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The Twinning Power of Data: Understanding How Data Drive Digital and Sustainable Transformation

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"There are some four million different kinds of animals and plants in the world. Four million different solutions to the problems of staying alive."

Sir David Attenborough, Life on Earth, 1979

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Abstract

Societal disruptions have grown in intensity, frequency, and mutual entanglement, converging into a polycrisis that confronts organizations with unprecedented structural pressures. Digital technologies play an ambivalent role in this context: they enable new forms of coordination and value creation, yet also risk reinforcing the unsustainable patterns they could help overcome. How digitalization can move from part of the problem to part of the solution has therefore become a defining question for information systems (IS) research - one increasingly addressed through the interplay of digital transformation and sustainability transformation. Recent debates on *twin transformation* conceptualize these two agendas as mutually reinforcing, yet how such reinforcement is enacted in organizational practice remains insufficiently understood. This dissertation argues that sustainability-related data constitute the connective resource through which digital and sustainability transformation become linked: digital technologies generate and process the data that make sustainability-related phenomena visible and actionable, while sustainability objectives determine which data matter and how they should be governed within digital systems and decision processes. Building on this argument, the dissertation addresses the overarching research question: *How do data drive digital and sustainability transformation to become mutually reinforcing?*

Drawing on nine research papers, the dissertation develops a cumulative sociotechnical perspective on data-based twin transformation, structured around two reciprocal directions. The first is the enabling direction, in which digital transformation creates the data foundations and organizational capabilities that make sustainability-related phenomena manageable in the first place - for instance by conceptualizing ESG data as heterogeneous, purpose-bound objects and by specifying maturity pathways for sustainability data management and industrial decarbonization. The second is the guiding direction, in which sustainability transformation shapes what digital systems measure, optimize, and make credible, as illustrated through studies on carbon-aware energy management, sustainable mobility, and digitally verifiable carbon information. The dissertation then brings both directions together, showing how sustainability-related data are mobilized for strategic value within an interorganizational network and how enabling and guiding capabilities jointly shape the reciprocal relationship between the two transformations.

Theoretically, the dissertation contributes to Green IS research by developing a data perspective on the mutual reinforcement of digital and sustainability transformation. It refines the emerging theory of twin transformation by showing that this relationship is neither automatic nor unidirectional: sustainability-related data become valuable only through organizational capabilities that make them usable, just as sustainability objectives shape digital transformation only once embedded into IS. For practice, the dissertation demonstrates that organizations must move beyond collecting sustainability-related data for compliance and instead mobilize it for decision-making across organizational boundaries. Overall, the dissertation positions data as the medium through which sustainability becomes organizationally actionable - and through which digital transformation can contribute to more resilient responses to contemporary sustainability challenges.

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Copyright Statement

The following chapters are partly comprised of content taken from the research articles in this thesis. To improve the readability of the text, I have omitted the standard labeling of these citations.

1 Introduction

1.1 Motivation

Since the 2007 financial crisis, societal disruptions have grown not only in intensity but also in frequency and mutual entanglement (Homer-Dixon et al., 2021). This convergence of simultaneous and mutually reinforcing crises at the regional and global levels — now commonly referred to as a polycrisis (Henig & Knight, 2023; Lawrence et al., 2024) — confronts societies, organizations, and individuals with an unprecedented accumulation of structural pressures. Accelerating consequences of climate change, accompanied by geopolitical instability and the collapse of formerly stable economic orders, are forcing them to undergo fundamental transformation. The material consequences of these pressures are becoming increasingly tangible: for example, climate change intensifies pressures on biodiversity, with rising wildfire risks threatening already vulnerable species and reinforcing concerns about future ecosystem integrity (Yang et al., 2026). At the same time, climate change is generating ecological novelty and new social challenges, as ecosystems change rapidly and societies must not only mitigate environmental degradation but also adapt to shifting ecological conditions (T. Heger et al., 2026). These pressures, and the responses they demand, unfold simultaneously across interdependent levels: in the everyday choices of individuals, in the strategies and capabilities of organizations, in the data ecosystems and infrastructures that connect them, and in the regulatory and societal arrangements that hold them to account.

Information Systems (IS) research offers a unique perspective on this challenge by treating information technology (IT) not merely as a technical artifact, but as a sociotechnical phenomenon embedded in organizational and societal contexts. This perspective is particularly important in an era in which digitalization has become a pervasive force of transformation. Digital technologies, understood broadly as information, computing, communication, and connectivity technologies (A. Bharadwaj et al., 2013), shape how people coordinate action, how organizations create value, and how societies organize infrastructures. In organizational contexts, these developments are commonly discussed under the notion of digital transformation, which denotes a technology-induced process of change through which digital technologies alter the properties of an entity and enhance its functioning (Vial, 2021; Wessel et al., 2021). Yet this transformative potential is ambivalent. While digital technologies enable new forms of coordination, optimization, transparency, and value creation, they also depend on energy- and resource-intensive infrastructures and may reinforce unsustainable patterns when efficiency gains translate into additional demand. This ambivalence is becoming further pronounced: the International Energy Agency (2025) projects that electricity demand will grow much faster than overall energy use, driven in part by data centers, artificial intelligence (AI), electrified heating, mobility, and advanced manufacturing. At the same time, global energy-related CO_2 emissions reached a record of 38 Gt in 2024, underscoring that digital transformation unfolds within an energy system that remains

both indispensable and environmentally strained. A sustained Green IS tradition has therefore emphasized that IS are both implicated in environmental burden and capable of enabling environmental and societal sustainability (Gholami et al., 2016; N. P. Melville, 2010; Seidel et al., 2013; vom Brocke et al., 2013; Watson et al., 2010). How to turn digitalization from part of the problem into part of the solution has accordingly become a defining question for the field (Boh et al., 2026; Veit & Thatcher, 2023).

