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Sustainable Information Systems: Insights from Inside

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Abstract

This study is at the intersection of digital technologies and environmental sustainability, focusing on the concept of digital eco-responsibility. Through interviews with a diverse range of organizations, we aimed to identify their perspectives, challenges, and practices regarding digital eco-responsibility. The research revealed that while digitalization is often seen as a solution for growth, it also poses significant environmental challenges, contributing to global greenhouse gas emissions and resource consumption. Organizations recognize the importance of addressing these challenges and have initiated various eco-responsible practices such as responsible digitalization and digital sobriety. However, implementing these practices effectively requires contextualized strategies tailored to organizational needs and cultures. This study is based on a literature review and interviews conducted with 8 experts. It aims to identify the perspectives and practices of digital eco-responsibility across diverse organizations. It emphasizes the need for continuous improvement and monitoring of eco-responsible practices to mitigate the environmental impact of digital technologies. By exploring insights from these organizational interviews, this research contributes to a deeper understanding of digital eco-responsibility and offers valuable insights for developing sustainable digital strategies across different sectors.

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Keywords: Sustainability; Information Systems; Digitalization; Eco-responsibility

1. Introduction

The perception of digital technologies as intangible often leads to underestimating their environmental impact and viewing them as a solution to the climate crisis without challenging current consumption patterns. However, digitalization is a significant contributor to global greenhouse gas emissions, exceeding even the aviation industry's share [1]. Digitalization is sometimes seen as a "third industrial revolution" [2] and the exponential growth in digital usage, driven by factors like smartphone adoption, video consumption, IoT expansion, AI demands, and data traffic, poses sustainability challenges for network infrastructures and data centers [1]. The issue when addressing the environmental impacts of digitalization lies in its usage. Digitalization becomes either a solution or a problem depending on how it is utilized and the significance assigned to it; It is precisely because digitalization is perceived

as a new tool for economic growth that it has become entrenched in our societies, leading to increasingly significant usage [4]. Nevertheless, current digital practices have significant environmental consequences that are not sustainable in the long term. Therefore, it is imperative to reflect on our lifestyles and our value system.

Responsible digitalization [3] and digital sobriety [4] have emerged as strategies to address these challenges. Responsible digitalization emphasizes continuous improvement and minimizing environmental impacts, while digital sobriety advocates for limiting digital usage to essential practices. These concepts, encapsulated in the term "digital eco-responsibility," aim to reduce the environmental footprint of digital activities. However, the current understanding of digital eco-responsibility is still evolving, with various terms like Green IT [5] or Green IS [6] contributing to the complexity. Organizations are increasingly aware of the need to evolve practices but may lack clear implementation strategies. Moreover, this is a long-term process that will need to evolve and be adapted based on encountered circumstances. This approach thus requires tools and indicators to evaluate it, to determine possible improvements and adaptations. It's crucial to define and integrate digital eco-responsibility practices to foster a sustainable approach to digitalization and reduce environmental impacts over time.

We conducted interviews with a diverse range of organizations, including businesses, non-governmental organizations, and associations, to gather insights into their perspectives on digital eco-responsibility. This approach allowed us to capture a broad spectrum of viewpoints and experiences regarding sustainable digital practices across different sectors. The interviews provided valuable firsthand information on how these organizations perceive and prioritize environmental considerations in their digital strategies, shedding light on challenges faced, successful initiatives implemented, and areas for improvement. This multi-sectoral approach enriched our understanding of digital eco-responsibility and offered valuable insights for developing context-specific strategies and recommendations.

This paper is organized as follows. The second section explains the research method and section 3 the related works. The results of the interviews are proposed in Sections 4 and 5. We conclude in Section 6.

2. Research Method

The research method used in this work follows the steps illustrated in figure 1.

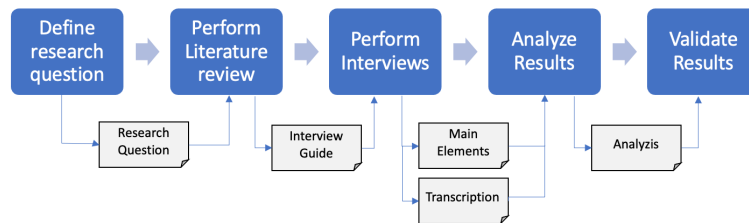


Fig. 1. Research Process.

The main research question is **What are the perspectives and practices of digital eco-responsibility across diverse organizations?** It can be decomposed in: What constitutes an eco-responsible approach for an organization? To what extent do individuals influence the adoption of an eco-responsible approach within an organization? What are the levers, or at least appropriate actions, to implement such an approach in a given environment?

