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Sustainable Assistive-Technology Procurement in Swedish Public Healthcare: Tensions and Paradoxes in Managers' Decision-Making

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Abstract

Assistive technology (AT) supports participation, independence, and well-being but also presents sustainability challenges for public healthcare organisations. This qualitative study explored sustainability tensions and paradoxes arising in AT decision-making. Semi-structured interviews were conducted with 24 managers and analysed using reflexive thematic analysis informed by paradox theory. The findings show that managers must simultaneously pursue competing economic, environmental, and social sustainability objectives, giving rise to four interconnected tensions: purchasing new AT versus reconditioning existing products; prolonging product life through donations versus organisational responsibility; providing digital AT versus enabling reuse; and expanding digital AT provision versus developing the knowledge and skills required to support it. While managers employed various strategies to navigate these tensions, the underlying contradictions persisted. The study contributes to both AT research and paradox theory by demonstrating how sustainability tensions in AT decision-making evolve into persistent paradoxes that require continuous managerial navigation rather than permanent resolution.

Keywords: assistive technology; sustainability; digital; decision-making; paradox theory

1. Introduction

From electronic health records to wearable devices and mobile apps, Assistive technology (AT) supports and transforms health and social care. With an ageing population living longer and with more age-related impairments and disabilities, AT enables people to live an independent, safe, and active everyday life. AT enhances users' independence, participation in both social and personal activities, and improves subjective and social well-being [1]. AT is also an area where improvement, social, and care costs can be decreased [2–4]. The World Health Organization defines AT as the 'systems and services related to the delivery of assistive products and services.' In contrast, Assistive Products (APs) are defined as the products which 'maintain or improve an individual's functioning and independence, thereby promoting their well-being [5]. Digital assistive technology is closely related to AT [6]. It can be described as a subset of AT that explicitly refers to digital or electronic solutions, such as software applications, smart devices, and AI [6–8]. The incorporation of digital technologies into AT marks a significant advancement in the AT field, providing new digital solutions to support the daily life of people with disabilities [7–9].

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Academic Editors: João Miguel Lourenço and Nuno Costa

Received: 2 August 2026
Revised: 1 October 2026
Accepted: 6 October 2026
Published: 8 October 2026

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More than 2.5 billion people worldwide currently need one or more AT, and this number is expected to increase to 3.5 billion by 2050 [5]. AT plays an important role in supporting participation, inclusion, independence, and well-being among people with disabilities and is central to the realisation of rights established in the United Nations Convention on the Rights of Persons with Disabilities (CRPD) [10]. From a sustainable development perspective, AT provision involves balancing economic, social, and environmental objectives. Sustainable development is commonly understood as encompassing these three interconnected dimensions, while the United Nations Sustainable Development Goals (SDGs) provide a global framework that promotes their integrated and balanced achievement [11,12].

In the context of AT, social sustainability involves ensuring equitable access to appropriate assistive technologies and services, economic sustainability concerns the responsible use of public resources, and environmental sustainability relates to reducing resource consumption, waste, and emissions. These considerations are becoming increasingly important as the demand for AT grows and environmental challenges mount. Although AT is designed to enhance accessibility and quality of life, its production, use, and disposal may contribute to environmental impacts. Many products require rare earth metals, plastics, and other materials, and some have relatively short lifespans due to wear, technological development, or product replacement [13].

As societies seek to reduce resource consumption and environmental impacts, increasing attention has been paid to sustainable production and consumption practices, such as the circular economy [14]. Circular economy practises emphasise product longevity through maintenance, reuse, repair, refurbishment, and recycling [14,15]. While sustainability issues have been discussed in relation to AT design, e.g., [16] and the logistics of AT programmes, e.g., [17], limited attention has been given to how sustainability considerations influence AT provision and the decisions made by those responsible for procuring and purchasing AT.

AT investments are substantial worldwide due to their potential to support participation, independence, and well-being among people with disabilities [18]. However, many investments have not achieved the expected outcomes, e.g., [19]. From a managerial perspective, providing innovative, sustainable, and high-quality AT requires balancing multiple objectives. While managers are expected to support economic efficiency, environmental sustainability, and equitable access to AT, they must do so within the constraints of limited public resources [20–22]. Consequently, those responsible for AT procurement and provision are frequently confronted with competing demands. Although previous research has examined AT in relation to access, service delivery, policy development, sustainability, and user outcomes, e.g., [1,11,18,23], less attention has been paid to the simultaneous pursuit of economic, environmental, and social objectives in AT decision-making. This oversight echoes a broader issue in sustainability research across sectors, where sustainability dimensions are frequently analysed in isolation [24–26]. Such a siloed perspective overlooks the interdependencies among sustainability dimensions and the potential trade-offs that arise when advancing one dimension affects another [26,27]. As a result, managers face persistent tensions when attempting to balance competing sustainability objectives that stem from broader societal sustainability demands [24]. Navigating these tensions has become a central challenge for managers, requiring strategies that help decision-makers respond to them without suboptimising individual sustainability dimensions [28,29]. While these tensions have attracted growing scholarly attention [30–33], limited research has examined how persistent tensions and the paradoxes they generate are navigated in the context of AT. The purpose of this study is therefore to explore tensions and paradoxes in AT decision-making within public healthcare organisations and the strategies used to

navigate them. Specifically, the present study examines how economic, environmental, and social objectives interact to shape AT procurement decisions. This study makes two contributions. First, it extends AT research by shifting attention from the outcomes of AT provision to the tensions and paradoxes that shape AT decision-making. Second, it contributes to the application of paradox theory in the AT field by providing insights into how decision-makers navigate tensions and paradoxes arising from competing economic, environmental, and social objectives. The study answers the following research question: What tensions and paradoxes do decision-makers face when procuring AT for healthcare organisations, and how do they navigate them? To address this question, the study draws on paradox theory. Paradox Theory has been widely applied in decision-making research to understand tensions and paradoxes, offering a useful lens for examining how managers navigate and respond to competing demands that must be pursued simultaneously [34–37]. Given that AT decision-makers operate within resource-constrained healthcare organisations and are expected to balance economic, environmental, and social objectives while ensuring continued access to appropriate AT for people with disabilities, paradox theory offers a relevant framework for analysing the tensions and contradictions that characterise AT management. Notably, in line with previous research [34], the focus is not on resolving tensions and paradoxes but on recognising and understanding how they are experienced and navigated in practice.