Two transformation agendas have proved especially consequential. The first is the digital transformation outlined above, manifest for instance in data-driven business models (Staudt & Hoffmann, 2024), platform-based ecosystems (Möller et al., 2025), and the algorithmic optimization of operations (Mariano-Hernández et al., 2021). The second, sustainability transformation, by contrast, refers to a paradigmatic and multi-dimensional change process through which organizations reorient their strategies, operations, and business models toward addressing critical sustainability challenges in their societal and ecological environments (Dao et al., 2011; Dyllick & Muff, 2016; Lahtinen & Yrjölä, 2019), for example through circular value creation (S. F. Jensen et al., 2023), decarbonized supply chains (Ströher et al., 2025), or sustainability-oriented reporting and accountability (J. Wang et al., 2024). Instead of treating sustainability merely as a constraint on business activity, this perspective foregrounds an outside-in logic in which organizations ask how their resources, capabilities, products, and services can contribute to resolving pressing problems for society and the planet (Dyllick & Muff, 2016). IS research typically frames the substantive goals of such efforts along the triple bottom line of environmental, social, and economic value (Elkington & Rowlands, 1999; Kotlarsky et al., 2023), which organizations operationalize through environmental, social, and governance (ESG) criteria rooted in responsible investing (Widyawati, 2020). Yet the two agendas have not received equal attention: sustainability transformation has remained the comparatively neglected sibling of digital transformation in IS scholarship (Christmann et al., 2024), and where the two have been examined together, studies have tended either to privilege one over the other or to treat them as largely independent problem spaces (Demartini et al., 2019).

The concept of *twin transformation* challenges this separation between digital and sustainability transformation. It holds that digital and sustainability transformations are not merely parallel but potentially synergistic processes that should be pursued in an integrated and mutually reinforcing manner (Balta et al., 2022; Ollagnier et al., 2021). Twin transformation has been defined as a value-adding interplay between digital and sustainability transformation efforts that improves an organization by leveraging digital technologies to enable sustainability and leveraging sustainability to guide digital progress (Graf-Drasch et al., 2023). Organizations that integrate both agendas may be better positioned to realize digital ambitions and sustainability goals while improving efficiency, reputation, and long-term competitiveness (Alsayegh et al., 2020). The interplay is not frictionless, however. Recent work highlights that digital and sustainability transformation can be as much in tension as in synergy, and that whether they reinforce or undermine one another is itself an open question (Ologeanu-Taddei et al., 2025). Despite numerous corporate initiatives addressing digital and sustainable business models, these two aspects have not yet been integrated consistently across the full range of organizational activities (Böttcher et al.,

2024). Conceptual and capability-oriented research has so far only begun to chart the underlying interplay (Breiter et al., 2024; Christmann et al., 2024; Graf-Drasch et al., 2023). Whether this interplay yields synergy or tension is thus not predetermined, but contingent on how it is organized.

Underlying both directions of the interplay is a resource that the twin transformation discourse has so far treated mainly implicitly: sustainability-related data. IS research increasingly regards data as a strategic organizational resource in its own right (Püchel et al., 2024). In the sustainability context, such data describe, measure, and inform ESG-related phenomena, and thereby render sustainability issues visible, comparable, and actionable. This is what makes data the connective tissue of twin transformation, and the connection runs in both directions: digital technologies can advance sustainability only once sustainability performance has been made measurable and steerable through data, while sustainability imperatives in turn determine which data must be collected, governed, and built into digital systems in the first place. ESG data form a particularly visible and consequential subset. They span domains as diverse as carbon emissions and energy use on the environmental side, labor and human-rights conditions on the social side, and board structures, anti-corruption, and data-privacy controls on the governance side. ESG data are generated by different functions, measured in incommensurable units, and governed under divergent conventions. It is precisely this breadth that turns them from a reporting by-product into a genuine object of management (Ixmeier et al., 2024; Körner, Michaelis, et al., 2023). Regulatory frameworks reinforce this status: the Corporate Sustainability Reporting Directive (CSRD) (European Parliament & European Council, 2022), the Carbon Border Adjustment Mechanism (CBAM) (European Parliament & European Council, 2023), and ESG risk-management guidelines (European Banking Authority, 2025) oblige organizations to collect, process, exchange, and disclose such information in auditable form, making sustainability-related data, and ESG data in particular, a critical basis for sustainability reporting, capital-market refinancing, and data-driven decision-making (Körner, Michaelis, et al., 2023; Kotlarsky et al., 2023; Kotsantonis & Serafeim, 2019; Ng & Rezaee, 2015).

Yet the value of these data is rarely realized within the boundaries of a single organization. Emissions accumulate along supply chains, ESG exposures are priced in capital markets, and mandates such as the CSRD and CBAM presuppose auditable data flows that cross organizational and national borders (European Parliament & European Council, 2022, 2023). The relevant unit of analysis is therefore the data ecosystem, understood as a network of interdependent actors that jointly source, share, and create value from data (Jarke et al., 2019; Möller et al., 2025). This perspective extends to data platforms and spaces that render such exchange technically and institutionally feasible (Möller et al., 2024; Otto & Jarke, 2019). Where these arrangements remain purely private, they tend to reproduce the very fragmentation they are meant to overcome. This is why scholarship and policy increasingly frame interoperable, openly governed data exchange as a form of digital public infrastructure for sustainability. Such infrastructure constitutes a shared layer, comparable to identity or payment rails, that establishes a level playing field for credible sustainability information on which markets, regulators, and the public can rely (Beverungen et al., 2022). The need for verifiability becomes particularly salient where sustainability claims

concern climate-oriented interventions themselves: recent evidence on avoided-deforestation projects shows that such interventions do not automatically preserve ecological integrity, underscoring the need for reliable data, verification, and governance mechanisms to assess their actual sustainability effects (Ong et al., 2026). The same infrastructural logic recurs at the level of the individual product or transaction, where digital product passports and digital measuring, reporting, and verification turn sustainability claims into verifiable, machine-readable credentials (Heeß, Rockstuhl, et al., 2024; Körner et al., 2025; Sedlmeir, Smethurst, et al., 2021). Twin transformation, on this reading, is not only an intra-organizational accomplishment but an infrastructural one: it depends on the governance arrangements and shared data foundations through which sustainability-related data become trustworthy, comparable, and actionable across organizational boundaries (Lefebvre et al., 2025; Legner & Lefebvre, 2026).

