*, and *(iii)* a list of tactics towards sufficiency and the perceived benefits and challenges associated to them. In our increasingly connected work environments, there are plenty of opportunities to decrease our digital footprint by re-centering on the essentials, and simultaneously bring co-benefits like focus, and better quality of life.

Future work could identify the cultural part of what is perceived as *necessary* by running the same study in other countries and professional environments. Further research would also be helpful to identify the potential impact and acceptability of the identified tactics.

***Index Terms*—qualitative research, focus group, digital sufficiency, sustainability, cloud computing, moderate use, work productivity, digital wellbeing, green IT, degrowth**

I. Introduction

Our modern human societies are damaging the Earth's ecosystems by extracting resources and releasing pollutants and greenhouse gases. This causes unprecedented harm to biodiversity – and ultimately ourselves. One way to reverse the trend is to keep our lifestyles and make everything more *efficient*. Another way is to start questioning our levels of consumption (and their highly unequal distribution) and focus on our needs for a decent and fulfilling life, i.e. *sufficiency*.

For the first time in 2022, the IPCC provides in its report a definition of "sufficiency policies". They are "a set of measures and daily practices that avoid demand for energy, materials, land and water while delivering human well-being for all within planetary boundaries" [1]. The focus shifts from "reducing the amount of resources needed for a given good or service" (*efficiency*) to reducing the demand for these goods or services *themselves*. While efficiency measures may lead to rebound effects by making the good or service more accessible, sufficiency measures tackle them, in principle, by setting limits to final consumption. This immediately raises the question of defining these limits while still ensuring "well-being for all within planetary boundaries".

Sufficiency in the ICT industry. The digital industry as a whole was already estimated to be responsible for 1.8%-2.8% of global GHG emissions in 2020, and this impact is projected to increase in the coming years [2]. Behind this growth lies an increase in usage: new users, new use cases, multiple devices, high replacement rate, etc., overcompensating the gains in efficiency. In this race for increased digitalization, the cloud[1] and global cloud migration [4] plays a central role. It allows access to everything, always and everywhere. This may lead to "unsustainable patterns" like overconsumption or superfluous usages [5] and brings us back to our original question: "How much and which cloud usage is *sufficient*?".

This study. In this work, we focused on professional usages, specifically in the context of flexible work[2]. In fact, remote working is largely enabled by the cloud and has a particular interest for sustainability because of its potential to reduce environmental impacts from commuting. However, this work mode may also lead to numerous rebound effects (see II-B).

This exploratory study aims to build initial knowledge in the opportunities for digital sufficiency in our daily professional lives, by using qualitative research methods. In practice, we analyzed the data collected from three focus groups with a total of 11 participants working in two different companies. We looked into their daily work activities performed on a computer or phone, simply called "tasks", and aimed to answer the following research questions:

(RQ1) Which tasks are cloud-based?

(RQ2) What types of cloud-based tasks are perceived as necessary, and under which circumstances?

[1]The term *cloud* in this article is to be understood in its broad sense i.e., "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources" [3], and for end-users (SaaS model)

[2]*Flexible work* is, in a definition by the UK government, "a way of working that suits an employee's needs, for example having flexible start and finish times, or working from home" [6]

(RQ3) What is the perception of the benefits and challenges when superfluous activities are provided *on demand*?

The paper follows the progression of the research questions. After providing some background and related work (Section II), we describe the details of our qualitative method and its execution (Section III). We list the tasks identified by the participants and differences in different work settings in Section IV (RQ1). From there, we present in Section V the participants' perception on what is needed and what is superfluous, and elicit tactics towards sufficiency (RQ2). We expose thereafter in Section VI the benefits and challenges associated with having cloud services *on-demand* (RQ3). We end this paper with a discussion on our findings (Section VII) and potential threats to the validity of our study (Section VIII).

II. Background and related works

The starting point of this study was the concept of digital sufficiency, which we investigate in the context of flexible work. In this section, we provide some background information about these two notions.

A. Digital sufficiency

Previous attempts for the quantification of human needs include the definition of Decent Living Standards (DLS) [7]. These comprise an inventory of universal material requirements for everyone. For each DLS, Millward-Hopkins et al. [8] derive quantitative thresholds: square meters of floor space per person, kilometers of mobility, etc. Those measures can in turn be converted into primary energy requirements (Joules), to put into perspective with the world's available resources. The DLS "household access to information and communication services" relates to digital technologies, for which they choose "one phone per person over 10 years old, one computer or television per household and access to an internet infrastructure" as a material requirement [8]. However, in contrast to e.g. calculable nutritional needs, this choice remains rather arbitrary as human "basic needs" for digital technologies can majorly depend on the social and cultural milieu.

All the same, the notion of "digital sufficiency" has started to emerge in the scientific literature [9], [10] and public discourse (see for example in France, under the name "sobriété numérique", with recent reports from think tanks or public institutions [11]). Santarius et al. define it as "any strategy aimed at directly or indirectly decreasing the absolute level of resource and energy demand from the production or application of ICT" [10]. They do not claim to provide a definition of our "basic digital needs", but rather conceive a conceptual framework. Consisting of four dimensions[3], this framework is helpful to identify challenges that prevent resource or energy saving and propose measures and policies to tackle them. Digital sufficiency measures are broken down by stakeholder and sufficiency dimension. A few examples are: blocking advertisement by default (service provider), producing long-lasting and reparable hardware (manufacturer), returning the device to collection points (private user) or regulating data collection (policy-maker). The authors' viewpoint focuses on starting from the current situation and adopting basic principles to avoid making it worse.

Another, more applied approach to digital sufficiency is the work of Widdicks et al. They explore which internet use is deemed as *necessary* and *unnecessary* in their own personal daily lives, and discuss the adaptations they developed to disconnect or reduce their use [12]. In a more recent work, they investigate how to design for "more meaningful and moderate online experiences" [13], by organizing design workshops with external participants and carefully analyzing the output material (transcripts, prototypes, post-its) through thematic coding. They ultimately develop concrete design recommendations, like "internet speed bumps" to set limits to digital consumption or "stripping back layers of service" to only retain the most meaningful content. This last study is very similar to ours, and we drew a lot of inspiration from their method. However, Widdicks et al. focus on personal use of digital technologies, whereas we investigate its use in the professional context.