1.1. Paradox Theory

This paper uses paradox theory to explore tensions and paradoxes in AT decision-making. Paradox theory, originally introduced by Quinn and Cameron [38], has become an influential framework in management research for understanding how organisations navigate competing and persistent demands [35]. A central concept is the paradox itself. Smith and Lewis [39] (p. 382) define a paradox as "contradictory yet interrelated elements that exist simultaneously and persist over time," while Schad, Lewis, Raisch, and Smith [35] (p. 10) describe it as "the persistent contradiction between interdependent elements.".

Despite differences in wording, both definitions emphasise the coexistence of contradictory yet interconnected elements that must be managed simultaneously. Organisational actors are therefore often confronted with competing demands that appear mutually exclusive but remain equally necessary. According to Putnam et al. [40], such situations generate tensions that are experienced as feelings of stress, uncertainty, and discomfort. These tensions are not temporary disruptions but recurring features of organisational life. When underlying contradictions persist over time, they may develop into paradoxes characterised by the simultaneous presence of competing yet interdependent demands [35,39,40]. A distinction must be made between paradoxes and dilemmas. A dilemma involves choosing between competing alternatives, often requiring trade-offs or sacrifices. In contrast, paradoxes cannot be permanently resolved because both sides of the contradiction remain necessary and continue to coexist over time [39,41]. Attempts to prioritise one element frequently strengthen the need for its opposite, causing tensions to persist. Therefore, paradoxes are not solved once and for all but continuously navigated and managed.

This distinction is particularly important for the present study. While tensions are common in organisational decision-making, paradox theory provides a framework for understanding how underlying contradictions generate persistent tensions and how organisational actors respond to them [35,39–41]. Previous research suggests that such tensions are especially prevalent in volatile, uncertain, complex, and ambiguous environments where competing demands coexist [25,28,30]. Since AT managers operate in similarly complex contexts [19], this study assumes that they are likely to encounter persistent tensions

and paradoxes when attempting to reconcile competing economic, environmental, social, and organisational demands.

1.2. The Swedish Context

The specific context of this study is Sweden, where local guidelines established by municipalities and regions govern the provision and delivery of AT services, and determine which products qualify as AT and should be prescribed for specific patients. Municipalities and regions in Sweden exercise significant autonomy and have a longstanding tradition of managing these processes.

Swedish municipalities are self-governing entities with the authority to levy taxes. Both municipalities and regions have the autonomy to make independent decisions and are governed by elected politicians on municipal and regional councils [42]. The municipalities and regions furnish AT through prescriptions or as granted assistance, as outlined by the National Board of Health and Welfare (Socialstyrelsen) [43]. The Nordic Welfare System operates in a decentralised manner, with municipalities and regions responsible for providing AT to individuals based on assessed needs. The actors involved in prescribing AT in this study are primarily occupational therapists (OTs), physiotherapists (PTs), or registered nurses (RNs). These actors do this daily, and most prescriptions are carried out in primary care or municipal settings as part of rehabilitation services. A key element in this service delivery process is how an individual obtains an AT that meets their needs. Every municipality and region is tasked with determining what services and products to offer and setting the associated costs and fees [44,45]. Decision-making within these municipalities and regions varies, making it complex. The autonomy of local authorities has led to differences among municipalities and regions in resources, development, and service-provision systems. With the delegation of efficient policy implementation to the grassroots of the healthcare system, there is pressure on healthcare sectors to ensure effective services and manage service allocation within established frameworks [43,46]. Thus, managers must make informed decisions when procuring AT for their health organisations, regardless of their financial resources.

2. Materials and Methods

This study explored paradoxes in AT decision-making related to economic, social, and environmental sustainability. A qualitative research design, supported by reflexive thematic analysis [47], was employed to gain an in-depth understanding of managers' experiences and perspectives. The study is reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines [48] (see Supplementary Table S1).

2.1. Participants and Recruitment

A purposive sample was sought among managers with strategic responsibility and decision-making authority for purchasing AT in Swedish public healthcare organisations. A reference group comprising eight representatives from the National Network of Assistive Technology Managers recommended 30 managers as potentially eligible. The reference group was instructed to invite experienced managers to ensure representation across all 21 regions. None of the eight members of the reference group participated in the interviews.

The 30 nominated managers were invited via email and provided written information on the purpose of the study, voluntary participation, confidentiality, and consent. Of those invited, 24 participated (80%). Four declined the invitation, and two did not respond after two reminders. No reasons for declining were collected.

The final sample included at least one participant from each of Sweden's 21 regions, providing national geographic representation, although the study did not seek statistical or organisational representativeness. Sample adequacy was assessed using the concept of information power [49]. Given the focused aim of the study, the highly specific participant group with direct strategic and purchasing responsibilities, the rich data generated through semi-structured interviews, and the use of an established theoretical framework to guide the analysis, the sample of 24 managers was considered to provide sufficient information power for an in-depth cross-case thematic analysis of sustainability-related tensions and paradoxes in AT decision-making.

Participant characteristics are presented in Table 1. A total of 24 managers participated in the study, of whom 62.5% (n = 15) were women and 37.5% (n = 9) were men. Most participants were aged 56–65 years (58.3%, n = 14) and had completed more than 3 years of postsecondary education (66.7%, n = 16). The majority had 0–10 years of managerial experience (70.8%, n = 17), and most worked in municipalities with 40,000–199,999 inhabitants (54.2%, n = 13). At least two participants reported working across regional boundaries.

Table 1. Participant Characteristics.