Realizing this value is far from automatic. Sustainability-related data are heterogeneous, fragmented, voluminous, and difficult to harmonize, which makes them hard to manage and to use consistently within and across organizations (J. Wang et al., 2025). The difficulty is not merely one of technical integration: it reaches into the conceptual foundations of the data themselves, which remain ambiguously defined, inconsistently operationalized, and often without shared semantics across organizational contexts (Ballnat et al., 2026; Ixmeier et al., 2024), thereby constraining the digitalization benefits that sustainability practices might otherwise reap (Schoormann et al., 2026). As a consequence, sustainability-related data are still used predominantly for backward-looking, compliance-oriented reporting rather than for proactive steering (Püchel et al., 2024; Teracino et al., 2026; J. Wang et al., 2024). The transformative promise of sustainability-related data thus hinges less on their availability than on the practices, capabilities, designs, and infrastructures through which organizations and interorganizational networks mobilize them for coordination, decision-making, and value creation. Beyond efficiency and compliance, data-enabled twin transformation may also strengthen organizational resilience, helping organizations anticipate and adapt to environmental and economic shocks while pursuing long-term value across the triple bottom line (Boh et al., 2026; Eccles et al., 2014).

How this potential is realized, however, remains insufficiently understood, particularly at the intersection of digital and sustainability transformation. Therefore, three observations motivate this dissertation. First, digital and sustainability transformation have largely been studied in isolation. Where they have been examined jointly, their relationship is portrayed as both synergistic and conflicting, without a clear account of what governs it (Demartini et al., 2019; Ologeanu-Taddei et al., 2025). Second, the twin transformation literature has begun to specify the capabilities and dynamics involved (Breiter et al., 2024; Christmann et al., 2024), yet treats data largely implicitly. Third, the data perspective on sustainability has advanced rapidly (Krasikov & Legner, 2023; Püchel et al., 2024), but has rarely been systematically connected to the twin transformation agenda. The connective role of data, i.e., the mechanism through which the two transformations come to reinforce one another, therefore remains empirically underexamined. This dissertation positions sustainability-related data as precisely this connective resource and examines how, through data, digital and sustainability transformation can become mutually reinforcing across individual, organizational, and ecosystem levels, even amid persistent uncertainty.

1.2 Research Aim

In this dissertation, sustainability-related data are understood as data that describe, measure, or inform phenomena bearing on ecological and societal sustainability. Their defining feature is functional: such data can be put to use in sustainability-oriented reporting and decision-making, as well as in the optimization, intervention, and value creation that organizations pursue in response. ESG data constitute a particularly important subset, especially in contexts of disclosure, governance, risk management, and capital-market communication. Operational and behavioral data, by contrast, capture how sustainability objectives are enacted and influenced within organizational and sociotechnical systems, for instance through records of energy consumption, mobility patterns, or technology adoption. Against this backdrop, the dissertation pursues one overarching question:

How do data drive digital and sustainability transformation to become mutually reinforcing?

It addresses this question along the two constitutive directions of twin transformation: digital transformation as an enabler of sustainability goals, and sustainability transformation as a force that guides the priorities of digital transformation. In both directions, data are the connecting element. Sustainability transformation becomes an information and coordination challenge that hinges on the availability and quality of data (Kotlarsky et al., 2023; Krasikov & Legner, 2023), while digital transformation is meaningful for sustainability only if the data it generates and processes can be trusted, integrated, and acted upon (Püchel et al., 2024).

The first direction departs from a basic observation: sustainability transformation generates substantial informational complexity. Organizations seeking to decarbonize operations, reduce resource consumption, or report on environmental performance confront heterogeneous data sources, inconsistent measurement conventions, and a lack of shared conceptual foundations (Ballnat et al., 2026; Legner et al., 2020; J. Wang et al., 2025). The problem is rarely one of scarcity, but rather that available data seldom cohere into a form that can inform decisions or create value (Barney, 1991; Sirmon et al., 2011). Two aims follow from this observation. The first is to conceptualize and structure sustainability-relevant data as an object of management in its own right. This entails clarifying what such data comprise, how they differ across organizational contexts, and which characteristics matter for their governance and use (Ixmeier et al., 2024; Körner, Michaelis, et al., 2023). The second is to specify the organizational capabilities required to move from data possession to effective data use. Drawing on the resource-based view, resource orchestration, and dynamic capabilities theory, this aim examines how organizations structure, bundle, and leverage sustainability-related data to build maturity over time (Becker et al., 2009; Sirmon et al., 2011; Teece et al., 1997). The underlying argument is that measurability and orchestration are preconditions for agency: without reliable indicators and the capabilities to act on them, sustainability transformation remains aspirational rather than manageable (Machado Ribeiro et al., 2022; Püchel et al., 2024).

The second direction inverts this perspective. Instead of treating digital transformation as a fixed infrastructure that serves sustainability objectives, this approach asks how sustainability imperatives reshape digital transformation itself, and how the resulting data can be utilized. This is important because digital technologies do not automatically yield sustainability benefits. They may reduce resource consumption through efficiency gains and substitution effects, but they may equally create new environmental burdens or rebound effects when efficiency improvements translate into increased demand (Sedlmeir et al., 2020). Sustainability objectives thus become design requirements for digital systems: Rather than entering as an outcome to be reported after the fact, sustainability is admitted as an objective function in its own right. Ranked alongside the economic criteria that have traditionally organized systems design, it reshapes what is measured, optimized, communicated, and evaluated. The third aim investigates how digital systems, when purposefully designed around ecological objectives and operational data, deliver measurable reductions in resource consumption and emissions within complex sociotechnical systems such as buildings, energy management, and mobility (Ketter et al., 2023; Staudt et al., 2019). The fourth aim turns to the behavioral dimension of transformation. Building on the sociotechnical tradition of IS research, it examines how behavioral data and digitally mediated sustainability information shape the adoption of sustainable practices (Wunderlich et al., 2019), the design of digital interventions (Seidel et al., 2013), and the conditions under which technology-mediated change becomes effective and trusted (Recker et al., 2025).