The search for scientific articles was initiated by defining a keyword string that would be sufficiently rich to retrieve works addressing the study subject, yet also sufficiently narrow to ensure relevance. To achieve this, search keywords were based on [7] which lists the main terms used to refer to the digital area with an environmental approach.

Interviews were conducted in 2023 with entities that have initiated such initiatives or offer related services. This approach facilitated a deeper understanding of the challenges and engagement levels within organizations regarding eco-responsible practices. The selection of interviewees was based on their affiliation with the NR Charter of the Institute of Digital Responsibility (INR), ensuring a diverse representation of both private and public entities. While some organizations were signatories, others had taken actions toward digital eco-responsibility, demonstrating a willingness to participate constructively in the study. Overall, the research methodology involved thorough consultations with stakeholders to gather insights and perspectives, ultimately contributing to the development of comprehensive best practices for digital eco-responsibility implementation.

Table 1. Interviewees.

Code	Interviewee Structure	Type	Code	Interviewee Structure	Type
[O1]	Cours des Comptes	Public Organization	[O5]	Fresque du numérique	Association
[O2]	Key4events	Private Company	[O6]	Renault	Private Company
[O3]	Infogreen Factory	Private Company	[O7]	(Anonymous)	Private Company
[O4]	Région Nouvelle Aquitaine	Public Organization	[O8]	CAF de Seine Maritime	Public Organization

All interviews were recorded and transcribed with the prior consent of the participants. An interview guide was provided to each of the organizations interviewed to best prepare for the exchange. This guide also served as the foundation for the subsequent analysis of these interviews. The guide was divided into three parts. The first part was relatively open-ended; its main focus was to contextualize digital eco-responsibility within the interviewed organization. The second part of the interview followed a predetermined framework; it involved discussing potential actions identified in scientific literature and translating them into actions within an entity's context. The criteria discussed were organized into the following axes: information technology governance, awareness and training, procurement policy, storage structures, and so on. The final part of the interview aimed to provide additional information to identify if the discussed measures seemed to cover all axes and means of action related to digital eco-responsibility, or if they felt that certain elements should be mentioned or further elaborated upon.

3. Related Works

Paton-Romero et al. [8] introduce the Governance and Management Framework for Green IT (GMGIT), addressing the lack of standardized guidance for eco-responsible digital approaches [9]. This model emphasizes the importance of governance and management in achieving sustainable goals [10]. Similarly, the SGIMM model [11] assesses energy consumption tools' quality and effects across four domains, providing valuable insights for organizations of different scales. The challenge lies in balancing practicality with complexity in governance models, ensuring they are adaptable and actionable for diverse organizational contexts [11].

Motivations for eco-responsible practices are multifaceted, ranging from internal efficiency to external market competitiveness [12]. Organizational forces such as mimetic, coercive, and normative pressures play a role in driving cultural change towards sustainability [12]. Models like the one proposed in [13] analyze factors influencing the diffusion of Green IS practices, essential for aligning digital strategies with eco-responsible policies.

Research like [14] explores Green IT implementation dynamics, emphasizing the importance of training, awareness, and cultural shifts within organizations. Best practices, as suggested in [15], highlight transitioning to cloud services, considering product longevity, and monitoring environmental impacts. These studies offer practical strategies applicable across diverse organizational contexts, bridging the gap between theory and actionable insights for sustainable digital practices. Innovations on sustainability issues are classified in [16]. The authors identify numerous terms to describe innovations created for the environment and conclude that, despite referring to the same concept, these terms are perceived differently by the various literature authors.

4. Exploration and Prospects of Responsible Digital Practices

Role and Tools for Responsible Digital Initiatives: Organizational Perspectives and Evolution. Among the eight organizations interviewed, two have dedicated positions for responsible digital practices [O2][O6], while four have integrated digital responsibility activities into existing roles [O1][O4][O7][O8]. The remaining two interviewees inherently prioritize digital responsibility [O3][O5]. Implementing responsible digital practices hinges on individual commitment within organizations [O1][O2][O4][O6][O8], motivated by various factors among the interviewees. Some are driven by personal dedication or a desire for institutional change [O3][O5][O6], while others see digital responsibility as a crucial societal and industry issue [O1][O2][O8]. One organization's interest in digital responsibility stems from broader sustainable development policies [O4], although initially not centered on digital aspects. Conversely, one entity lacks a dedicated digital responsibility initiative [O7], yet has departments focused on sustainability efforts that indirectly touch upon digital aspects. The absence of dedicated digital focus in certain organizations can be linked to their primary activities, such as aerospace [O7] or automotive construction [O6], despite

the latter's strategic shift towards technology. Responsible digital practices aren't limited to IT services but can align with CSR policies [O2][O8] or involve multiple departments [O1][O6][O7]. [O4] specifically fosters digital responsibility within the IT department while supporting innovative firms in their digital sustainability efforts. Two organizations have established networks of responsible digital ambassadors, fostering awareness across departments and aligning digital responsibility with business functions [O4][O6]. Employee-driven initiatives often catalyze organizations' engagements with digital and environmental impacts. These personal efforts, spurred by various motivations, lead to increased awareness of digital environmental challenges. Engaging with like-minded communities encourages some interviewees to champion digital responsibility within their institutions, driven by internal and external demands. These initiatives, while recent for some, reflect a growing recognition of responsible digital practices beyond IT departments.