Characteristic	Category	n (%)
Gender	Male	9 (37.5)
	Female	15 (62.5)
Age (years)	36–45	5 (20.8)
	46–55	5 (20.8)
	56–65	14 (58.3)
Educational background	Postsecondary education (<3 years)	4 (16.7)
	Postsecondary education (>3 years)	16 (66.7)
	Other education (e.g., management training)	4 (16.7)
Years of experience as a manager	0–5 years	9 (37.5)
	6–10 years	8 (33.3)
	11–15 years	3 (12.5)
	16–20 years	2 (8.3)
	21–25 years	0 (0.0)
	≥26 years	2 (8.3)
Municipality size	<40,000 inhabitants	3 (12.5)
	40.000–199,999 inhabitants	13 (54.2)
	≥200,000 inhabitants	8 (33.3)

Note. Percentages are rounded to one decimal place and may not sum to exactly 100% due to rounding. At least two participants reported working across regional boundaries.

2.2. Data Collection

An interview guide was developed to support data collection. The semi-structured interviews were guided by a small number of broad, open-ended "grand tour" questions designed to encourage participants to describe their experiences and perspectives in their own words. The questions were informed by the study aim and covered key topics related to AT provision and sustainability, including organisation, knowledge and skills, procurement and sustainability policies, decision-making and financial considerations, and present and future digitalisation (see Table 2). Examples of grand tour questions included: "Can you tell me about your experiences of managing AT provision in your organisation?" "How are decisions regarding AT procurement and provision made?", and "What role do

innovation and digitalisation currently play in your organisation, and how do you see this developing in the future?" Follow-up questions and prompts were used throughout the interviews to explore emerging issues, clarify participants' accounts, and encourage further reflection on topics they considered important. This flexible approach ensured that all key themes were addressed while allowing participants to direct the discussion towards issues most relevant to their experiences.

Table 2. Topic areas explored within individual participant interviews.

• General views about AT provision and sustainability
• Organisation, knowledge, and skills
• Policies of procurement and sustainability
• Decision-making and economy
• Exploring the potential for innovation and digitalisation within their AT health organisations
• Current and future aspects of digitalisation in health organisations

The interviews were conducted in Swedish by the first author, either by telephone or digital meeting, between February and June 2023. They lasted between 30 and 60 min (mean duration approximately 45 min), were audio-recorded with participants' consent, and subsequently transcribed verbatim for analysis. Although the data were collected in 2023, the study focuses on sustainability-related tensions and paradoxes in AT decision-making rather than on specific technologies. Following Heaton [50] and Hughes and Tarrant [51], the value of qualitative data lies in its ability to provide insights into underlying social and organisational processes rather than in its temporal proximity alone. As the sustainability objectives examined in this study, namely the balancing of social, economic, and environmental sustainability dimensions [25,52], have remained largely unchanged since data collection, the dataset was considered appropriate for exploring enduring tensions in sustainable AT decision-making.

2.3. Data Analysis and Theme Development

A qualitative analysis was conducted, with themes (i.e., tensions and paradoxes) emerging from the data, following the steps developed by Braun and Clarke [47,53,54]). The answers to the semi-structured questions were subjected to reflexive thematic analysis, during which tensions, paradoxes, and an overarching theme emerged.

NVivo® 14 (Lumivero, Denver, CO, USA) was used to support the data analysis process. First, the authors independently read the interview transcripts to gain familiarity with the data and develop an overall understanding of the dataset. Their initial interpretations were subsequently discussed to establish a shared understanding of the data. The first author then identified and extracted content relevant to the study's aim. These extracts were condensed and coded by focusing on tensions and contradictions related to AT decision-making. Through an iterative process of coding, interpretation, and discussion, tensions and contradictions within the data were identified. The identified tensions were compared across cases to examine similarities and differences and to deepen the understanding of the patterns emerging from the dataset. The analysis then continued with condensing and abstracting the tensions into paradoxes and an overall theme. The analytical framework guiding this process focused on sustainability tensions, underlying contradictions, navigating strategies, persistence, and sustainability paradoxes (see Table 3).

Table 3. Analytical framework guiding the analysis of tensions and paradoxes.

Analytical Element	Description
Tensions	Experienced manifestations of underlying contradictions, often expressed through uncertainty, stress, or discomfort.
Underlaying contradictions	Competing demands, objectives and goals that must be pursued simultaneously despite appearing difficult to achieve together.
Sustainability dimensions	Economic, environmental, and social objectives associated with the identified tensions and contradictions.
Boundary conditions	Organisational, technological, institutional, and contextual factors shaping how tensions are experienced and managed.
Persistence	Conditions explaining why tensions continue despite managerial efforts to address them.
Navigating strategies	Actions and practices used by managers to respond to and navigate competing demands.
Sustainability paradoxes	Persistent contradictions between interdependent sustainability objectives that remain over time.

The final stage involved writing up the findings, which are organised according to the identified tensions and paradoxes. Throughout the analysis, contradictions, tensions, paradoxes, and themes were continuously revisited and discussed among the authors, resulting in the refinement and reorganisation of the final theme and a deeper understanding of how these elements were interconnected.

Reflexivity was maintained throughout the study by documenting analytical decisions, interpretations, and the development of codes and themes, thereby creating an audit trail. The emerging thematic structure was reviewed against both the coded extracts and the complete dataset before being finalised by the author group.

The final stage involved writing the findings, which are organised around the identified tensions and paradoxes. To enhance transparency, Supplementary Table S2 presents a coding example. The table demonstrates how interview quotes were coded, categorised, and subsequently interpreted in terms of underlying contradictions, persistence, sustainability dimensions, tensions, and paradoxes. Consistent with Braun and Clarke's [47,53,54] reflexive thematic approach, the navigating strategies were developed through a similar iterative process of interpretation and discussion of participants' accounts of how they managed and responded to these tensions.

Illustrative quotes are included in the findings to demonstrate how the interpretations were grounded in participants' accounts and to allow readers to assess the credibility of the analysis. All quotations were pseudonymised and translated from Swedish into English by the authors. As all interviews were conducted in Swedish, a forward-and-back translation procedure was used to minimise the risk of losing the original meaning [55]. Given differences in syntax, expressions, and word order between Swedish and English, minor edits were made where necessary to improve readability without altering the intended meaning of the quotations. In accordance with the Swedish Research Council's guidelines [56], the study did not include any personal or sensitive information that required ethical approval.