B. Flexible work

New technologies are infiltrating the workplace as well as our private lives to such a great extent that today it seems impossible to do without them. For some categories of jobs (e.g. research or consulting) they have enabled people to work more flexibly by using doing remote work. The COVID-19 pandemic accelerated the adoption of telecommuting. During the first global lockdown in 2020, many people were forced to work from their home, resulting in a growth of 15-20% of internet traffic within a week (and 200% for remote working applications like VPN and video conferencing) [14]. Remote working is commonly admitted to have rather positive environmental implications, by reducing physical commuting. Nevertheless, we see at least two reasons to be vigilant. First, the true environmental consequences of remote work become more complex when energy use at home, induced internet traffic and other rebound effects are taken into account [15]. Second, digitalization in this area continues to develop at a fast pace. The calculation should be revised when innovations such as spacial video, digital smell or digital touch [16] come into being, with all their induced effects.

Our work attempts to take stock of the current needs for a decent and quality flexible work experience. It starts by making a list of digital usages for work. Some taxonomies exist in the literature, like the taxonomy of software types of Forward and Lehbridgen [17] or the categorization of cloud use cases of Milenkoski et al. [18]. We preferred to these theoretical classifications bottom-up collections from the field, like in the thesis of J. Stiles [19]. Using qualitative and quantitative methods, he investigates the impact of cloud computing on work location decision-making. He identifies five categories of cloud usage for flexible work, namely using messaging platforms across multiple devices, accessing shared company

[3]Digital sufficiency dimensions [10]: hardware, software, user and economic sufficiency. See their definition in Table IV

databases, video/audio conferencing, document-sharing and collaboration, and online project management. Our results are in line with his categories.

To the best of our knowledge, digital sufficiency is a rather new concept that remains unexplored in the context of flexible work, which is what we attempt in this study.

III. Study Design and Execution

To address our research questions, we apply a mixed-method empirical research design that is intended to be conducted inside companies, and that, for each participating company, combines a preliminary interview with a knowledgeable person, with one or several focus groups with employees.

A. Preliminary interview

The first study step is a one-hour interview consisting of 11 questions with a top manager or IT responsible having a good overview of the company. The intention is to *(i)* identify the working culture and the company's vision for flexible work, and *(ii)* gather data on the IT infrastructure and solutions used to support work. The interviewee also helps identify the types of roles and the specific people covering such roles within the company, and hence that are relevant to include in the focus groups. Finally, they act as a champion to recruit such people.

B. Focus groups

The second and main step of the study consists in a series of focus groups organized as follows. The participants gather around a table and are given a sheet to fill out that they can use for individual note-taking. The facilitator has slides with the prompts to guide the discussion and a white board for collective note-taking. Each session lasts about two hours and follows an identical structure:

1) *Introduction and context.* The context of global greenhouse gas emissions and the increasing projected contribution of the ICT industry is presented by the facilitator. The concepts of "digital sufficiency" and "flexible working" are defined and the goal of the study is explained.
2) *Warm-up: smartphone usage.* The participants are asked to choose from a list the three *most frequent* uses of their smartphone. Then, they choose the three uses that they find the *most necessary* for them. Going around the table, the facilitator asks: "is there one task that you do frequently but is not on your necessary list?" This warming up exercise is used as an ice-breaker and an invitation to radical thinking. The discussion allows the facilitator to highlight the addictive nature of new technologies and the differences between *needs* and actual *usages*.

   From here, the data collection begins:
3) *Working week organization.* Going around the table, the participants describe the organization of their working week with regard to flexible working (work location, working hours, work-life balance).
4) *Cloud-based usages for flexible work* (RQ1). In the different working settings previously identified, the participants list the daily tasks they do for work on their computer or phone and identify the ones that are cloud-based. The discussion takes the form of a brainstorming, with the facilitator leaving them time to think and take individual notes before sharing to the group. During the discussion, the facilitator notes the tasks on the white board and links them to specific working settings.
5) *Tactics towards sufficiency* (RQ2). For each cloud-based daily task, the participants are invited to reflect: "could you do without? If yes, how? If no, why?". The discussion is left open and interactive, with the participants using their notes and the white board to recall the previously collected tasks and the facilitator making sure to cover most of them.
6) *On-demand activation* (RQ3). Finally, the participants are asked to focus on possible ways to embed sufficiency in their own work practice. They discuss the potential benefits and challenges for different cloud-based tasks.
7) *Wrap-up.* The facilitator closes the session and thanks the participants, after making sure that nothing was forgotten and answering potential questions.

The slide-deck for the focus groups contains 14 slides that were made visual by the use of colors, icons and minimal text.

C. Study execution

We carried out a dry-run of the focus group session with five colleagues to collect feedback and check for potential problems. After this session, we made minor changes on the slide-deck and decided to help the participants keeping track of the conversation by distributing a pre-filled sheet for individual note-taking and taking collective notes on a white board.

Then, we rolled out the study in Nov-Dec 2022 in two companies, Company A (a SME) and Company B (a large multi-national), in the Netherlands. The participating companies were found within our network of industrial relations.

We conducted a preliminary interview by videoconference with our contact in each company. Afterwards, these people kindly took charge of the recruitment of participants for the focus groups, by reaching out internally and making sure to get a representative panel of roles and responsibilities. They both participated themselves. The focus groups took place in-person on company premises. We carried one focus group at Company A with four participants and two focus groups at Company B with three and four participants, respectively. Table I provides the anonymized demographic information about the participants.

D. Data analysis

The interview- and focus group sessions were video-recorded. The focus groups were transcribed, producing 67 pages of text from 5 hours of discussions, constituting the primary data for analysis.

We performed a thematic analysis [20] on the data, with the help of the qualitative analysis software Saturate[4]. We progressed by open coding, defining and modifying the codes

[4]www.saturateapp.com

TABLE I
THE FOCUS GROUP PARTICIPANTS.

P#	Age, Gender	Occupation	FG#	work locations*
1	36-45, M	Consultant	A	**H**, O, C
2	26-35, M	IT developer	A	**H**, O
3	36-45, M	IT developer	A	**H**, O
4	56-65, M	Consultant	A	**H**, O, C
5	36-45, F	HR manager	B1	**H**, O
6	18-25, M	HR recruiter	B1	**H**, **O**
7	36-45, M	IT support	B1	**H**, O
8	26-35, M	Sustainability Procurement	B2	**H**, O
9	18-25, F	Sustainability Operations	B2	**O**, H
10	46-55, F	HR manager	B2	**H**, O, CW
11	46-55, F	Sustainability Procurement	B2	**H**, O

*we reported the work locations from which the participants declared to work more than one day a week (**bold**: more than two days a week).
Abbreviations: H:Home, O:Office, C:Customer site, CW:Co-Working space

through the analysis. One researcher generated the initial codes from the transcripts and the other reviewed them critically, indicating where he/she would have coded differently. Progressing by iterative steps, we produced a Codebook consisting of 248 codes sorted by three levels and by research question.