Defining Responsible Digital Practices: Implications and Strategies. From an economic standpoint, sustainable digital practices primarily aim to reduce organizational consumption, leading to cost savings. They also serve as quality benchmarks and differentiation criteria, boosting market share, enhancing employer branding, attracting talent through meaningful work, and attracting investments. On the social front, eco-responsible actions are closely linked to Corporate Social Responsibility (CSR), reflecting attention to diversity, inclusivity, integration of people with disabilities, social inclusion, and accessibility within organizations. Ethical considerations ensure legal and ethical labor conditions throughout the equipment lifecycle, avoiding products made through child labor, conflict zones, or under unacceptable working conditions. Environmental aspects focus on reducing environmental impacts from digital usage, emphasizing carbon footprint reduction, air, water, and soil pollution mitigation, and biodiversity preservation.

Taking a holistic view, an eco-responsible approach encompasses organizational, decision-making, strategic, and technical aspects, influencing specific processes and driving continuous improvement initiatives for organizational resilience. Implementing such an approach faces challenges in aligning with societal shifts, economic factors, quality of service, and citizen-centric considerations, alongside operational challenges in awareness-raising, mastering eco-responsible concepts, and integrating them into organizational goals. Addressing these challenges requires collective awareness, engagement in associations or philanthropy, shaping a digital realm focused on the common good, and considering future generations' needs. Despite defined strategies and action plans, organizations are still in the early stages of implementing digital eco-responsibility initiatives, requiring tailored strategies aligned with organizational activities, resources, needs, and corporate culture.

Future Outlook on Responsible Digital Practices. Interviewed organizations unanimously stress the growing significance of digital eco-responsibility as a collective concern. They emphasize the need for concerted efforts to seamlessly integrate eco-responsible practices into the norm [O3][O7]. However, achieving this objective requires sustained and long-term efforts [O3][O7], including research and development studies to address organizational needs and expectations better [O3][O7]. Advocacy for regulatory frameworks is crucial to foster nationwide initiatives for significant reductions in digital environmental impacts [O3][O7]. Respondents highlight the complexity of accurately forecasting digital eco-responsibility due to the interconnected nature of digital technologies [O3]. This interconnectedness makes it challenging to predict future usage patterns accurately. While observable shifts in consumption habits due to factors like inflation and environmental awareness are noted, these changes are still deemed insufficient by some. Additionally, emerging initiatives require careful scrutiny to avoid falling into greenwashing traps [O3]. Despite progress and increased awareness, two organizations express concern about fragmented actions and their limited impact compared to current environmental consequences and digital usage trends [O3][O7]. Furthermore, the rapid development of new technologies like artificial intelligence (AI) and the Internet of Things (IoT) presents challenges by contradicting frugality principles and fueling digital growth exponentially, significantly contributing to environmental concerns [O3][O7]. The future of digital eco-responsibility extends beyond national borders [O3]. Geopolitical dynamics significantly impact digital technologies, especially concerning material sourcing and electronic components, necessitating assessments of resilience amid potential conflicts [O3]. Finite resources cannot sustain exponential growth indefinitely, leading to an inevitable shift towards a new, resource-constrained model. Navigating this transition effectively requires proactive actions involving engagement with new generations, which are considered essential and feasible [O3][O7].

5. Key Aspects of Sustainable Information Systems Management

Introducing various categories for sustainable digital practices involves understanding key areas that organizations must address. These categories encompass strategic management, operational standards, and technological optimization to promote responsible digital behavior and minimize environmental impact. The categories include Strategy and Initiative Management, which involves creating dedicated roles and defining overarching strategies for sustainable digital practices. Standards and Measurement Tools focus on establishing performance indicators, adopting evaluation tools, and adhering to relevant standards such as ISO 14001. Training and Awareness initiatives aim to educate employees across all departments about sustainable digital practices and integrate relevant skills into training programs. Equipment and Data Management strategies promote reuse, recycling, and optimization of digital resources, alongside responsible data handling and infrastructure management. Responsible Procurement emphasizes the importance of sourcing sustainable digital products and services, while Optimization Practices target efficiency improvements in energy use, data management, and overall digital operations. These categories form a comprehensive framework for organizations to develop and implement sustainable digital strategies effectively.