Nevertheless, the study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [57].

3. Results

The findings generated an overarching theme, Sustainability Challenges, reflecting the ongoing challenges that AT decision-makers face in striving to support a sustainable society. Within this overarching theme, four sustainability tensions were identified: (1) Purchasing new AT and Reconditioning old AT; (2) Prolong Product Usage Time and Donating AT; (3) Digital AT and Reuse AT; and (4) Future Digital Technology Supply and Demand for Technology Knowledge and Skills. These tensions reflected situations in which managers experienced competing economic, environmental, and social demands when procuring and providing AT. Table 4 provides an overview of the identified tensions, their underlying contradictions, and the sustainability dimensions involved. The findings are organised according to the four identified tensions and explore them in greater detail.

Table 4. Overview of the identified sustainability tensions, underlying contradictions, and sustainability dimensions.

Tension	Underlying Contradiction (i.e., Competing Demands)	Sustainability Dimension
Purchasing new AT and Reconditioning old AT	Environmental objectives through reuse and reconditioning vs. cost-efficient resource use while maintaining access to AT	Economic, Environmental, Social
Prolong Product Usage Time and Donating AT	Environmental and social objectives through donations vs. organisational accountability, legitimacy, and ethical conduct	Environmental, Social
Digital AT and Reuse of Digital AT	Social objectives through social value of digital AT vs. environmental objectives	Social, Environmental
Future Digital Technology Supply and Demand for Technology Knowledge and Skills	Social objectives through advanced digital AT vs. organisational capability	Social, Social

3.1. Tension 1—Purchasing New AT and Reconditioning Old AT

One source of tension arose when managers had to decide on AT while considering competing economic and environmental demands. Most managers reported that their sustainability awareness has grown, as AT health organisations need to comply with the national environmental policy certificate and make decisions aligned with Agenda 2030 for Sustainable Development.

The managers explained they strove to purchase quality AT because higher quality meant the AT would have a longer product lifetime, a lower repurchase frequency, and a greater possibility of reconditioning. These AT qualities supported the demands to reduce consumption and waste.

However, the tension in the decision-making process was noted as purchasing a new AT was less costly than reconditioning it. Thus, this fact encouraged the managers to increase the repurchase frequency rather than focus on reconditioning, as this alternative

would support demand for using fewer financial resources. Conversely, the participants expressed a tradition in Sweden that AT should be reused. Yet the costs of reconditioning AT are considered too high, creating tension in decision-making. According to the managers, it is too expensive to maintain and recondition certain ATs, especially those considered lower quality or cheap. This aspect encouraged the managers instead to increase the repurchase frequency of ATs with lower quality, considering the economic aspect:

> *We look at the whole picture when we procure the new AT. How long will we be using the AT, and what will the balance be between throwing away and reconditioning? [. . .] We must consider all this. When can we reuse it? It is much easier if we decide not to reuse the AT.* (Manager 3)

> *I believe we should be able to reuse far more than we do today. For example, hygiene products and plastic assistive technology, but it is hard. We are tied up due to the economic budget.* (Manager 10)

According to the study participants, there are numerous instances where purchasing new AT is more cost-effective than repairing existing devices. The threshold for this decision varies depending on the specific AT. For example, one manager said the following when discussing a particular AT: "You cannot spend 700 SEK on reconditioning an AT." *Spending a lot of money on a cheap product is a huge problem.* (Manager 5).

One of the managers also proudly said that their AT health organisation won a special sustainability prize, showing that it is continually thinking and working towards a better, more sustainable AT health organisation. However, the same manager concluded that "*it is cheaper to buy a new product than to maintain and reuse them.*" (Manager 12).

3.2. Tension 2—Prolong Product Usage Time and Donating AT

Another tension arose when the AT reached the end of its life from a Swedish healthcare perspective but not from a usability perspective. As mentioned, reconditioning costs are very high in Sweden, making it cheaper to buy a new AT. Aiming to prolong the usage time, managers explained they strove to send ATs that are no longer considered usable in Sweden (due to users' changed needs, obsolescence, or deaths). However, they still fit and are safe for organisations and firms in other countries to support people with disabilities in those countries.

> *When AT is good as AT but not for us here in Sweden [. . .] we send it to help organisations [. . .] so that the AT can be used abroad and make sure that they come to use in other ways.* (Manager 21)

Although the managers thought this was an essentially social act and a way to contribute to sustainability, these donations created tensions in decision-making due to unclear legal and responsibility arrangements and difficulties finding organisations and companies that seriously accept old AT and review their authenticity and credibility:

> *[Well], if it is for cosmetic reasons and not severe functional problems, we give AT away to various companies that donate or sell it abroad, but there is a minor obstacle. They have become more challenging to handle. Where is the line of responsibility? We will solve it in the future, as we have declined responsibility for it. We have seen another picture of this. They did not want to accept the shipment. It has been quiet [from them] for a while, but now it is back on at full speed again, and they want to take care of the old AT.* (Manager 7)

> *We donate it to [help organisations] as we build schools in Africa for children with disabilities. They help us send AT which we can no longer use. Before [this help organisation] existed, there was a risk with [donations]. [. . .] Sometimes, they say that*

> *they have a cousin who is working with aids [. . .] Is this a serious [organisation]? It is not easy to keep track of this.* (Manager 2)

> *Yes, for a period, we sent it to Poland. However, now Poland has cancelled this as they joined the EU, and there were other laws [. . .]* (Manager 7)

One of the managers also felt a moral and ethical contradiction in donating old AT that was still usable to other countries. The manager felt ashamed to think that the AT was not suitable for people with disabilities in Sweden but was deemed acceptable for people with disabilities in other countries:

> *When I started [working as a manager], we had refugees from Somalia who needed beds, and they wanted to send beds to Somalia [. . .] I was almost ashamed that they would get these older beds, as we would change all the beds to care beds. However, they told us there was not much electricity there, so the beds suited them very well. It still feels good to reuse [AT], both for the environment and humanity.* (Manager 13)

3.3. Tension 3—Digital AT and Reuse of Digital AT

Most managers had access to the latest, most advanced technology, enabling people with disabilities to enhance their safety, independence, and daily living activities. For example, the managers had access to AT, such as assistive robots. These autonomous systems can 'live' with a person and assist with all kinds of everyday activities, such as eating, toileting, companionship for persons with dementia, fetching items, and non-physical activities like interpersonal interaction.