E. Replication package

For the sake of transparency, we provide a replication package in Zenodo [21] containing the material used in the study. The package includes:

- the interview guide for the preliminary interview
- the focus group slides and note-taking template
- the Codebook containing all the extracted codes along with their definition, number of occurrence in the transcript and description on when the code is applicable

For privacy reasons, and upon agreement with the participants, the video recording and transcripts are not included, and the data is anonymized.

IV. CLOUD-BASED USAGES FOR FLEXIBLE WORK

Our participants' cloud experiences in relation to flexible work are presented in three parts corresponding to the sections below: IV-A) the list of their digital activities, IV-B) the differences observed between different work settings, and IV-C) the impact that the cloud and COVID-19 have had on the way we work.

A. List of tasks

The daily work activities performed by our participants on a computer or phone (simply called "tasks") are summarized in Table II. We reported only general-purpose tasks, cross-cutting different functions inside the company, and excluded function-specific tasks, e.g. coding, CV-screening, employee advising. Please refer to the Codebook [21] for the complete list. Such a list, emerging from the field, is an important basis to reflect upon sufficiency in everyone's context of flexible work.

When asked "which of the tasks are cloud-based?" (RQ1), our participants actually struggled to find some that did *not* rely on the cloud. As P10 expressed it: "everything is cloud-based in the work that we do". For this reason, the answer to RQ1 is nuanced. All the same, we could identify three categories:

1) **tasks that require constant access to the cloud** (e.g. meeting online (P4), processing internal requests on an internal tool (P6, P7));
2) **tasks that only need access to the cloud from time to time** to synchronize (e.g. coding using GitHub (P2), collaborative editing on a shared file (P7)); and
3) **tasks that do not use the cloud at all** (e.g. modifying a local file (P1), physical meetings (P5)).

Some tasks fall either in the first or the second category, depending on the technical solution used. For example, P1 explained that for some email accounts he uses a web version, and for some others, a desktop version.

Suggestions towards sufficiency
Strategies to reduce cloud usage could be adopted, where possible, to move from the first to the second category, or from the second to the third one.

B. Work settings

Are the work activities different depending on the work setting? The first observation is that all the participants are *mobile* workers: all of them work from home and from the office at least one day a week each (see Table I). They are also mainly *remote* workers: 10 out of 11 have home as their main location (in fact, for Company A, working from home except on Fridays is the common practice).

During the focus groups, the participants were asked to describe their work settings and potential differences between work settings in the tasks they perform. Five work locations emerged: home, the company office, a customer site, the car and the train. Besides, some participants (P8, P9, P10) are mobile between different locations where their company has an office. The overall impression is that *their work locations are completely interchangeable* (P1, P2, P4, P9, P10): "I do exactly the same here than at home" (P2). Small differences remain however, for example the case of transports, as P4 pointed out: "only the case of transport, that's a different situation".

We enumerate the reasons driving the choice of a work location, divided in three themes (IV-B1). And, once at a specific location, specificities of the location in terms of tasks performed (IV-B2).

1) Reasons to choose a location: the choice of work location can be guided by the task nature, by personal preference or by absence of alternative.

a) Task driven: The most important driver seems to be the task locality: "there are appointments where I just need to be on a certain location" (P1). It can as well be the access to specific gear: "at home office I have a huge screen that's really helpful if you're coding" (P1). P5 also mentioned confidentiality reasons to work from home when she has to deal with employee matters.

TABLE II
LIST OF GENERAL-PURPOSE DIGITAL USAGES FOR FLEXIBLE WORK IDENTIFIED BY THE FOCUS GROUP PARTICIPANTS.
Sorted from the most mentioned to the least mentioned (see column #). Function-specific tasks are excluded.

Task	#	Description
email	9	Reading and sending emails
messaging	6	Communicating through instant messaging
planning	5	Making appointment, organizing one's week.
online meeting	5	Participating in a meeting through a videoconference tool
phone	4	Communicating through a phone call
reviewing	4	Carefully examining data or documents to find out whether changes or improvements need to be made
project management	4	Organizing a (personnal or collective) project with an online tool
data analysis	4	Examining and making sense of data, most of the time with a speadsheat
preparing presentation	3	Structuring the presentation, creating the support material
giving presentation	3	Presenting, remotely or physically, with or without the help of support material
gathering information (internal)	3	Searching and browsing for information on an intranet
gathering information (external)	3	Searching and browsing for information on the internet
writing time	2	Declaring one's time spent on each project or department, using internal tools
writing documents	2	Producing virtual documents
watching video	1	Watching a video, streamed or not
taking notes	1	Writing down information about something happening, for future notice
online training	1	Learning new skills for a particular job through online resources
online presence	1	Providing a substitute to being in the same room, e.g. with video on and mike only when needed
creating visuals	1	Producing graphs, schemes, flowchart etc. for strategy planning
brainstorming	1	Interacting with other people to suggest many ideas on a topic
attending digital event	1	Participating in an online event, through a videoconference, video-streaming or dedicated tool

b) Opportunistic driven: The reason to go to the office that came back often is the opportunity to see colleagues. For example, some teams in Company B have introduced the "team day": "our team tries to come together and actually see each other once in a while, so we decided that Tuesday was the best day for that" (P5). Otherwise, in this highly remote environment, home is the default (P1, P4, P6). Other reasons are personal attraction to certain locations (P8, P10, P11), or appeal for change of scenery (P9). P5 also mentioned the problem of availability of office space as a reason to stay at home. The opportunistic nature of the choice of location was well summarized by P1:

> "for me flexible work means [...]: being there where you need to be, followed by being there where it is most efficient or most suitable, the easiest place of working" (P1)

c) No choice: Finally, in some cases, there is no choice because there is only one alternative, e.g. for the colleagues of P10 which are on a fully-remote contract.

Suggestions towards sufficiency

Awareness of the reasons to choose a location allows planning ahead for quality work in an appropriate environment, e.g. by grouping together tasks that require the same location.