5.1. Organizational Coordination and Strategy

A specific position for coordinating the eco-responsible approach. Opinions differ on whether to create a dedicated position for digital eco-responsibility: some advocate for a full-time role [O1][O5][O6], while others suggest assigning responsibilities to existing roles [O1][O2][O3][O4][O6][O7]. The decision often hinges on organizational size and commitment [O1][O6]. Large organizations prefer dedicated roles, whereas medium or small entities may opt for focal points. Training or interest in eco-responsibility is crucial for the appointed person [O4][O7], ensuring effective implementation and monitoring [O4][O6]. However, role appointment alone isn't enough; action plans are vital [O4]. Balancing workload is a concern [O2][O6], especially given the depth of research and considerations required. Allocating 20% of a focal point's time to eco-responsibility is suggested. Organizational support, especially from management [O8][O6], is vital for successful integration. Cross-functional roles in large organizations pose challenges [O7], requiring experienced individuals and adequate resources [O5].

A strategy or roadmap for responsible digital practices. All respondents stress the importance of formalizing a strategy for implementing digital eco-responsibility within an organization. Defining this strategy is crucial for setting clear development axes, actionable steps, and achievable goals. However, mere formalization isn't sufficient; proper implementation is key to avoid being perceived as mere greenwashing [O2][O4]. Support from top management is highlighted as essential [O2][O4], as they play a critical role in fostering organization-wide adoption of eco-responsibility practices. Collaboration with various departments is also crucial to consider their unique needs and constraints [O5], fostering greater engagement and accountability. Tailoring objectives for each department based on CSR axes is recommended [O3], allowing for flexibility and integration into existing processes. While some suggest starting with an action plan instead of a detailed strategy [O1], the need for regular revisions post-implementation is emphasized [O1]. One respondent even sees this as the beginning of a new business model for organizations [O6].

5.2. Performance Indicators and Standards

Use of indicators. The use of indicators in a digital eco-responsibility approach is deemed relevant by all respondents. Indicators serve as crucial management tools to assess a structure's position in implementing such an approach. They help measure the initial status and progress made or needed, providing additional arguments to support the initiative with management. However, indicators must be relevant and clear, not numerous but tailored to the organization's situation and goals [O7][O4]. They should be user-friendly, easy to establish and maintain for effective management. Indicators not only aid in management but also facilitate benchmarking, which is highly valued by some organizations for sharing experiences and identifying effective strategies [O6][O8]. However, benchmarking requires comparable organizations, which can be a challenge due to the novelty of digital eco-responsibility initiatives [O2]. Similar business cases are crucial for meaningful comparisons [O3], but in sectors with few comparable entities or complex organizational structures, benchmarking may not be feasible [O7].

Evaluation tools and Norms. Organizations generally find the use of standards or validated frameworks relevant [O1]. These documents are certified by reputable bodies, peer-reviewed journals, or through experiments, providing a reliable basis for implementing digital eco-responsibility initiatives. Compared to labels requiring credibility evaluation, standards offer a more straightforward approach [O1]. They enable self-assessment [O1], promote best practices [O3], provide guidance [O4], and can garner support from management [O2] to initiate eco-responsible strategies. However, criticisms exist. Adapting standards to specific organizations is crucial as they are inherently general and may not align perfectly with each organization's context [O2][O4][O7][O8]. Strictly adhering to a standard for certification suits organizations with eco-responsibility maturity [O1]. Some argue that non-certified procedures can still be valuable aids [O4]. Due to its recent emergence, digital eco-responsibility lacks a robust structure [O6]. Although there are best practice guides and maturity matrices, they may lack contextualization, leading to information overload and decision-making challenges for organizations [O7].

5.3. Budget Allocation and Resource Planning

Organizations differ in their approach to budget allocation for digital eco-responsibility initiatives. Some advocate for a dedicated budget, albeit temporarily [O2][O3][O4][O5][O6], while others propose integrating these expenses into the overall digital budget [O1][O4][O7]. Another viewpoint suggests including these costs in the organization's global budget [O8]. Supporters of a dedicated budget argue that it offers autonomy for experimentation with tools [O6] and training [O2][O5][O6], improving visibility internally [O4]. However, management may perceive it as an additional burden [O2][O4]. On the other hand, proponents of integration into the digital budget stress leveraging existing processes [O4], data centers, and procurement policies [O1], suggesting that specific budgeting may not be necessary as it aligns with ongoing digital budget practices. [O7] recommends integrating these costs into the global budget for better alignment with departmental needs [O8]. However, this approach might face coordination challenges and potential delays, contingent on the organization's size and structure.