Taken together, these four aims structure the cumulative contribution of this dissertation and advance the argument that sustainability-related data constitute the connective resource through which digital transformation and sustainability transformation become mutually reinforcing. The dissertation moves from conceptualizing sustainability-related data as an object of management, through the organizational capabilities required to orchestrate them, to the ways in which sustainability objectives guide the design and use of digital systems and how those systems produce measurable sustainability outcomes and behavioral change. This progression frames twin transformation as a data-enabled sociotechnical phenomenon that demands more than parallel digital and sustainability ambitions: it requires a shared data foundation, the capabilities to turn data into action, and an understanding of how data-enabled synergies create strategic value These synergies arise both within organizations and across the data ecosystems and infrastructures that connect them (Auweiler et al., 2025). Throughout, the dissertation follows the connective role of data across the levels at which transformation unfolds, from the everyday choices of individuals and the capabilities of organizations to the interorganizational data ecosystems and the societal infrastructures and regulations that frame them. In doing so, the dissertation derives both theoretical contributions and practically actionable insights for organizations operating at the intersection of technological change and sustainability transformation.

1.3 Structure of the Dissertation and Embedding of the Research Papers

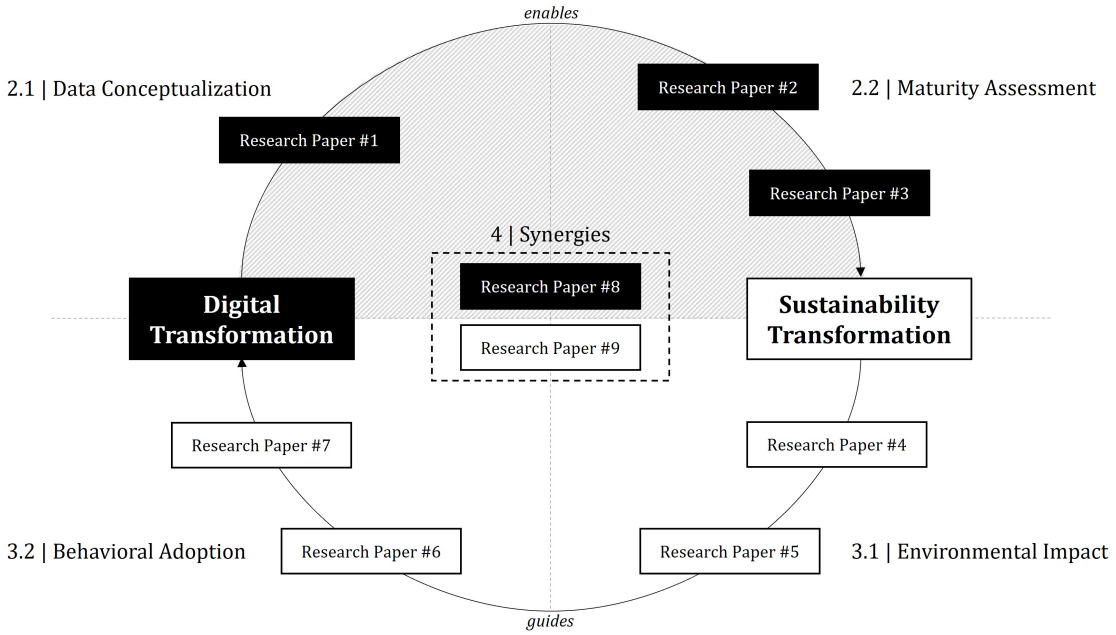


Figure 1.1: Structure of this dissertation with chapter numbers and embedding of the research papers.

The dissertation is structured into five chapters, with nine embedded research papers (cf. Figure 1.1). These papers are organized into three thematic blocks, each corresponding to a level at which twin transformation unfolds. Chapter 2 establishes the conceptual and empirical foundations for how digital transformation enables sustainability transformation, moving from data conceptualization to organizational maturity, and operates primarily at the organizational level. Chapter 3 reverses the analytical direction and examines how sustainability transformation guides digital transformation, spanning the systemic level of energy and the built environment and the individual level of behavior, adoption, and trust. Chapter 4 synthesizes both directions at the interorganizational and institutional level and demonstrates the strategic value that arises at their intersection. Chapter 5 concludes the dissertation by summarizing contributions and outlining implications for research and practice.

Chapter 2, *Enabling — Digital Transformation Enables Sustainability Transformation*, contains Research Papers #1, #2, and #3. Section 2.1 establishes the data foundation: Research Paper #1 develops an ESG data taxonomy with three meta-dimensions, 17 dimensions, and 63 characteristics, demonstrating the heterogeneity and application diversity of ESG data and establishing it as a central IS research object. Section 2.2 addresses measurement and maturity: Research Paper #2 presents the Sustainability Data Management Maturity Model (SDM-MM), which conceptualizes sustainability-related data as a latent strategic resource and specifies the organizational capabil-

ities required to leverage it across four dimensions and five maturity levels. Research Paper #3 extends this logic to the manufacturing sector with the IS-based industrial decarbonization maturity model (ISbid-MM), a sector-specific maturity model for IS-enabled industrial decarbonization. Together, these papers establish that organizations advance their sustainability transformation to the extent that they collect, understand, and purposefully deploy data.

Chapter 3, *Guiding – Sustainability Transformation Guides Digital Transformation*, contains Research Papers #4, #5, #6, and #7. Section 3.1 examines energy efficiency and decarbonization: Research Paper #4 demonstrates through a quantitative case study in sustainable tourism how digitalization-driven optimization generates measurable carbon efficiency gains. Research Paper #5 illustrates that effective IS design in this context requires user behavior as a structural input, introducing a guest-centric vehicle-to-building optimization model for hotel energy management that achieves significant emission reductions when mobility patterns are incorporated. Section 3.2 addresses behavioral change and adoption: Research Paper #6 analyzes approximately 118,400 real-world carsharing trips using machine learning and explainable AI, revealing how behavioral data drives the continuous refinement of sustainable digital infrastructure. Research Paper #7 closes the value chain by demonstrating that internal sustainability value requires external credibility: a best-worst scaling experiment demonstrates that digitally verifiable carbon information generates significantly higher perceived utility than manufacturer claims or third-party certification, establishing digital verification as a structural prerequisite for sustainable consumer decision-making.