2) Choice of tasks driven by location: The participants also revealed differences between work locations, in terms of the tasks they choose to perform there. For the sake of space, we will report here only about the most discussed: tasks in the train (differences for other locations can be found in the Codebook). Similarly to the car, the train as a work location stands out because the worker only stays for a limited time and does not have all the usual comfort (space, good internet connection). On top of that, in a train, one does not want to disturb the other passengers. These have various implications depending on the participants. Some said they never work from the train (P8). Some reported using the travel time to focus on individual tasks: answering emails (P1, P5, P10, P11), preparing a presentation (P11), doing data analysis (P10), reading up (P11) or chatting (P11). Finally, some tasks were identified as never done in a train, namely having a meeting (P1, P4, P11), giving a presentation (P1), for obvious reasons of discretion, or screening CVs (P6), for confidentiality reasons.

If the train as a place to work has many disadvantages, one participant reported enjoying working there a lot, being focused and efficient:

> "I take the train at 6:30 and I have those two hours. I'm so productive between 6:30 and 8:30! I do so much! That's why I love it, actually. Because I have no other emails. I just focus on what I have to do. I'm not disturbed." (P11)

Suggestions towards sufficiency

Working from constrained environments allows progressing on individual tasks while reducing one's digital usage to the essential.

C. Impact of cloudification

New technologies have profoundly modified the way we work and the pace of work. Along the study, we collected evidence that more recently, the over-availability of work tools brought by the cloud has further reshaped the organization of work. This phenomenon has been amplified by the lockdowns

and social distancing measures imposed during the COVID-19 pandemic. Even if we did not specifically ask the participants, this topic often came in the discussions. The participants reported that work has accelerated (IV-C1), has become fragmented (IV-C2) and involves less human contact (IV-C3). They also felt the impact of this new work paradigm on wellbeing (IV-C4).

1) Acceleration of work: P4 perceived an increase in productivity: "that's a revolutionary time now, how you work. [...] for us it changed a lot the last few years. I think the productivity is higher". Since the pandemic, people started working from home more (P4, P5): "I remember we would come to the office be default at least 4 times a week and now it's more the other way around" (P5). There are more online meetings (P5, P7) and more digital events (P8, P11). P11 mentioned the new common practice of having 'back-to-back meetings' i.e., series of online meetings straight after one another, symptomatic of contemporary way of working.

2) Fragmentation: The 24/7 availability model results in the workers multitasking a lot:

> "Cloud definitely help in the availability... whether it's people's availability, whether it's availability of data, whether it's the availability of systems that you use. I mean, it's all there all the time, which is kind of also... brings to risk that you are doing everything at the same time all the time, right?" (P7)

As P1 put it, "there is a lot of fragmentation" (P1): the different projects and tasks of the participant are broken in small parts and spread out over the working week, as opposed to having them contained in dedicated days.

3) Less relationship: Unsurprisingly, a by-product of working more often remotely is to lose human contact. We remind that "seeing colleagues" was an important reason to work from the office for the participants (see IV-B1). P5 declared trying to do more physical meetings now, to build a relationship with the people she works for. In focus group B2, the second facilitator and P11 pointed out that the informal circuit, where one could quickly ask a question to a colleague, has been lost and needs to be replaced by booked meetings.

4) Impacts on wellbeing: The perception of the impacts of contemporary way of work on well-being was mixed. On the one hand, participants appreciated the flexibility of work location and work hours, the time saved in transports or the hierarchical differences that became less visible with online interactions (P10). On the other hand, many participants underlined that working remotely is tiring (P4, P6, P8, P11): "it's mentally draining to keep meeting online" (P6). In P4's opinion, it can be stressful, unhealthy or even lead to burnout. Remote working tends to blurry the personal/professional boundary, as P10 explained: "when you're preparing for dinner or so you're still going on about that last call and think 'oh I need to write this"'. In the end, the post-COVID-19 hybrid system leads to situations where a participant shared having the impression of accumulating the disadvantages of both onsite and remote working:

> "What I find the worst is this mix that I now encounter. There is a lot of things happening on site, in my case. I do have half a day of online meeting followed by half a day of onsite meetings. That's... You have the disadvantages of traveling onsite, and the disadvantages of being in online calls for the other half of the day... So you lose all the advantages." (P1)

V. Distinguishing the necessary from the superfluous

In this section, we tackle RQ2. The participants were invited to reflect on their tasks: "Could you do without? If yes, how? If no, why?" Same as for RQ1, the answer to RQ2 is not black or white. Through the focus groups we intended to get an understanding of the reasons why some tasks are perceived as necessary (52 excerpts collected) or superfluous (26 excerpts).

We will only present here the results for the task "online meeting", symptomatic of contemporary work style. Our motivations for this choice are the amount of data collected for this task and the number of hours the participants spend in online meetings (more than 50% of their working time for most of them, sometimes as high as 80%). Besides, online meeting is probably among the most data-intensive of the identified tasks (Table II). As usual, interested readers are invited to look at the online Codebook [21].

A. Why do we meet online?

The reasons why online meetings or one of its features are deemed necessary by our participants were clustered in four themes, presented below.

Suggestions towards sufficiency
Through the four themes, we give an understanding of the nature of the services rendered by this task, in other words, what to focus on for a sufficient use.

1) Substitute a physical meeting: The participants have online meetings for the same reasons they would have had an in-person meeting. P6 noted that meetings are an essential part of team-work: "[Company B] is a team-based organization, there is no other way to collaborate than through meetings" (P6). P5 strives to have calls with the people she advises, "to give some personal attention" (P5). Finally, P10 simply wants to keep human contact: "I really need the time to talk to people. So can I do it more efficiently? Probably yes, but then I would lose the click with ..." (P10).

2) External reasons: Some participants (P5, P8, P11) work with collaborators spread out in the country, sometimes abroad. When they need to meet, they do it by videoconference. Besides that, doing the meeting online can be imposed by the schedule. P1 described a day in which he had three meetings in three different cities and explains that he could not physically have done them without joining some of them

online. Finally, a topic that came back several times in the three focus groups is the weight of *expectations* on availability: it is assumed that everyone can drop in an online meeting at any time, so people feel compelled to follow that norm. Overall, the three reasons above result to be experienced as external constraints, on which the participants have no influence. Expectations and the *agency* of participants are further discussed in Section VII.

3) Convenience: Remote participation in meetings can also be a *deliberate* choice. It allows saving travel time (P1, P4), making it easier to arrange (P6), or not excluding someone that cannot attend in-person (P6).

4) Camera- and screen-sharing: During the online meeting itself, some features can be enabled or disabled, e.g., the camera. Two participants (P10, P11) expressed a strong feeling: they want to see their interlocutors, all the more since online meetings are becoming a common practice. Camera helps understand nonverbal communication, like facial expressions (P10). Moreover, it was perceived as necessary for important meetings: "If the setting is bigger, with a more formal session, with an agenda and multiple people involved also from other teams, it has to be always with the camera on" (P7). At the same time, P5 admitted that having always the video on is culture-dependent, and noticed a difference in other countries.