However, the managers experienced tensions stemming from advanced technology, specifically digital AT, and its short lifespans. Notably, managers acknowledged that the daily use of digital AT can enhance an individual's ability to live. They emphasised that procuring more advanced digital AT for youth and teenagers with various disabilities is crucial from an identity perspective. Nevertheless, the participants expressed that they also need to consider the cost and lifespan of digital AT. These AT become outdated quickly due to the need for program updates, app changes, and battery replacements. Thus, according to the participants, digital AT has a shorter depreciation period and usage time:

> *There is a concern with IT interfaces. [They are] not super simple and are challenging to use today, and [they might] not be helpful in 5 years. [. . .] We probably cannot look too far ahead. We must live with a limited future perspective.* (Manager 13)

Although the managers are aware of this when considering the purchase of digital AT, they still believe it is essential to offer the best AT for people with disabilities. However, the managers described digital AT as challenging to recondition and reuse due to the product design. This aspect contributed to the tension when deciding whether to procure digital AT, as it did not support the environmental goals: cognitive technologies become outdated quickly; *we must consider this when we buy or procure them. These digital ATs are more challenging to reuse. We know that as well.* (Manager 15)

> *If you think about new digital ATs, it becomes about cost and working in new ways [. . .]. They cannot be handled like any other AT, right? No, we have discussed this. [Digital AT] is more difficult. How do we recondition [them]? It is a digital and technical product.* (Manager 19)

> *Digital AT is much more difficult to reuse.* (Manager 24)

3.4. Tension 4—Future Digital Technology Supply and Demand for Technology Knowledge and Skills

The study participants knew how digital AT could help people with disabilities and how such advanced technology could improve their functional capabilities. This

awareness encouraged the managers to purchase digital AT. However, they reported ongoing technological development, noting that the pace had accelerated considerably. With technology advancing rapidly, managers grew concerned about the imminent need for knowledge and skills in emerging digital AT to sustain the provision of advanced technological support to people with disabilities. This concern made the managers reluctant to purchase digital AT.

The managers elaborated on how they aimed to meet these future demands, given the knowledge and skills within their AT health organisation. Some managers reported already encountering problems with their current knowledge and skill set, which made them worried about continuing to provide digital AT to people with disabilities. This caused tensions in decision-making, as AT health organisations may lack knowledge and skills associated with the technology and its use to offer digital AT to people with disabilities:

> *Yes, if we were to handle more digital technology, we would need to have more skills in-house and change the skill areas.* (Manager 17)

> *We cannot keep up the speed of increasing the staff's knowledge and skills. We have the routines and the technology, but how are we supposed to have time for all the other things?* (Manager 24)

Another manager struggled to keep up with the speed of technology development. For example, the managers described that the caregivers who meet and care for the patient do not have the time to keep up with the technology. The caregivers do not have the time or skills; that is, this new digital technology cannot benefit the patients who need the technology. One manager noted differences in interest levels across various job roles within the AT health organisation regarding updating their knowledge of advanced AT. According to the manager, technicians were more interested than consultants and prescribers.

> *Yes, we struggle a lot. If we increase the amount of digital AT, I think [we] need to stay up to date and keep up the knowledge. The technicians are often very interested; it is worse with the consultants and prescribers.* (Manager 6)

4. Discussion

To synthesise the empirical findings, Table 5 summarises the underlying contradictions, sustainability Dimension boundary conditions, persistence, and navigating strategies associated with each identified sustainability tension, as well as the resulting paradoxes. The table provides an overview of the key characteristics of the tensions and illustrates how competing sustainability demands give rise to persistent paradoxes in assistive technology management.

Taken together, the findings suggest that the identified tensions are not isolated phenomena but interconnected manifestations of broader sustainability paradoxes arising from attempts to pursue economic, environmental, and social objectives simultaneously. This is consistent with previous research showing that sustainability initiatives frequently generate persistent tensions because these objectives are simultaneously interdependent and contradictory [24,33,37].

The findings reflect two broader developments shaping AT decision-making: the transition towards circular economy practices and the increasing digitalisation of assistive technologies. However, these transformations unfold within a Swedish public healthcare context characterised by expectations regarding cost-efficient resource use, accountability, and continued access to AT. Thus, managers are required to navigate tensions not only because new sustainability ambitions emerge, but also because these ambitions must be realised while ensuring the efficient use of public resources and continued access to AT for people with disabilities. While managers employ a range of strategies to navigate these

competing demands, the tensions persist because the underlying sustainability objectives remain simultaneously interdependent and contradictory. These findings provide the foundation for the paradoxes.

Table 5. Analytical synthesis of the identified sustainability tensions and paradoxes.

Tension	Underlying Contradiction (i.e., Opposing Demands)	Sustainability Dimension	Boundary Conditions	Persistence	Navigating Strategies	Paradox
Purchasing new AT and Reconditioning old AT	Environmental objectives through reuse and reconditioning vs. cost-efficient resource use while maintaining access to AT	Economic, Environmental, Social	Low-value AT Reconditioning costs exceed product value	Economic pressures continue to favour replacement of AT over reuse	Life cycle thinking Durable AT Selective reconditioning of AT	Managers are pressured to prioritise short-term cost efficiency, which discourages the use of reconditioned and repaired AT despite their contribution to circular economy objectives.
Prolong Product Usage Time and Donating AT	Environmental and social objectives through donations vs. organisational accountability, legitimacy, and ethical conduct	Environmental, Social	Unclear responsibilities Weak recipient assessment, Limited partnerships	Accountability and legitimacy concerns remain unresolved	Intermediary organisations Recipient screening Contextual adaptation	Managers are encouraged to donate AT to extend product life cycles and support social and environmental sustainability demands. However, uncertainty about the recipient's legitimacy, accountability, and ethical responsibility discourages donations.
Digital AT and Reuse of Digital AT	Social objectives through social value of digital AT vs. environmental objectives	Social, Environmental	Rapid obsolescence Software dependency Evolving digital infrastructures	Digital innovation limits reuse and life cycle extension	Long-term value assessment Durable technologies Extended utilisation	Managers are encouraged to procure and provide advanced digital AT to achieve social sustainability objectives. However, the characteristics that make these technologies valuable also limit their potential for reconditioning and reuse, thereby undermining environmental objectives.
Future Digital Technology Supply and Demand for Technology Knowledge and Skills	Social objectives through advanced digital AT vs. organisational capability	Social, Social	High workloads Limited opportunities for competence development Uneven organisational expertise	Digital innovation outpaces organisational learning	Competence development Time for competence development	Managers are encouraged to procure and provide advanced digital AT to improve the lives of people with disabilities. However, the effective implementation of these technologies depends on knowledge and skills that organisations often struggle to develop and maintain.