Chapter 4, *Synergies – The Strategic Value of Twin Transformation*, contains Research Papers #8 and #9. Research Paper #8 examines how ESG data can be mobilized across organizational boundaries through a qualitative single case study of the *ESG-Data&Analytics* platform, illustrating that ESG data gains strategic value only through coordinated network-level data practices and that digital platforms can enable a shift from compliance reporting to proactive sustainability management. Research Paper #9 provides the empirical foundation for the twin transformation concept that frames the entire dissertation: a quantitative study with hypothesis-driven regression analyses finds a positive and reciprocal relationship between digital and sustainability transformation, and demonstrates that organizations managing both simultaneously generate greater economic value from their data. Collectively, these papers confirm that digitalization and sustainability are interdependent – and that data are the shared foundation through which their mutual reinforcement becomes strategically productive.

Chapter 5 concludes the dissertation by synthesizing its overarching findings, elaborating its theoretical contributions and practical implications, and reflecting on limitations and avenues for future research.

2 Enabling – Digital Transformation Enables Sustainability Transformation

Building on the dissertation's overarching argument that sustainability-related data constitute the connective resource of twin transformation, this chapter examines how digital transformation enables sustainability transformation. It argues that digital transformation contributes to sustainability transformation not merely through the adoption of digital technologies, but through the generation, structuring, and organizational use of sustainability-related data. Across industries, organizations rely on digital technologies to improve resource efficiency, monitor environmental impacts, support decarbonization initiatives, and comply with growing sustainability reporting requirements (Schoormann et al., 2023). These technologies continuously generate, process, exchange, and store data (Legner et al., 2017), thereby making ESG-related phenomena increasingly visible, measurable, and actionable (Teracino et al., 2026). Yet these data only become transformative when organizations understand what they represent, how they differ, and which capabilities are required to govern and use them effectively (Püchel et al., 2024).

Accordingly, this chapter focuses on two prerequisites for the enabling role of digital transformation. First, organizations need conceptual clarity regarding sustainability-related data. Without a shared understanding of the characteristics, contexts, and uses of such data, digital technologies may generate information without enabling meaningful sustainability action (Ixmeier et al., 2024; Seidel et al., 2013). Second, organizations require capabilities to orchestrate sustainability-related data as strategic resources (Sirmon et al., 2011). IS research increasingly conceptualizes data not merely as supporting assets within information management systems, but as active sources of organizational value creation (Beverungen et al., 2022). This shift is reflected in research on data-centric business models, data ecosystems, and data management capabilities (Kakuschke et al., 2025; Otto & Jarke, 2019). However, data do not support sustainability transformation by themselves. Their potential unfolds only once they are woven into the infrastructures, governance, and decision-making routines that organizations rely on.

Within the broader category of sustainability-related data, ESG data have emerged as a particularly consequential domain. ESG data encompass a broad range of sustainability-related information, including emissions, energy consumption, labor conditions, human rights, diversity, governance structures, anti-corruption measures, and data privacy indicators. Their organizational importance has increased substantially through regulatory initiatives such as the CSRD and the European Sustainability Reporting Standards (ESRS), which require organizations to systematically collect, process, and disclose sustainability-related information (Teracino et al., 2026; J. Wang et al., 2024). As a result, ESG data have become a critical foundation for sustainabil-

ity reporting, strategic decision-making, risk management, and capital market access (Körner, Schober, et al., 2023; Kotsantonis & Serafeim, 2019). They do not merely support sustainability transformation in isolation. Instead, they connect digital and sustainability objectives across organizational boundaries and value chains (Ströher et al., 2025), and thus constitute a central element of the enabling relationship between digital and sustainability transformation.

Yet the growing availability of sustainability-related data does not automatically translate into sustainability outcomes. Krasikov and Legner (2023) highlight that organizations frequently struggle to make effective use of ESG data, whose sources tend to be fragmented and whose structures and definitions vary considerably across organizational contexts (J. Wang et al., 2025). Importantly, these challenges extend beyond technical integration problems and point toward more fundamental issues of conceptualization and governance. As Ixmeier et al. (2024) argue, ESG data are often ambiguously defined and inconsistently operationalized, lacking shared semantic foundations that would allow for meaningful interpretation, comparability, and effective use. Consequently, many well-known data management challenges can be understood as manifestations of deeper conceptual ambiguities regarding the nature of sustainability-related data itself (Ballnat et al., 2026). A recurring structural manifestation of these difficulties is the persistence of data silos, in which relevant data remain fragmented across departments (Püchel et al., 2024). Such fragmentation not only limits access to existing data but may also leave stakeholders unaware of what data their organization holds, while accessibility alone offers little assurance of timeliness or quality (Legner et al., 2020). Because silos typically reflect entrenched organizational structures that predate digitalization, they are especially pronounced in large multinational corporations, long-established firms, and public-sector organizations (Gong & Li, 2023; Gust et al., 2017; Zhang et al., 2022). Notably, while these data-related problems, e.g., unavailability across operational units, limited integration, and neglected data quality, surface repeatedly across sustainability studies (Machado Ribeiro et al., 2022; Marx Gómez & Teuteberg, 2015; N. P. Melville et al., 2017; Watson et al., 2010; Zampou et al., 2022), the Green IS literature has not yet sufficiently examined the data perspective on sustainability (Krasikov & Legner, 2023). Guidance on how to address these problems, whether through data requirements, practices, or design approaches, remains nascent.

This observation highlights a first prerequisite for the enabling role of digital transformation: data must be understood before it can become transformative. While digital transformation dramatically increases the availability of sustainability-related data, organizations require a shared conceptual understanding of what sustainability-related data represent, how they differ from one another, and how they can be governed and managed. Without such conceptual foundations, data remain largely inert and cannot effectively support sustainability transformation. Research Paper #1 addresses this challenge by developing a taxonomy of ESG data and thereby establishing sustainability-related data as a distinct object of IS research. Conceptual clarity alone, however, is insufficient to realize the transformative potential of data. Even well-defined and well-governed data only create value when organizations possess the capabilities required to utilize them effectively. Oberländer et al. (2021) argue from a resource-based view that data represent a latent strategic resource whose value emerges only through appropriate orchestration, governance, and

organizational deployment. Building on this logic, Huber et al. (2024) emphasize that value creation depends on organizations' ability to mobilize and combine digital resources rather than merely adopting new technologies. Consequently, a second prerequisite for the enabling role of digital transformation is measurability: organizations can only systematically improve what they are able to assess. Sustainability transformation therefore requires mechanisms that allow organizations to evaluate their data-related capabilities, identify development needs, and establish pathways for continuous improvement. Research Papers #2 and #3 address this challenge through maturity assessment approaches that operationalize how sustainability-related data can be transformed into organizational capabilities and sustainability outcomes.