B. An excess of meetings

Having online meetings is essential in the eyes of the participants, but not all of them are perceived as necessary. In fact, some seem rather useless, as P6 pointed out ironically: "There's a bunch of meetings about meetings and pre calls for the meeting and then different meetings to evaluate the meetings. It's a lot of... yeah... meetings" (P6). Too many meetings, but also meetings that last longer than what they need to: "sometimes I actually need the full half-hour, and sometimes it's done in 15 minutes. So it's surprising how long the meetings do take in the end" (P5). Several participants (P1, P4, P7) shared having recurring online meetings on their agenda as a replacement of dropping by a colleague when needed. Everyone in the focus groups seemed to relate. This phenomenon of blocking recurring online meetings is also a side effect of the difficulty to find a slot. These meetings are "not driven by any content or agenda" (P7), and end up sometimes being inefficient:

> "In the early days we had corridor meetings. I see someone by the coffee machine and we have a talk. We miss that. So what we do to replace that: we organize meetings to have that kind of conversations. But it's not really efficient because you do it with too many people, and it takes too long" (P5).

Even when a meeting happens physically, an online broadcast may be set up for the people that could not join in person (P5). The norm has become 'online by default', to the point that "you really have to explicitly mention 'this is an *in-person* meeting' because otherwise people would expect that there is a virtual option" (P7). On top of that, some participants noticed having many different clients for the same purpose: "Teams, Skype, Google Meet, Zoom, I forgot the name of the 3 or 4 that I sometimes have to use" (P1). All these applications require an account, to be downloaded, installed, updated.

Suggestions towards sufficiency

While online meetings are essential to the work of the participants, there seems to be substantial room for improvement in finding the *sufficient* quality and amount.

C. Addressing the superfluous: tactics towards sufficiency

From the transcripts of the focus groups, we extracted 48 distinguished tactics that emerged from the conversations (some mentioned by the participants as being already applied in their everyday practice of working flexibly, some others as suggestions of future strategies). The tactics were thematically organized into themes. The result is shown in Table III, ordered according to the goal of the tactic itself (cf. column GOAL).

As illustrated in the Table, we identified three ways to classify each tactic:

- **Who should apply it?** Tactics are meant for either humans (Human Oriented - HO), a computing system itself (System Oriented - SO), or for the context where systems and humans operate, e.g. the organization, the environment (Context Oriented - CO). For example, tactic "offline_with_regular_sync" should be applied by humans, while "raise_awareness" aiming to create a sufficiency mindset in the whole organization, must be adopted by the context.
- **Where should it be applied to?** The identified tactics can be applied to either human behavior (see column NON TECH), or technical artifacts (column TECH). For example, tactic "set_mailbox_quota" is clearly a technical feature, while tactic "disable_camera" requires a change in human behavior, hence is non-technical.
- **What types of effects does it have?** The effects of the identified tactics have been found as either visible to humans and addressing the superfluous (hence implementing sufficiency - column SUFF), or transparent to humans and addressing efficiency (column EFF). For example, tactic "self_regulation" removes distractions, hence promotes sufficiency, while tactic "app_aggregator" supports a more efficient work experience.

Finally, we observe that the goals of the identified tactics are of two kinds, pursuing a positive outcome (e.g. sufficiency, focus, quality of life) or counteracting a negative one (e.g. overconsumption, social pressure, useless communication).

VI. Going offline: benefits and challenges

Towards the end of the focus group sessions, the participants were asked to reflect on their perception of challenges and benefits associated with having cloud services provided *on-demand*, as opposed to being *always on* (RQ3).