4.1. Sustainability Paradoxes

The data show that managers continuously consider economic, environmental, and social objectives when procuring and purchasing AT for healthcare organisations. These objectives give rise to various tensions and paradoxes. The findings suggest that the first tension stems from an underlying contradiction between environmental sustainability objectives and the need to ensure the cost-effective use of public resources while maintaining access to AT for people with disabilities. On the one hand, managers are expected to support circular economy ambitions through reuse, reconditioning, and extended product lifecycles, which are commonly regarded as key strategies for reducing resource consumption and environmental impacts [14,15]. On the other hand, they are responsible for providing

access to AT within limited budgets, which often makes purchasing new devices more economically viable than maintaining existing ones. This contradiction becomes particularly pronounced for lower-value AT, where reconditioning costs may exceed the device's value. A similar contradiction has been identified in sustainability research, suggesting that tensions arise when organisations attempt to pursue environmental objectives while responding to economic pressures and resource constraints [24].

AT Managers employ several strategies to navigate this tension. One strategy involves adopting a life-cycle perspective when making procurement decisions. Rather than focusing solely on the initial purchase price, managers consider product longevity, reuse potential, maintenance requirements, and environmental impacts throughout the product's lifetime, reflecting principles commonly associated with sustainable procurement and circular-economy thinking [14,15]. Another strategy is to prioritise higher-quality AT during procurement. Although such devices may require greater upfront investment, they are perceived to have longer service lives and greater potential for reuse and reconditioning. Managers also apply selective reconditioning practices, where decisions to reuse or replace AT are based on factors such as product quality, expected lifespan, and reconditioning costs.

While these strategies help managers navigate competing demands, they do not eliminate the underlying contradiction. Managers must continuously assess when reuse and reconditioning are environmentally desirable and when replacement is economically justified. Although recycling can recover materials from discarded AT, reuse and repair are generally preferable from a circular economy perspective because they extend product lifecycles and reduce resource consumption, pollution, and waste [14,15]. Nevertheless, organisational conditions often prioritise short-term economic efficiency, causing the tension to persist. This leads to the first paradox:

Paradox 1: Managers are pressured to prioritise short-term cost efficiency, which discourages the use of reconditioned and repaired AT despite their contribution to circular economy objectives.

The second tension emerged when AT had reached the end of its useful life within the Swedish healthcare system but remained functional and potentially valuable in other contexts. Managers viewed donations as a means of supporting both environmental and social sustainability by reducing waste and increasing access to AT for people with disabilities in other countries. This is consistent with previous research highlighting donations and reuse as mechanisms for extending product lifecycles and improving access to AT in resource-constrained settings [58,59]. The findings indicate that managers employ several strategies to navigate the tension between donations and legal, ethical, and organisational responsibilities. One strategy involves collaborating with established intermediary organisations that facilitate the transfer of AT to users in other countries. These collaborations, together with assessments of recipient organisations' credibility and reliability, help reduce uncertainty regarding accountability and increase confidence that donated devices reach appropriate recipients. Similar governance mechanisms and intermediary arrangements have previously been identified as important for managing risks and ensuring accountability in international donation initiatives [60].

AT Managers also adapt donation decisions to local needs and conditions, recognising that AT considered obsolete in Sweden may still be valuable elsewhere. Despite these efforts, managers reported considerable challenges. Uncertainty about the credibility, long-term reliability, and governance of recipient organisations often discouraged donations, even when they aligned with sustainability objectives. Some managers also expressed concerns about the broader ethical implications of donations, noting that such practices could reinforce unequal social and economic conditions between countries. These concerns echo previous research highlighting the ethical paradox of technology donations, whereby efforts

to promote social inclusion may simultaneously generate dependency and undermine long-term sustainability [61].

Thus, donations simultaneously represent an opportunity for AT managers to promote more sustainable use of resources and a source of uncertainty regarding legitimacy, responsibility, and ethical conduct. This leads to the second paradox:

Paradox 2: Managers are encouraged to donate AT to extend product life cycles and support social and environmental sustainability objectives. However, uncertainty about the recipient's legitimacy, accountability, and ethical responsibility discourages donations.

A third tension emerged between the ambition to provide advanced digital AT and the need to address economic, social, and environmental objectives. Managers emphasised that digital AT plays a crucial role in supporting participation, independence, and social inclusion for people with disabilities. Digital technologies were considered particularly important for younger users, as access to modern AT contributes not only to functional support but also to identity formation and inclusion. Therefore, managers expressed a strong commitment to providing up-to-date digital AT despite their relatively high costs and limited lifespans. The findings suggest that managers employ several strategies to navigate this tension. One strategy is to assess the long-term value of digital AT during procurement by considering user needs, product lifespan, maintenance requirements, and future technological developments. Managers also prioritise technologies perceived to offer greater durability and adaptability and seek to maximise their utilisation while they remain functional and relevant. Through these practices, they attempt to balance social benefits with economic and environmental considerations.