Following this logic, the chapter is structured in two parts. Section 2.1 examines the conceptual foundations of sustainability-related data and elaborates how Research Paper #1 establishes ESG data as a distinct object of IS research. Section 2.2 then shifts from conceptualization to capability development and explains how Research Papers #2 and #3 use maturity assessment to operationalize the organizational capabilities required to transform sustainability-related data into actionable sustainability value.

2.1 Data Conceptualization

The world's capacity to generate, store, and process data has grown exponentially over the past two decades (Hilbert & López, 2011). This development gave rise to the notion of big data, commonly characterized along four dimensions: the sheer volume of data, the velocity at which it must be processed, the variety of its formats and sources, and the veracity, or degree of uncertainty, of its content (Bendler et al., 2014). As data have become abundant, the decisive challenge has shifted from generating or storing them to the conditions under which they can be understood and used efficiently.

In this sense, the enabling role of digital transformation for sustainability transformation rests on a fundamental yet often overlooked prerequisite: the ability to understand data. While sustainability transformation ultimately aims to change organizational and societal outcomes, its realization depends on data that make ESG-related phenomena visible, measurable, and actionable. Understanding how data acquire this enabling function therefore requires a closer examination of their evolving role within IS research and organizational practice.

This changing role of data is also reflected in the evolution of IS research. Early research primarily viewed data as a supporting asset within database and information management systems, with attention focused on data collection, storage, processing, and integration. More recent scholarship has moved considerably beyond this framing. Püchel et al. (2024) conceptualize data as a strategic organizational resource and even as a production factor in its own right, arguing that organizations must treat data with the same deliberateness they apply to other strategic assets. This perspective is reinforced by Kakuschke et al. (2025), who demonstrate that organizational value creation depends not on IS themselves but on the data these systems generate, exchange, and mobilize. Research on data products, data ecosystems, and data spaces has further elaborated

this argument, underscoring that data must be actively governed and shared across organizational boundaries to realize their full value creation potential (Beverungen et al., 2022; Möller et al., 2024).

This conceptual shift is particularly relevant in the sustainability domain. Sustainability transformation requires organizations to observe and manage phenomena that are often difficult to measure directly, including greenhouse gas emissions, resource consumption, biodiversity impacts, labor conditions, human rights practices, and governance structures. Crucially, much of this information has rarely been captured systematically in the past and cannot be easily retrieved from existing systems. Instead, it must be actively sourced, estimated, or inferred, which turns the provision of sustainability-related data into a demanding organizational task (Kotlarsky et al., 2023). Against this backdrop, Püchel et al. (2024) emphasize the pivotal role of data in sustainability transformations and call for a stronger integration of data management perspectives into sustainability research. Data enable organizations to monitor sustainability performance, assess risks, allocate resources, identify improvement opportunities, and evaluate progress toward sustainability objectives. In this sense, sustainability transformation depends on data as a prerequisite for evidence-based action.

The growing importance of sustainability-related data has been substantially reinforced by regulatory developments. Within the European Union, the CSRD and the accompanying ESRS have created powerful incentives for organizations to systematically collect, process, and disclose sustainability-related information (European Parliament & European Council, 2022). Additional regulations such as the European Union (EU) Taxonomy Regulation, the CBAM, and national laws such as Germany's Supply Chain Due Diligence Act have further extended these requirements into global value chains and across organizational boundaries (European Commission, 2025; European Parliament & European Council, 2023; Federal Ministry of Justice, 2021; Krasikov & Legner, 2023). As J. Wang et al. (2024) reveal, these regulatory pressures have fundamentally changed how organizations approach sustainability-related data, prompting a shift from ad-hoc data collection toward routinized and increasingly standardized data management processes. Consequently, sustainability-relevant data are no longer generated solely as a by-product of operational monitoring but have become strategic organizational assets with legal, financial, and reputational implications.

Within this context, ESG data have become the dominant mechanism through which organizations operationalize sustainability. While academic discussions often conceptualize sustainability through the triple-bottom-line perspective, organizations translate sustainability objectives into ESG-related metrics, indicators, and reporting requirements (Kotlarsky et al., 2023). The ESG framework, which is rooted in responsible investing, translates sustainability objectives into measurable and actionable data and thereby connects sustainability ambitions with capital market expectations (Widyawati, 2020).

Yet the growth in ESG data volume has not been accompanied by a comparable growth in conceptual clarity. Sustainability-related data are inherently heterogeneous: they originate from operational systems, external databases, third-party audits, supplier disclosures, regulatory reporting

frameworks, and manually collected organizational records. Püchel et al. (2024) and Krasikov and Legner (2023) outline that ESG data differ substantially regarding their granularity, temporal reference, verification requirements, ownership structures, measurement logic, and intended use. The same sustainability phenomenon may be measured, categorized, and reported differently depending on the reporting framework, organizational context, or stakeholder perspective applied. The CSRD and the Ecodesign for Sustainable Products Regulation (ESPR), for instance, both mandate Scope 3 emissions disclosure, yet the former targets enterprise-level and the latter product-level emissions (Martinek-Jaguszewska, 2024). Further, J. Wang et al. (2025) characterize ESG data consistently as fragmented, heterogeneous, voluminous, and difficult to harmonize across organizational settings, a characterization that is echoed across the broader data management literature (Legner et al., 2020).

Importantly, these challenges extend beyond technical issues of data integration or interoperability. While organizations frequently struggle with fragmented architectures, inconsistent data quality, and limited traceability, these difficulties often represent symptoms of a deeper problem. Ballnat et al. (2026) and Ixmeier et al. (2024) argue that ESG data remain ambiguously defined, inconsistently operationalized, and frequently lack shared semantic foundations across organizational contexts. As a consequence, organizations may possess large quantities of sustainability-related data while simultaneously lacking a coherent understanding of what these data represent, how they differ, and how they should be managed.