TABLE III
EXTRACTED TACTICS TOWARDS SUFFICIENCY

TACTICS (NAME)	TACTICS (DEFINITION)	GOAL	HO	SO	CO	NON TECH	TECH	SUFF.	EFF.
raise_awareness	Inform, sensibilize, share tips&trick on the issue	adopting sufficiency			✓	✓		✓	
sufficiency_in_company_culture	Integrating digital sufficiency principles in the company culture	adopting sufficiency			✓	✓		✓	
train_for_sufficiency	Explaining sufficiency and how to implement it	adopting sufficiency			✓	✓		✓	
local_if_not_shared	Use local, off-cloud solutions if the work doesn't need to be shared	avoiding overconsumption	✓			✓		✓	
use_local_resources	Using resources (manuals, documents, ..) that are locally available rather than internet	avoiding overconsumption	✓	✓		✓		✓	
use_messenging_instead_of_email	Using an instant messaging app instead of sending an email	avoiding overconsumption	✓			✓		✓	
avoid_device_and_data_duplication	Preventing oneself from having several devices with the same purpose or several copies of similar data	avoiding overconsumption	✓			✓		✓	
give_more_freedom_to_employees_to_use-_their_devices	Not restricting employees too much in the usage of their professional devices so that they do not need to have separate ones for private use	avoiding overconsumption			✓	✓		✓	
separate_pro_and_perso_environments	Having a way to separate business from private matters on the same device can help use the same device for both	avoiding overconsumption	✓				✓	✓	
respect_do_not_disturb_status	If someone has the status 'do not disturb', not sending messages or calling that person	avoiding social pressure	✓			✓		✓	
respect_blocked_time_in_agenda	If someone has blocked focus time in his/her agenda, not insisting on scheduling a meeting on that slot	avoiding social pressure	✓			✓		✓	
set_mailbox_quotas	Having a (low) quota on the mailbox size	countering data accumulation		✓			✓	✓	
auto-disappearing_messages	Deleting messages automatically after a certain time in messaging apps	countering data accumulation	✓				✓	✓	
data_lifecycle_management	Archiving or deleting old or useless data	countering data accumulation	✓				✓	✓	
shared_agenda	Having a single and shared agenda could avoid a lot of back and forth communication	decreasing useless comm.	✓				✓	✓	
don't_send_unnecessary_email	Preventing oneself from sending an email that is not necessary	decreasing useless comm.	✓			✓		✓	
use_reaction_functionnality_instead_of-_a_message	Using the reaction functionality in instant messaging instead of sending a textual answer	decreasing useless comm.	✓			✓		✓	
geographical_separation	Having separate locations for work / non-work	improving quality of life			✓	✓		✓	
integrated_environment	Having all features in a same solution to avoid moving data between the solutions	improving user experience			✓		✓		✓
app_aggregator	Receiving messages coming from different sources in a single app allows everyone to use the solution they prefer	improving user experience	✓				✓		✓
self_regulation	Preventing oneself from being disturbed	increasing focus	✓			✓		✓	
block_focus_time_in_agenda	Planning ahead for periods of uninterrupted work on a specific topic, hence making oneself unavailable to others	increasing focus	✓			✓		✓	
define_channel_for_urgent_matters	Informing collaborators of an way to be reached for urgent matters in order to disconnect from other channels	increasing focus	✓			✓		✓	
disable_notifications	Turning the notifications off	increasing focus	✓			✓		✓	
in_person_meetings	Doing a meeting in person rather than online	increasing focus	✓			✓		✓	
prioritize_notifications	Tuning the notifications to give more priority to urgent matters	increasing focus	✓				✓	✓	
set_do_not_disturb_status	Using the status functionality of messaging app to signal one's availability	increasing focus	✓			✓		✓	
stacking_notifications	Being notified at regular intervals instead of in real time	increasing focus		✓			✓	✓	
use_a_focus_app	Making use of an application helping to organize and keep focus	increasing focus	✓				✓	✓	
use_noise_cancelling_headphones	Using noise-cancelling headphones to help focus	increasing focus	✓			✓			✓
work_in_early_morning	Working at times where one gets less disturbed	increasing focus	✓			✓		✓	
switch_off_client	Closing an application, window or tab	increasing focus	✓			✓		✓	
disable_camera	Turning the video off in an online meeting	lowering tech	✓			✓		✓	
accept_low_tech	Working on oneself to accept tools that are *good enough*	lowering tech	✓			✓		✓	
low_video_quality_by_default_in_meeting	Lowering the video quality in meetings by default	lowering tech	✓				✓	✓	
lower_video_quality_in_meetings	Lowering the video quality in meetings	lowering tech	✓			✓		✓	
replace_cloud_with_phone	Replacing the use of the cloud by phone calls or SMS	lowering tech	✓			✓		✓	
use_pen_and_paper	Using pen and paper instead of a digital tool	lowering tech	✓			✓		✓	
cancel_recurring_meeting_if_no_update	Cancelling the next session a recurring meeting when it has no purpose	rationalizing meetings	✓			✓		✓	
prepare_before_meeting	Getting ready before a meeting can reduce meeting duration and increase focus	rationalizing meetings	✓			✓		✓	
replace_meeting_by_an_email	Sending an email instead of having a meeting	rationalizing meetings	✓			✓		✓	
shorten_default_meeting_duration	Setting a lower value for the default meeting duration	rationalizing meetings	✓				✓	✓	
space_out_recurring_meeting	Deciding to meet less often with a person or a group one has a recurring meeting with	rationalizing meetings	✓			✓		✓	
online_meeting_saves_travel	Having a meeting online rather than making people travel	saving emissions	✓			✓		✓	
email_attachment_as_link	Enclosing big files as links rather than attachments	saving resources	✓			✓			✓
auto-scaling	Resource management technique to automatically adapt server capacity	saving resources		✓			✓		✓
automatically_killing_unused_applications	Having a smart feature detecting and killing unused applications on one's computer	saving resources		✓			✓		✓
offline_with_regular_sync	Performing the task offline and only synchronizing occasionally with the online version	saving resources	✓			✓		✓	

This would be achieved for example by applying the tactics "offline_with_regular_sync", "switch_off_notifications" or "use_pen_and_paper", to only name a few.

On the benefits, some (P6, P7, P10) stressed the opportunity to have "more space to focus on a certain task" (P7) or to simply stop being distracted by notifications (P4, P7). Shutting down pieces of software running in the background would also benefit energy consumption (P4).

On the other hand side, being partially offline comes with the risk of missing critical emails (P7, P10), not keeping collaborators updated with the latest version (P9, P10), not being reachable (P3, P11) and not benefiting from automatic backup (P9). The difficulty is also that most things in the participants' jobs happen online (P1) and disconnecting momentarily would require to catch up afterward (P11). Finally, P10 admitted not seeing any challenge as long as the on/off feature is controlled by the user, to which P11 added that the feature should also not have impacts on other people.

In the focus group sessions, we only skimmed over the benefits and challenges encountered by the participants, as we wanted them to reflect primarily on their experiences and think about how sufficiency would influence their work habits. In addition to the reflections above, we notice that main benefits and challenges are already expressed in the goal of the identified tactics, for example "improving quality of life". Of course, the tactics bring co-benefits that require further work.

VII. Discussion

On digital sufficiency. Our study aims to explore digital sufficiency *in practice*. To that end, we narrowed down the context to flexible working. From there, the most logical approach seemed turning to flexible workers and trying to distinguish the necessary from the superfluous in their daily practice. The initial idea was then to focus on what is superfluous and find strategies to avoid it, in different work settings. We were surprised by three results: *(i)* almost all the tasks performed by our participants are cloud-based, *(ii)* their tasks are mostly independent of their work location, and *(iii)* workers identified fewer tasks than expected as superfluous.

Results *(i)* and *(ii)* showcase an almost total cloud adoption and flexibility inside the two participating companies. Results *(ii)* and *(iii)* challenged our initial idea of looking at tasks one by one, in different work settings, to find ways to address the unnecessary. We also noticed that despite our efforts, it was difficult for the participants to adopt critical thinking. This might be explained by the novelty of the concept, but also the complexity of questioning their own practices and the system in which they are embedded. That being said, we could still uncover strategies to improve sufficiency. This occurred both through the focus group discussions (the collected tactics) or through the "suggestions towards sufficiency" (text boxes in the paper) that we, authors, propose in light of the results.

On the tactics in Table III. We observe that most (37 out of 48) are *human-oriented*. This is not surprising, as participants were invited to think in terms of their individual habits. On the opposite side of the spectrum, 6 of the remaining 11 tactics are *context-oriented*, which is a promising result. It could indicate that practitioners are adopting a more systemic mindset by thinking in terms of the needed shift in the organizational culture, and the global ecologic implications. Only 5 tactics out of 48 result to be of technical nature: is that surprising? Maybe it is, in that the starting point concerns technological solutions enabling sufficiency. Maybe it is not (as, after all, it is us humans that determine the balance between the digital and the *nondigital*).

Coming back to the original definition of digital sufficiency by Santarius et al. [10] (see Section II-A), again, we note that our tactics mostly concern only one stakeholder: the private user. It is far from the many other actors they take into consideration, namely producer/developer, seller/provider, organizational user, policy regulator and civil society. Nonetheless, we believe that the identification of the tasks and the questioning of the essential needs of end-users is the starting point for the consideration of sufficiency by the rest of the system. Besides, the identified tactics successfully encompass three of the four dimensions of digital sufficiency (see Table IV).