5.4. Training and Skill Development

Awareness actions for responsible digital practices. Interviewees unanimously stress the importance of raising awareness and training employees in digital eco-responsibility. This involves sensitizing personnel across departments, especially digital actors and procurement [O1][O2]. Establishing a common language and facilitating communication are deemed crucial for effective coordination [O2]. While implementing comprehensive awareness campaigns can be costly for larger entities [O7], solutions like MOOCs offer cost-effective training options [O8]. Highlighting employees as citizens [O5][O6][O7] extends the impact beyond organizational boundaries, influencing societal digital usage habits positively. Notably, personal digital devices carry a significant environmental impact, emphasizing the need for broad awareness initiatives [O5][O6]. A dual approach to sensitizing employees and citizens is pivotal, ensuring a collective understanding and action toward digital eco-responsibility.

Incorporating skills specific to responsible digital practices into the training plan. Interviewed organizations unanimously emphasize the importance of prioritizing the purchase of reused or recycled components in equipment procurement. It aligns with circular economy principles [O1][O8] and warrants further development. Some interviewees suggest a prioritization order: first reuse, followed by refurbishment, and then recycling [O3][O4]. However, this measure may not be suitable for all types of organizations [O4][O6]. Implementing reuse practices is more feasible for small organizations [O6], while large enterprises, especially those reliant on external providers, face challenges due to the need for configuration uniformity across numerous devices [O6]. Identifying equipment suitable for reuse, refurbishment, or recycling post-procurement can optimize digital eco-responsibility efforts, even with limitations from national procurement markets [O8]. Encouraging reuse and refurbishment internally or externally post-procurement remains achievable [O2][O8], promoting sustainability beyond initial strategies.

Internal training for equipment repair. The interviews highlight that internal training for equipment repair is not the main focus; rather, it's about instilling a culture of repair. It's relevant to have internally trained personnel for basic

services and to use external providers when needed [O3][O4][O5][O6][O7][O8]. The decision may also depend on costs and timelines [O1][O2][O4]. If opting for an external provider, it's preferable to prioritize circular economy principles [O8]. However, this criterion may not always apply universally across organizational contexts. Some large companies use external providers for equipment supply under leasing contracts [O6][O7]. Consequently, when equipment needs repair, it's sent back to the provider who may or may not perform the repair.

Importance of prioritizing the purchase of reused or recycled components. Interviewed organizations unanimously emphasize prioritizing reused or recycled components in equipment procurement. This approach aligns with circular economy principles [O1][O8] and warrants further development. Some interviewees suggest a prioritization order: reuse first, followed by refurbishment, and finally recycling [O3][O4]. However, this measure may not suit every organization type [O4][O6]. Implementing reuse practices is more feasible for smaller organizations [O6], while larger enterprises, especially those relying on external providers, face challenges due to configuration uniformity needs across numerous devices [O6]. Identifying equipment suitable for reuse, refurbishment, or recycling post-procurement can optimize digital eco-responsibility efforts, even if national procurement markets limit initial procurement policies [O8]. Encouraging reuse and refurbishment internally or externally post-procurement remains viable [O2][O8], promoting sustainability beyond initial strategies.

Prioritizing the purchase of sustainable equipment. Interviewees unanimously stress the importance of prioritizing sustainable equipment purchases. However, challenges exist, such as ensuring suitability for intended use [O4] and navigating complexities in implementation [O2]. Such measures may only take effect during subsequent refresh cycles, with returns on investment visible long-term, reflecting a need for foresight and sustained commitment [O2][O4]. Engagement with suppliers is proposed to drive eco-responsible agendas [O3][O6], potentially encouraging legislative interventions to establish minimum thresholds for sustainable equipment purchases [O1]. Considerations extend to software design for hardware compatibility, further emphasizing the necessity of legal frameworks to foster broader sustainable practices [O5]. These diverse perspectives converge on the strategic integration of sustainability considerations into organizational and legislative frameworks for meaningful and lasting impact.

Prioritizing the purchase of eco-labeled IT equipment. Once again, all interviewed organizations agree that prioritizing the purchase of eco-labeled IT equipment is relevant. It would involve adding an additional criterion to the procurement policy [O6]. However, it is essential to verify the reliability of the label before making any acquisitions [O1][O2][O3][O4]. Several organizations also note that the certification process can be lengthy and costly. Therefore, there may be suitable solutions without a label that can be considered [O1][O2].