Despite these efforts, managers described digital technologies as particularly challenging from a circular economy perspective. Rapid technological development, software updates, changing digital infrastructures, and battery degradation contribute to accelerated obsolescence and limit opportunities for reuse and reconditioning. These challenges are consistent with previous research, which highlights that modern digital devices are inherently difficult to recycle because of their complex material compositions, designs, and tightly integrated or glued components [62]. While managers recognise the environmental benefits of extending product lifecycles, they also acknowledge that circular economy principles are more difficult to apply to digital technologies than to conventional AT. Previous research on digitalisation and sustainability has similarly highlighted tensions between technological innovation and environmental objectives, as increasingly advanced technologies often improve service quality and accessibility while accelerating product obsolescence and resource consumption [63,64]. Thus, the strategies employed by managers help them navigate, but not eliminate, the underlying contradiction. Digital AT remains essential for supporting inclusion and participation [5], while its technological characteristics simultaneously constrain opportunities for circular resource use [62]. This leads to the third paradox:

Paradox 3: Managers are encouraged to procure and provide advanced digital AT to achieve social sustainability objectives. However, the characteristics that make these technologies valuable also limit their potential for reconditioning and reuse, thereby undermining environmental objectives.

A fourth tension emerged between the ambition to provide advanced digital AT and the organisational capability required to support its effective implementation. Managers recognised the potential of digital AT to enhance participation, independence, and quality of life for people with disabilities. As a result, they were encouraged to procure increasingly advanced technologies to meet users' needs and support social sustainability objectives.

To address this tension, managers described efforts to strengthen organisational capability through training, professional development, and ongoing assessments of knowledge

needs related to digital AT. They also sought to create learning opportunities despite demanding workloads and often focused implementation efforts on personnel with a particular interest in technology. This approach enabled organisations to develop local expertise while acknowledging that broader competence development across staff groups remained necessary. In addition, procurement decisions were increasingly informed by assessments of whether the organisation possessed the knowledge and resources required to support digital technologies in practice.

Despite these efforts, managers reported persistent challenges. Heavy workloads and limited time for professional development constrained opportunities for learning, while the rapid pace of technological change made it difficult for both managers and healthcare personnel to keep up with emerging technologies and changing implementation requirements. Similar challenges have been identified in previous studies, which describe competence development as a central yet often overlooked aspect of digital transformation [65,66]. While organisations may invest in training and upskilling, the effectiveness of such initiatives depends not only on the availability of educational opportunities but also on employees' motivation to learn, attitudes towards change, and perceived relevance of the new technologies [65,66]. Furthermore, organisational conditions, such as managerial support, opportunities to participate voluntarily in training activities, and involvement in implementation processes, have been shown to facilitate learning and the adoption of new technologies [65]. The present findings suggest that managers attempted to address these challenges by building local expertise among interested staff members. However, the ongoing knowledge gaps reported by participants indicate the need for more systematic, organisation-wide approaches to competence development for digital AT. As a result, uncertainty remained about the long-term ability of health organisations to support the growing use of advanced digital AT. Previous research on digital transformation similarly suggests that organisations are increasingly expected to adopt advanced technologies while simultaneously developing the competencies, structures, and resources required to support them [67]. Because technological change often progresses more rapidly than organisational learning and capability development, tensions between technological ambitions and organisational readiness tend to persist over time [67,68].

Thus, while advanced digital AT can support important social sustainability objectives, its successful implementation depends on organisational capabilities that are often difficult to develop and maintain. This leads to the final paradox:

Paradox 4: Managers are encouraged to procure and provide advanced digital AT to improve the lives of people with disabilities. However, the effective implementation of these technologies depends on knowledge and skills that organisations often struggle to develop and maintain.

4.2. Interconnected Sustainability Paradoxes in Assistive Technology Management

The findings demonstrate that sustainability in AT management is characterised by persistent paradoxes rather than stable balances between competing priorities. Although sustainability is often described as balancing economic, environmental, and social objectives [52,69], managers in this study were required to pursue these objectives simultaneously, even when progress towards one objective constrained another. Sustainability in AT management is therefore better understood as an ongoing process of navigating contradictions than as the achievement of equilibrium, which is consistent with paradox theory suggesting that competing sustainability objectives are rarely resolved and instead require continuous management over time [24,32,33].

A key finding is that the identified paradoxes extend beyond economic and environmental concerns to encompass social sustainability. Across all four paradoxes, managers

sought to ensure access to appropriate AT that supports participation, inclusion, independence, and well-being for people with disabilities. However, these objectives often came into tension with environmental and economic demands. For example, decisions regarding reuse and reconditioning were influenced not only by cost and environmental considerations but also by the need to provide timely access to suitable AT. Likewise, digital technologies supported participation and inclusion while simultaneously creating environmental challenges and increasing demands for organisational competence. These findings show that social sustainability is closely intertwined with environmental and economic considerations rather than being a separate objective, supporting previous calls for more integrated approaches to sustainability that recognise interdependencies among sustainability dimensions [24–27,32].

The findings also highlight the role of managerial strategies in addressing competing sustainability demands. Managers employed practices such as life cycle thinking, selective reconditioning, donation collaborations, and competence development initiatives to address tensions in AT decision-making. However, these strategies did not remove the underlying contradictions. Instead, they enabled managers to continue pursuing multiple sustainability objectives despite persistent competing demands, reflecting prior research suggesting that paradoxes are typically navigated rather than resolved [34–36].

The study contributes to paradox theory by demonstrating how sustainability-related paradoxes emerge through interactions among economic, environmental, and social objectives in assistive technology management. Rather than representing isolated challenges, the four paradoxes form an interconnected system in which actions taken to advance one sustainability objective may constrain another, reflecting broader paradox research that emphasises the interconnected and mutually reinforcing nature of organisational tensions [24,33,37].

The findings further suggest that these paradoxes are embedded in two broader developments that shape AT decision-making, namely the transition towards circular economy practices and the increasing digitalisation of assistive technologies. While the first two arise from efforts to extend product lifecycles through reuse, reconditioning, and donations, the latter two are linked to the opportunities and challenges associated with digital AT. Together, these developments pose sustainability challenges that managers must address in a public healthcare context characterised by expectations of cost-efficient resource use, accountability, and continued access to AT.