TABLE IV
Comparison of our tactic classification in Table III (column TC) with the digital sufficiency dimensions [10]

Digital sufficiency dimension: *definition* [10]	**TC**
User sufficiency: *users apply digital devices frugally and make use of ICT in a way that fosters sufficiency oriented lifestyles*	Human Oriented
Hardware sufficiency: *producing and designing hardware for longevity, repairability, and with the least possible resource and energy demand*	NA
Software sufficiency: *software development and implementation that ensures long-term functionality and the lowest possible data traffic and hardware utilization for task performance*	System Oriented
Economic sufficiency: *ICT-borne improvements are used to nurture public and common good instead of economic growth*	Context Oriented

Barriers to the adoption of sufficiency. The biggest challenge of sufficiency is not technical, but rather societal. This study revealed a number of barriers to adopting a more sufficient digital behavior during flexible work. First, reducing user experience to the minimum goes against the most common practice in companies today. P7 pointed out that the use of the cloud has been pushed by his company for years, and that there are discussions about upgrading the laptop cameras for improving the online meeting experience. Moreover, several participants commented on the weight of expectations from the peers. The socio-professional context pushes the workers to always be available and use the latest technologies. We also noticed a low level of awareness on the environmental impacts of digital technologies, both from the participants themselves, but also from the companies that do not show any concern at this point. Finally, while striving to find opportunities for sufficiency, the participants sometimes felt powerless (P1, P5, P9-P11): "I think we're sort of... condemned" (P1). They then tend to turn to efficiency measures, as those seem more attractive:

"If we see that this is necessary to have the cloud,

> shouldn't we try to address how efficient it is in terms of sustainability? [...] So maybe the source of electricity for instance for the data center, to ensure that they are 100% renewable or decarbonized." (P8).

The three tactics with the goal "adopting sufficiency" seem to be a good way to counteract the previous barriers. They aim to shift the culture towards promoting quality of work rather than quantity. This target the "goals of the system" which is, according to Donella Meadows, among the most powerful leverage points to intervene in a system [22].

Points of attention. In this paper, we studied human behaviors in relation to cloud technologies and their environmental impact. We would like to point out that our intention is *not* to demonize all cloud usages. The cloud offers powerful opportunities for a low-carbon transition – starting with the very possibility to work flexibly – as long as its use is controlled, and maybe limited to certain sectors. In addition, the use of cloud for flexible work is certainly not the most computation- and network-intensive usage, compared to e.g., artificial intelligence or industry 4.0. However, we are not aware of any detailed quantification.

We are *not* arguing either that all the responsibility for a sustainable transition lies with the individual, which would be reductive [23]. On the contrary, as noted before, digital sufficiency involves many more stakeholders, and we consider our work as a first step in that direction. Besides, we faced in several occasions the question of the participants' *agency*, i.e., their capacity to deliberately initiate actions to influence the course of events [24]. We saw that their agency is constrained and that action at a higher level is needed.

VIII. Verifiability and Threats to Validity

We ensure the anonymity of our participants, their companies, and their collaborators. Hence, we keep their identifying details confidential, under the human ethics guidelines governing this study. Accordingly, the verifiability of our results should derive from the soundness of the research method. We therefore describe in Section III the study design we followed throughout our investigation, and (within space constraints) reference direct quotes from our participants as much as possible. Despite our best efforts, we are aware of potential limitations to the validity of our results. Below, we follow the classification of Wohlin et al. [25], to discuss them.

Conclusion validity, i.e., if the instruments put in place are suitable for the study purpose. As this is a qualitative study (focus groups) involving humans, one must ensure that misinterpretations are avoided. To mitigate this threat, we designed the study upfront, and run a dry-run session with colleagues to uncover possible issues.

Internal validity, i.e., if the collected data enables researchers to draw valid conclusions [26]. To mitigate this threat, we provided introductory material to explain motivation and context, and to align the participants to a common understanding and terminology. We also embedded, in the focus group sessions, a small exercise for the participants to get acquainted with the concept of sufficiency in their own everyday lives. In addition, to ensure that no important information went unaccounted for, we ended each focus group session with an open-ended question. There, participants could add anything they forgot, and address open remarks.

To ensure the quality and reliability of data analysis, both authors independently analyzed and coded the transcripts of the focus group sessions, and discussed any inconsistencies to check data interpretation, reduce biases in analyzing the data, and formulate the results.

Construct validity, i.e., if the empirical evaluation is appropriate to answer the RQs. A potential threat is the moderator's bias on the collected data. To mitigate this threat, besides determining the questions upfront, we involved a third researcher who would support the moderator in overcoming the subjectivity.

External validity, i.e., the extent to which the results can be generalized [26]. This is an exploratory study and, as such, we do not claim generalizability. Rather, we intend to build initial knowledge on how digital sufficiency can be pursued. However, we recognize two possible validity threats, here, namely *(i)* the fact that the study was carried out in the Netherlands, a country that is very advanced in both digitalization and flexible work; and *(ii)* our participants are all "office workers", mostly working on computers. Consequently, their flexibility and dependence on the cloud might be overrepresented. For both reasons, our results cannot be considered generalizable to all types of work and contexts. However, it could serve as a starting point for further works to build upon.

IX. Conclusion

In this paper, we presented our study exploring the question *"how much and which cloud usage is sufficient?"* in the context of flexible work. We carried out three focus groups in two companies and involving a total of 11 flexible workers. The results provide a preliminary picture of the nature of our digital professional needs, perceived benefits and challenges if we choose to go offline sometimes, along with a first list of tactics towards digital sufficiency at work. Overall, the study shows that our participants are "always *on*". The notion of digital sufficiency resonates a lot with them, even though they need concrete suggestions.

Based on our results and discussions, we identify two promising directions for future work:

- Creating evidence of the actual benefits of applying tactics for digital sufficiency, i.e., select promising tactics, maybe from the 48 tactics that emerged from this work, apply them and measure their actual impacts on e.g., resource efficiency, productivity and flexibility.
- Replicating this study with different types of jobs (e.g., in sectors other than IT) and in different countries (e.g., less digitally transformed).