From a business perspective, one interviewee believes that buying eco-labeled equipment contributes to the entity's positive image, potentially gaining market share [O7]. However, if obtaining a label incurs additional costs in equipment acquisition, this measure may not be suitable for all organizations based on their financial means [O7].

One entity also considers it necessary to discuss this measure with suppliers so that they initiate initiatives that contribute to digital eco-responsibility by evolving their service offerings [O5].

A sourcing policy within the procurement strategy. Interviewed organizations express significant interest in implementing sourcing policies as part of their procurement strategies, focusing on tracing supply and manufacturing chains to uphold human rights standards [O1][O2][O3][O4][O5][O6][O7][O8]. However, one entity downplays the ethical significance due to perceived indirect impacts [O8], while others emphasize concerns such as child labor [O4][O6][O7] and materials from conflict zones [O3][O6][O7]. Despite enthusiasm, challenges in implementation are noted, particularly for resource-limited organizations [O1][O4]. Sourcing policies seem more feasible for larger entities, while smaller ones can include sourcing clauses in contracts to improve transparency [O1][O2][O4][O8]. This approach can benefit all organizations, with suggestions to encourage suppliers to develop independent procedures [O2][O5] and create responsible supplier charters [O2] for quality assurance and policy alignment. Additionally, integrating sourcing policies goes beyond digital eco-responsibility, acknowledging environmental crimes and contributing to societal awareness [O3]. This broader perspective aligns ethical standards with organizational practices, fostering a more responsible and informed supply chain approach.

Partnering with an organization specialized in recycling. The majority of interviewees find partnering with a specialized organization for recycling or refurbishing waste electrical and electronic equipment (WEEE) relevant for end-of-life equipment management [O1][O2][O4][O5][O6][O7][O8]. However, they stress the importance of prioritizing reuse and refurbishment over recycling [O3][O4]. Recycling is seen as a last resort due to its complexity, environmental costs, and lack of transparency in processes [O2][O5]. Several organizations also note that dedicated WEEE organizations may lack the capacity to handle all end-of-life equipment from larger entities [O6][O7]. Leasing contracts complicate this measure, but clauses can be included to address recycling, reuse, and refurbishment concerns [O6]. Additionally, one entity advocates for legislation to promote WEEE recycling at a broader scale [O8].

5.5. Infrastructure and Data Management

Optimizing the organization's IT asset management. Interviewed organizations unanimously stress the importance of optimizing IT asset management. Precise tracking of IT assets is crucial for understanding and controlling them [O1][O6][O8], leading to reflections on optimization and extending hardware lifespan [O4]. Proper deployment after IT fleet refreshes is also emphasized to avoid waste [O3]. Reflections on equipment needs help reduce unnecessary materials, such as in printing fleets [O8]. Aligning IT refresh cycles with organizational needs [O4][O8] and exploring redeployment options before renewal are also recommended [O4][O8]. However, concerns include old materials becoming unusable due to software updates [O7], and associating equipment with social status requires addressing for effective eco-responsible initiatives [O5].

Data center provider that adheres to the European Code of Conduct for Data Centers. The majority of respondents find it relevant to use a data center provider adhering to the European Code of Conduct for Data Centers [O2][O5]. However, this measure may not apply universally, as signatory hosts may lack the absorption capacities for large-scale organizations or those with substantial data volumes [O6][O7]. Moreover, certain security constraints, sometimes quite strict, must be met depending on an entity's activity, which not all data hosting providers can satisfy [O6][O7]. Looking forward, two entities believe that organizations should phase out their own data rooms in the long run [O1][O4]. Consolidating facilities within large-scale data centers is seen as key for optimization and reducing environmental costs [O1]. Another proposed solution is migrating to cloud solutions for storage optimization [O6].

Virtualization. Overall, server optimization, especially through virtualization, is recognized as a relevant practice in the context of environmentally responsible digital initiatives. Many interviewed organizations highlight that it is already a widely disseminated measure [O1][O3][O4][O5][O6][O7][O8]. However, some entities draw attention to the possibility of optimizing existing virtualizations [O3][O4]. A discussion should be held on this matter because while virtualization optimizes data storage, it does not question the need to store that data [O3]. Even today, organizations often face issues of data overprovisioning [O3]. Addressing this issue could ultimately optimize and potentially lead to a server reduction policy for an organization [O8]. It would also be relevant to consider whether servers need to be constantly running; some activities do not require such availability [O3]. Additionally, one organization discusses storage optimization in a Cloud solution [O6]. It points out that using the Cloud may seem like a more sustainable solution. However, the Cloud provides unlimited access to storage capacities. Consequently, a significant rebound effect can sometimes be observed: since everything can be stored, organizations may be less inclined to question the relevance of retaining data.