The core challenge, therefore, is not data scarcity but data understanding. Generating and collecting sustainability-related data is a necessary but insufficient condition for sustainability transformation. What is required is a structured conceptual foundation that clarifies what these data are, how they relate to one another, and which characteristics determine their management requirements and value creation potential. Khatri and Brown (2010) demonstrate that effective use of data depends on governance mechanisms that assign access rights, decision rights, and responsibilities for data management, and that these mechanisms cannot be established without a clear conceptual understanding of the data they are meant to govern. Without such a foundation, data governance risks remaining confined to operational concerns, e.g., master data quality, falling short of the strategic role that data, including sustainability-related data, could play for organizational decision-making (Fadler et al., 2021). This challenge becomes critical as organizations move toward data sharing and ecosystem-based approaches. Otto and Jarke (2019) and Beverungen et al. (2022) demonstrate that effective data exchange across organizational boundaries depends on common semantics, interoperability standards, data sovereignty, and shared governance mechanisms. Emerging sustainability applications reinforce this point. S. F. Jensen et al. (2023) show that digital product passports require consistent interpretations of ESG-related information across the entire product lifecycle and across multiple organizational actors. van der Valk et al. (2022) make a similar argument for digital twins in supply chain contexts, while Ströher et al. (2025) demonstrate that automated carbon accounting across value chains depends critically on semantic interoperability of sustainability-related data. Conceptual clarity is therefore not merely a prerequisite for compliance reporting but a foundation for sustainability-oriented value creation and digital collaboration.

A further reason for this gap lies in the orientation of prior Green IS research, which has largely concentrated on the design and implementation of systems for managing sustainability-related data, such as environmental management, rather than on the nature of the data themselves (El-Gayar & Fritz, 2006; Frost et al., 2012; Walls et al., 2011). Although this stream has repeatedly noted data-related difficulties, it has not examined sustainability-related data as an object of inquiry in its own right, and a shared approach to their management is still lacking (Jarvenpaa & Markus, 2020; Krasikov & Legner, 2023).

Despite these developments, a systematic conceptualization of ESG data has remained largely absent from the literature. Krasikov and Legner (2023) and J. Wang et al. (2024) provide valuable insights into how organizations manage sustainability-related data and develop data sourcing practices. However, their focus lies on data management processes and organizational responses, leaving the conceptual structure of sustainability-related data itself unaddressed. J. Wang et al. (2025) extend this work by developing design principles for sustainability reporting and disclosure, yet the literature still lacks a shared conceptual vocabulary that clarifies what sustainability-related data, and particularly ESG data, are, how they differ across contexts, and which characteristics shape their governance and use. Research Paper #1 addresses this gap directly by asking:

> *How can ESG data be systematically categorized across organizational contexts to provide a comprehensive foundation for ESG data management in research and practice?*

The paper develops the first comprehensive taxonomy of ESG data and thereby establishes ESG data as a distinct object of IS research (Zwede et al., 2026). Following established taxonomy development procedures (Kundisch et al., 2021; Nickerson et al., 2013), the study combines a structured literature review of 73 publications, 22 expert interviews, an expert workshop, and the analysis of 180 ESG data objects from academic, regulatory, and practitioner sources. The resulting taxonomy comprises three meta-dimensions, seventeen dimensions, and sixty-three characteristics and provides a systematic conceptual structure for understanding ESG data across organizational contexts (cf. Figure 2.1).

A key insight emerging from the taxonomy is that ESG data should not be understood as a homogeneous category. Instead, ESG data differ substantially regarding their context, management requirements, and usage purposes. Characteristics such as source, temporality, aggregation level, verification degree, ownership, and functional purpose fundamentally shape how ESG data can be interpreted, governed, integrated, exchanged, and utilized. Particularly important is the observation that ESG data derive much of their meaning from their intended use. The same data object may serve purposes ranging from regulatory compliance and external disclosure to operational optimization, strategic steering, sustainability risk management, or organizational learning. Consequently, as the taxonomy demonstrates, ESG data cannot be understood independently of the organizational contexts in which they are mobilized.

The contribution of Research Paper #1 extends beyond classification. By consolidating fragmented knowledge on ESG data into a single structured framework, the taxonomy provides a conceptual foundation that prior research had not established. It shifts the focus of ESG data

MD	Dimension	Characteristic						E/N
Context	Data Classification	Environmental		Social		Governance		E
	Data Source	Internal		External				N
	Data Type	Primary		Secondary				E
	Data Temporality	Persistent Data	Historical	Real-time	Forecasted			E
	Data Scope	Downstream		In-house		Upstream		N
	Data Aggregation	Company-level		Location-level		Product-level		E
	Sector	Energy & Utilities		Financial Services		Consumer Goods & Retail		N
		Manufacturing		Technology & Telecom		Transportation & Logistics		
Data Management	Data Structure	Unstructured		Structured				E
	Data Format	Qualitative		Quantitative				E
	Data Collection & Dissemination	Manual		Semi-automated		Automated		E
	Data Processing & Analytics	Manual		Semi-automated		Automated		E
	Data Verification	None	Manual	Semi-automated	Automated			E
Data Usage	Functional Purpose	Performance & Optimisation	Strategy & Development	Risk, Reporting & Compliance	Communication & Engagement			N
	Disclosure Standard	Internal use only	ESRS	GRI	CDP	SBTI	GDPR	N
	Judgement Rule	Binary Threshold		Score / Rating		Qualitative Audits		N
	Internal Groups	Top-level Management	Finance & Controlling	Procurement & Logistics	R&D & Production			N
		Legal & Compliance		Marketing & Sales		Human Resources		
	External Groups	Internal use only		Customers		Civil Society		N
		Rating Agencies & Capital Providers		Regulatory Authorities & Auditors		Suppliers		

Figure 2.1: Taxonomy of ESG data comprising three meta-dimensions, 17 dimensions, and 63 characteristics (Zwede et al., 2026).

management research from isolated processes toward the underlying characteristics of ESG data as an object of management, a shift that Püchel et al. (2024) explicitly call for. For practitioners, the taxonomy offers a diagnostic instrument that supports governance design, interoperability planning, and cross-organizational data exchange. For the present dissertation, it provides the conceptual vocabulary upon which subsequent contributions are built: the maturity models developed in Section 2.2 draw directly on this understanding of sustainability-related data, while later sections investigate how ESG data create organizational value and support sustainability transformation.