Taken together, the findings suggest that sustainable AT management involves navigating interconnected sustainability paradoxes arising from the simultaneous pursuit of economic, environmental, and social objectives. AT decision-makers therefore play a central role in ensuring access to appropriate AT while responding to the competing demands associated with circularity, digitalisation, and resource constraints.

5. Conclusions

This study explored the tensions and paradoxes faced by decision-makers when procuring AT within public healthcare organisations. The findings identified four sustainability paradoxes arising from efforts to simultaneously pursue economic, environmental, and social objectives in AT decision-making. Specifically, managers were required to balance cost-efficient procurement with circular economy practices. They sought to extend product lifecycles through donations while addressing concerns regarding legitimacy, accountability, and ethical responsibility. They were also expected to provide advanced digital AT to support social objectives despite limited opportunities for reuse and reconditioning. In addition, they faced increasing demands to implement advanced technologies while managing challenges related to organisational knowledge and competence. The

findings demonstrate that managers actively employ a range of strategies to navigate these competing demands, including life-cycle thinking, selective reconditioning practices, donation collaborations, credibility assessments, competence development initiatives, interdisciplinary collaboration, and partnerships with technology suppliers. Although these strategies support decision-making, they do not eliminate the underlying contradictions. Economic pressures continue to challenge circular economy ambitions. Accountability concerns constrain donation practices. Digital technologies complicate reuse and reconditioning efforts, and competence requirements remain difficult to meet in rapidly evolving technological environments. As a result, the paradoxes persist over time. From a theoretical perspective, the study contributes to paradox theory by demonstrating how sustainability-related paradoxes emerge through interactions among economic, environmental, and social objectives in AT decision-making. The findings show how procurement decisions are shaped by competing sustainability demands that cannot easily be reconciled. Rather than representing isolated challenges, the four paradoxes form an interconnected system in which actions taken to advance one sustainability objective may constrain another. The findings further suggest that these paradoxes are embedded in two broader developments that shape contemporary AT management, namely the transition towards circular economy practices and the increasing digitalisation of AT. While the first two paradoxes are linked to efforts to extend product lifecycles through reuse, reconditioning, and donations, the latter two arise from the opportunities and challenges associated with digital AT. Managerial strategies primarily function as mechanisms for navigating these paradoxes rather than resolving them, thereby extending understanding of how sustainability paradoxes are embedded in everyday decision-making within public healthcare organisations.

The findings also have important practical implications. In the Swedish context, AT organisations operate with considerable autonomy within regional and municipal structures, enabling managers to respond to the needs of people with disabilities. At the same time, limited public resources and competing sustainability demands create persistent tensions that challenge decision-making. Recognising these paradoxes may help policymakers and healthcare organisations develop procurement policies, circular economy initiatives, competence development programmes, and organisational support systems that better enable managers to balance competing objectives. Overall, the study suggests that sustainable AT decision-making is not achieved by eliminating tensions or identifying optimal solutions. Instead, in line with paradox theory, it requires the continuous navigation of interconnected sustainability paradoxes arising from the simultaneous pursuit of economic, environmental, and social objectives. AT decision-makers therefore play a central role in ensuring access to appropriate AT while responding to the competing sustainability demands.

Method Considerations and Future Research

This study has several limitations that should be acknowledged. First, the study was conducted within the context of Swedish AT provision. As healthcare systems, procurement practices, and sustainability priorities vary across countries and institutional settings, caution is warranted when transferring the findings to other contexts. Future research could examine whether similar tensions emerge in other national healthcare systems and decision-making environments.

Second, the study relies on qualitative interview data and captures managers' experiences and interpretations of sustainable AT decision-making. Although this approach provides rich insights into how tensions and paradoxes are perceived and managed, it does not allow for statistical generalisation. Future studies could complement these findings by incorporating additional stakeholder perspectives, including clinicians, prescribers, policymakers, suppliers, and AT users.

Third, a limitation of the study is the nomination-based recruitment process. Although the reference group was instructed to nominate experienced managers and ensure representation from all Swedish regions, this approach may have favoured those who were particularly visible within professional networks or known to the nominators, potentially limiting the range of perspectives captured.

Another limitation is that the data collection was completed some years before publication. During this period, technological developments, digitalisation initiatives, and sustainability agendas have continued to evolve. However, the purpose of this study was not to provide a time-specific account of particular technologies or procurement practices. Rather, the study sought to explore the underlying tensions associated with balancing economic, social, and environmental sustainability objectives in AT decision-making. We argue that these tensions remain relevant despite changes in the technological landscape. Nevertheless, future longitudinal studies could investigate how these paradoxes evolve as digital technologies, circular economy practices, and sustainability requirements continue to develop.

Finally, while the study identifies key tensions and paradoxes in sustainable AT decision-making, it does not seek to develop or test specific solutions. Consistent with paradox theory, the objective was to understand how competing demands emerge and coexist rather than how they can be permanently resolved. Future research could build on these findings by exploring organisational practices, governance arrangements, and policy interventions that may help decision-makers navigate these tensions.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/su181910208/s1.

Author Contributions: K.B. conducted the interviews; K.B. and A.S.K. performed dataset analysis, interpreted the data, and drafted the manuscript. K.B. and A.S.K. contributed to conceptualisation, design, methodology, data analysis, review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The overall purpose of this study was in accordance with the Swedish Research Council. Potential participants were provided with written and verbal information about the study and its aim, including that participation was voluntary, that they could withdraw at any time without explanation, and that the treatment and the presentation of the data would be kept confidential. Informed consent was obtained from all study participants. The study did not include any personal or sensitive information that would require ethical approval under the standards of the Swedish Research Council, but it was conducted in accordance with the Declaration of Helsinki.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The datasets generated and analysed during the current study are not publicly available due to ethical and confidentiality considerations. Given the nature of the qualitative interview data and the relatively small sample of managers, anonymised data may still contain information that could lead to participant identification.

Acknowledgments: The authors would like to thank the participants who contributed their experiences to this study.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AP	Assistive products
AT	Assistive technology
OT	Occupational therapists
PT	Physiotherapists
RN	Registered nurses
SDGs	Sustainable Development Goals
TAM	Technology Acceptance Model
UN	United Nations
WHO	World Health Organization

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