Data archiving strategy. Interviewed organizations hold varied opinions regarding formalizing data archiving strategies [O1][O2][O3][O6][O7][O8], with many already implementing such strategies [O1][O4][O5][O6][O7], especially for GDPR compliance [O2]. These strategies primarily address legal and optimization needs rather than environmental concerns [O1][O2][O4][O5][O6][O7]. Considering this, it may be valuable to re-evaluate data archiving strategies from an environmental viewpoint, possibly adjusting management and retention decisions accordingly. Some suggest revising existing strategies, acknowledging potential variations in effectiveness across organizations [O5], with possible revisions in retention periods [O6], involving IS architects where feasible [O6]. Despite some considering it less impactful due to low environmental costs in data storage [O4][O6], except for data-intensive sectors like video-on-demand [O6], implementing data archiving strategies still aids in employee awareness

[O6]. Certain entities also emphasize data deletion campaigns alongside archiving strategies [O3][O5][O8], necessitating timely disposal of unused data [O3] while considering retention needs to manage information overload [O5].

Limiting data flows. Concerning limiting data flows to the strict necessary, the interviewed organizations see it as a relevant measure. Many entities note that data flows are generally already optimized [O4][O6][O8]. However, establishing criteria to guide data flow practices could still be beneficial [O6]. This opportunity relates to the tendency of professions to retain all data flows "just in case" [O1][O6]. Defining criteria could evolve practices and reduce an organization's data flows to only those necessary for its activities. Some entities find implementing such a practice complex or are unsure how to proceed with it [O2][O5][O8]. Several entities have critical views of this measure. Firstly, one participant noted that most data flows currently occur through fiber optics, which has minimal environmental impact compared to ADSL, 4G, and 5G [O4]. Thus, reducing data flows is not seen as a primary lever [O1][O4]. Another organization emphasizes that the environmental consequences of data transit are minor compared to manufacturing IT equipment [O1]. Therefore, implementing such a measure is relevant but should follow a certain maturity in an organization's environmentally responsible digital approach after activating primary levers. Lastly, one participant suggests that implementing such a measure could be challenging as it may affect employees' working conditions [O5], possibly leading to resistance that necessitates appropriate change management.

Reducing data volumes. Interviewees generally view reducing data volumes, particularly through compression, as a valuable measure for optimizing energy usage and cutting costs [O2]. Some organizations already practice this approach [O4][O7], although there's potential for further optimization [O7]. However, opinions vary regarding the importance of data volume reduction. While some consider it secondary due to perceived limited environmental impact in data storage [O4][O6], certain sectors like video-on-demand companies see its significance [O6]. One participant highlighted its potential to create efficiencies by reducing server needs, thereby lowering electricity consumption and materials for server production [O1]. Implementing data volume reduction requires careful alignment with business and organizational needs [O3], necessitating discussions with IT architects to ensure compatibility with existing IT frameworks and usage patterns [O6]. However, concerns about potential biases in data volume reduction strategies, particularly through compression, were raised [O7], as it may inadvertently promote data retention without evaluating data necessity [O5][O7].

5.6. Refurbishment and Recycling Practices

Refurbishing IT equipment. Interviewees unanimously agree that refurbishing IT equipment is a relevant measure, as extending equipment lifespan is key for eco-responsible digital approaches [O3][O6]. Prioritizing repair is necessary to optimize eco-responsibility, and this measure should be associated with a reflection on circularity and equipment reuse, both internally and externally [O6]. Promoting the sale or donation of equipment once it is no longer operational for an entity's activities is crucial to avoid landfill waste [O2][O4]. Leasing IT equipment is a common practice for some organizations, limiting their control over the end-of-life process [O6]. However, integrating clauses favoring equipment reuse and refurbishment during leasing contracts could be beneficial [O6]. Security concerns, especially for organizations with sensitive activities, may require hard drive destruction, limiting full equipment reuse [O7]. Salvaging non-problematic parts for other devices or repair markets is a feasible strategy for these situations.

6. Validation

The interviewed organizations found that the axes and criteria addressed in the second part of the interview adequately cover the theme of digital eco-responsibility. However, two organizations noted that aspects related to digital services, especially in terms of eco-design and project management, were not fully addressed [O3][O6]. Another entity emphasized that more could have been discussed regarding the social dimension, particularly inclusion [O2]. Some interviewees also took the opportunity to highlight what they considered essential, such as sharing experiences regarding the implementation of digital eco-responsibility [O8] and training and awareness [O5]. Lastly, one interviewee inquired about the treatment of the social dimension in the research topic, given the limited questions or measures related to it [O7]. The response indicated that the social dimension was primarily addressed through

interviews, as they provide insights into organizations' eco-responsibility concepts, the contexts for digital eco-responsibility initiatives, and the specific challenges and constraints faced by different entities.