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REFERENCES

[1] IPCC, "Climate Change 2022: Mitigation of Climate Change. Summary for policymakers." IPCC, Tech. Rep. 6, 2022. [Online]. Available: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf

[2] C. Freitag, M. Berners-Lee, K. Widdicks, B. Knowles, G. S. Blair, and A. Friday, "The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations," *Patterns*, vol. 2, no. 9, Sep. 2021. [Online]. Available: https://www.cell.com/patterns/abstract/S2666-3899(21)00188-4

[3] P. Mell and T. Grance, "The NIST Definition of Cloud Computing," National Institute of Standards and Technology, Tech. Rep. Special Publication 800-145, Sep. 2011.

[4] M. Razavian and P. Lago, "A survey of SOA migration in industry," *International Conference on Service-Oriented*, vol. 7084, pp. 618–626, 2011.

[5] K. Toczé, M. Madon, M. Garcia, and P. Lago, "The Dark Side of Cloud and Edge Computing: An Exploratory Study," in *Computing within Limits*. LIMITS, Jun. 2022. [Online]. Available: https://limits.pubpub.org/pub/dark/release/1

[6] gov.uk, "Flexible working: Definition by the UK government." [Online]. Available: https://www.gov.uk/flexible-working

[7] N. D. Rao and J. Min, "Decent Living Standards: Material Prerequisites for Human Wellbeing," *Social Indicators Research*, vol. 138, no. 1, pp. 225–244, Jul. 2018. [Online]. Available: https://doi.org/10.1007/s11205-017-1650-0

[8] J. Millward-Hopkins, J. K. Steinberger, N. D. Rao, and Y. Oswald, "Providing decent living with minimum energy: A global scenario," *Global Environmental Change*, vol. 65, p. 102168, Nov. 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0959378020307512

[9] L. Hilty, "Computing Efficiency, Sufficiency, and Self-sufficiency: A Model for Sustainability?" in *LIMITS 2015, First Workshop on Computing within Limits*, Irvine, CA, USA, Jun. 2015. [Online]. Available: https://www.zora.uzh.ch/id/eprint/110766/

[10] T. Santarius, J. C. T. Bieser, V. Frick, M. Höjer, M. Gossen, L. M. Hilty, E. Kern, J. Pohl, F. Rohde, and S. Lange, "Digital sufficiency: Conceptual considerations for ICTs on a finite planet," *Annals of Telecommunications*, May 2022. [Online]. Available: https://link.springer.com/10.1007/s12243-022-00914-x

[11] T. S. Project, "Expanding digital sufficiency," The Shift Project, Tech. Rep., Oct. 2020. [Online]. Available: https://theshiftproject.org/wp-content/uploads/2023/02/TSP_DigitalSufficiency2020_Summary_230201-1.pdf

[12] K. V. Widdicks, T. Ringenson, D. Pargman, V. Kuppusamy, and P. Lago, "Undesigning the Internet:An exploratory study of reducing everyday Internet connectivity," in *ICT4S2018. 5th International Conference on Information and Communication Technology for Sustainability*, B. Penzenstadler, S. Easterbrook, C. Venters, and S. I. Ahmed, Eds., CAN, May 2018, pp. 384–397. [Online]. Available: https://doi.org/10.29007/s221

[13] K. Widdicks, C. Remy, O. Bates, A. Friday, and M. Hazas, "Escaping unsustainable digital interactions: Toward "more meaningful" and "moderate" online experiences," *International Journal of Human-Computer Studies*, vol. 165, p. 102853, Sep. 2022. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S1071581922000799

[14] A. Feldmann, O. Gasser, F. Lichtblau, E. Pujol, I. Poese, C. Dietzel, D. Wagner, M. Wichtlhuber, J. Tapiador, N. Vallina-Rodriguez, O. Hohlfeld, and G. Smaragdakis, "The Lockdown Effect: Implications of the COVID-19 Pandemic on Internet Traffic," in *Proceedings of the ACM Internet Measurement Conference*, ser. IMC '20. New York, NY, USA: Association for Computing Machinery, Oct. 2020, pp. 1–18. [Online]. Available: https://doi.org/10.1145/3419394.3423658

[15] W. O'Brien and F. Yazdani Aliabadi, "Does telecommuting save energy? A critical review of quantitative studies and their research methods," *Energy and Buildings*, vol. 225, p. 110298, Oct. 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0378778820317710

[16] Ericsson, "The dematerialized office," Ericsson, Tech. Rep., Oct. 2020. [Online]. Available: www.ericsson.com/industrylab

[17] A. Forward and T. Lethbridge, "A taxonomy of software types to facilitate search and evidence-based software engineering," in *Proceedings of the 2008 Conference of the Center for Advanced Studies, CASCON'08*, Jan. 2008, p. 14.

[18] A. Milenkoski, A. Iosup, S. Kounev, K. Sachs, P. Rygielski, J. Ding, W. Cirne, and F. Rosenberg, "Cloud Usage Patterns: A Formalism for Description of Cloud Usage Scenarios," arXiv, Tech. Rep. arXiv:1410.1159, May 2013. [Online]. Available: http://arxiv.org/abs/1410.1159

[19] J. Stiles, "Working at home and elsewhere in the city: Mobile cloud computing, telework, and urban travel," Ph.D. dissertation, Rutgers University - School of Graduate Studies, 2019. [Online]. Available: https://rucore.libraries.rutgers.edu/rutgers-lib/61118/

[20] M. Maguire and B. Delahunt, "Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars." *All Ireland Journal of Higher Education*, vol. 9, no. 3, Oct. 2017. [Online]. Available: https://ojs.aishe.org/index.php/aishe-j/article/view/335

[21] M. Madon and P. Lago, "Replication package for the study "Digital Sufficiency in Flexible Work"," Feb. 2023. [Online]. Available: https://doi.org/10.5281/zenodo.7645518

[22] D. Meadows, "Leverage Points: Places to Intervene in a System," *The Sustainability Institute*, p. 18, 1999.

[23] E. Shove, "Beyond the ABC: Climate Change Policy and Theories of Social Change," *Environment and Planning A: Economy and Space*, vol. 42, no. 6, pp. 1273–1285, Jun. 2010. [Online]. Available: http://journals.sagepub.com/doi/10.1068/a42282

[24] A. Bandura, "Toward a psychology of human agency," *Perspectives on psychological science*, vol. 1, no. 2, pp. 164–180, 2006.

[25] C. Wohlin, P. Runeson, M. Höst, M. C. Ohlsson, B. Regnell, and A. Wesslén, *Experimentation in Software Engineering*. Springer Science & Business Media, 2012.

[26] J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage publications, 2017.

[5]https://digitalsustainabilitycenter.nl