7. Conclusion

This paper delves into the intersection of environmental awareness and increasing digital usage, examining perceptions of digital initiatives aimed at reducing environmental impacts. While regulations in this area are gradually emerging, there remains a lack of a practical framework tailored to organizations' needs. Interviews with entities initiating digital eco-responsibility initiatives highlight the pivotal role of committed individuals and the benefits such initiatives offer in economic, social, and environmental terms. Challenges persist in prioritizing and contextualizing eco-responsible concepts, requiring tailored strategies aligned with organizational contexts.

Digital eco-responsibility presents significant opportunities, but widespread adoption faces hurdles in awareness, prioritization, and integration into organizational goals. While the government and regulatory measures can play a crucial role, providing support and tools to organizations is equally vital. The study suggests further research on change management perspectives and collaborative initiatives among organizations to promote knowledge exchange and effective implementation. Developing a network of digital advisors trained in digital eco-responsibility can also facilitate support at the state level, complementing existing digital advisory schemes.

There are some limitations to this work as with any qualitative research method. Interviews can induce personal bias as some people might not want to reveal much more personal information out of concern that it might be used against them. Moreover, it's essential to keep in mind that not all of what is mentioned during an interview will be actually correct or true. This study can then be perfected by looking into more organizations to confirm the findings.

8. References

- [1] The Shift Project (2021) « Impact environnemental du numérique : Tendances à 5 ans et gouvernance de la 5 G »
- [2] Flipo, F. (2020) "L'impératif de la sobriété numérique. L'enjeu des modes de vie". Editions Matériologiques, Paris
- [3] Cardinali, Pier Giacomo, and Pietro De Giovanni (2022) "Responsible digitalization through digital technologies and green practices." *Corporate Social Responsibility and Environmental Management* 29.4: 984-995.
- [4] Péréa, Céline, Jessica Gérard, and Julien de Benedittis. "Digital sobriety: From awareness of the negative impacts of IT usages to degrowth technology at work." *Technological Forecasting and Social Change* 194 (2023): 122670.
- [5] Faucheux, Sylvie, and Isabelle Nicolai. "IT for green and green IT: A proposed typology of eco-innovation." *Ecological economics* 70.11 (2011): 2020-2027.
- [6] Dedrick, Jason. "Green IS: Concepts and issues for information systems research." *Communications of the Association for Information Systems* 27.1 (2010): 11.
- [7] Bordage, F., and Chaussaut, J-C. (2018) « Du Green IT au numérique responsable. Lexique des termes de référence », *le Club greenIT*, Version 1.8.3, 19
- [8] Paton-Romero, J., Baldassarre, M., Rodriguez, M., and Piattini, M. (2018) « Green IT Governance and Management based on ISO/IEC 15504», *Computer Standards & Interfaces*, n° 60, pp 26-36
- [9] Paton-Romero, J., Baldassarre, M., Piattini, M., and Garcia Rodriguez De Guzman, I. (2017) « A Governance and Management Framework for Green IT », *Sustainability*, vol. 9, n°1761, pp 1-18
- [10] Paton-Romero, J., Baldassarre, M., Rodriguez, M., and Piattini, M. (2019) « A Revised Framework for the Governance and Management of Green IT », *Journal of Universal Computer Science*, vol. 25, n° 13, pp 1736-1760
- [11] Hankel, A., Oud, L., Saan, M., and Lago, P. (2015) « A Maturity Model for Green ICT : The Case of the SURF Green ICT Maturity Model», *EnviroInfo – 28th International Conference on Informatics for Environmental Protection*, pp 33-40
- [12] Molla, A. (2009) « Organizational Motivations for Green IT : Exploring Green IT Matrix and Motivation Models », *Pacific Asia Conference on Information Systems*
- [13] Bokolo, A., Mazlina, A., and Awanis, R. (2018) « Green IS diffusion in organizations : a model and empirical results from Malaysia », *Environment, Development and Sustainability*, n° 22, pp 383-424
- [14] Dolci, D., Lunardi, G., Salles, A., and Ferreira Alves, A. (2015) « Implementation of Green IT in organizations : a structural view », *Revista de Administração de Empresas*, n° 55, pp 486-497
- [15] Verdecchia, R., Lago, P., Ebert, C., and De Vries, C (2021) « Green IT and Green Soft-ware », *IEEE Software*, n° 38, pp 7-15
- [16] Szopik-Depeczyńska, K., Cheba, K., Vikhasta M., Depeczyński, R. (2021) "New form of innovations related to the environment - a systematic review", *Procedia Computer Science*, Volume 192, pp 5039-5049