In summary, this section has argued that digital transformation enables sustainability transformation only when sustainability-related data become intelligible, comparable, and manageable. ESG data do not create sustainability value simply because they are collected. Their transformative potential emerges only when organizations understand what these data represent, how they differ, and how their characteristics shape governance, interoperability, and use (Zwede et al., 2026). By establishing such conceptual clarity, Research Paper #1 provides the foundation upon which the subsequent capability and maturity perspective of this dissertation is built.

2.2 Maturity Assessment

While Research Paper #1 established a conceptual foundation for understanding sustainability-related data, conceptual clarity alone does not generate sustainability outcomes. Organizations may possess extensive sustainability-related data and even understand their characteristics, yet

still struggle to translate these data into meaningful environmental, social, or economic improvements. Consequently, the challenge of sustainability transformation extends beyond understanding sustainability-related data toward developing the organizational capabilities required to utilize them effectively.

This challenge reflects a broader observation within contemporary sustainability practice. Regulatory initiatives such as the CSRD and the accompanying ESRS have substantially increased the quantity of sustainability-related data that organizations must collect, process, verify, and disclose (J. Wang et al., 2024). Yet Püchel et al. (2024) observe that these data often remain confined to reporting and compliance: many organizations have become proficient at collecting sustainability-related data without being able to translate them into strategic decision-making, organizational learning, or new sustainability-oriented business opportunities (Krasikov & Legner, 2023; Ströher et al., 2025). Realizing this potential requires moving beyond compliance toward the proactive management of data as a strategic resource – a transition for which, as Püchel et al. (2024) note, the field still lacks an integrative capability perspective. This raises a critical question: which organizational capabilities are required to transform sustainability-related data into sustainability value?

Addressing this question requires a capability perspective. Within strategic management research, the resource-based view conceptualizes organizations as bundles of heterogeneous resources whose characteristics influence competitive advantage (Barney, 1991). A. S. Bharadwaj (2000) extended this perspective to IS research by demonstrating the strategic relevance of IT capabilities for firm performance. More recently, Oberländer et al. (2021) argue that value creation in the context of digital transformation depends on organizations' ability to mobilize and combine digital resources rather than merely adopting new technologies, while Huber et al. (2024) illustrate how this logic applies specifically to the development of Industry 4.0 capabilities.

This perspective is particularly relevant in the context of sustainability transformation.
Sustainability-related data can be understood as a potentially strategic organizational resource because they enable organizations to monitor environmental and social performance, identify opportunities for improvement, manage risks, and develop new sustainability-oriented offerings. However, resources alone do not create value. Sirmon et al. (2007) emphasize through resource orchestration theory that competitive advantage emerges not from resource possession alone but from managerial actions that structure, bundle, and leverage resources over time. Sirmon et al. (2011) extend this argument by underscoring that these orchestration priorities shift across different stages of an organization's development, a life-cycle-sensitive insight that is directly relevant to the maturity perspective developed in this section. Sustainability-related data therefore represent latent strategic resources whose value depends on organizations' ability to integrate them into infrastructures, governance structures, decision-making processes, and organizational routines.

This argument aligns with broader research on dynamic capabilities and digital transformation. Teece et al. (1997) conceptualize dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments, and

Teece (2007) later explicates the microfoundations of these capabilities as the capacities to sense and shape opportunities, seize them, and reconfigure the asset base accordingly. Weritz et al. (2020) apply this logic to digital transformation by demonstrating that dynamic capabilities and digital culture are key antecedents of digital maturity, while Braojos et al. (2024) illustrate that digital leadership and continuous learning environments are critical for translating transformation capabilities into organizational commitment and performance. In the twin transformation context, Christmann et al. (2024) demonstrate that digital and sustainability transformation require integrated organizational capabilities, reinforcing the argument that sustainability transformation should not be understood merely as a technological challenge but as a capability development process through which organizations learn to orchestrate sustainability-related resources effectively.

To make such capability development visible and manageable, organizations require mechanisms for assessment and continuous improvement. Maturity models have emerged as one of the most established approaches for addressing this challenge. Their lineage reaches back to early stage-based models of organizational growth and quality management (Crosby, 1979; Gibson & Nolan, 1974), before Humphrey (1988) established the maturity logic in software process improvement and thereby shaped its modern form. Since then, maturity models have evolved into widely used instruments for evaluating organizational development across a broad range of domains (Becker et al., 2009; Doctor et al., 2023; Röglinger et al., 2012). Rather than viewing transformation as a binary state, they conceptualize development as a progression through distinct stages of increasingly advanced capability, typically arranged from an initial, ad hoc state to a fully institutionalized one. This staged perspective makes capability gaps visible and provides a structured basis for diagnosing current capabilities and planning improvement (de Bruin et al., 2005; Pöppelbuß & Röglinger, 2011). At the same time, the approach has been criticized for oversimplifying organizational realities and implying unduly linear development paths (de Bruin et al., 2005; Gollhardt et al., 2020). Maturity is therefore best understood as a diagnostic and comparative device rather than as a claim that development unfolds through fixed, strictly sequential stages.

Within IS research, maturity models have been applied extensively across contexts such as digital transformation, business process management, data management, Industry 4.0, healthcare digitalization, and public-sector transformation. Doctor et al. (2023) develop a maturity model for assessing the digitalization of public health agencies, demonstrating how the approach can be adapted to domain-specific organizational realities. Corallo et al. (2023) apply a similar logic to the assessment of big data management capabilities in industrial companies, while Van der Merwe et al. (2022) demonstrate the applicability of data management maturity models in healthcare contexts. Brock et al. (2023) extend the approach to process mining, outlining how maturity models can translate abstract improvement intentions into concrete organizational actions. Across these applications, a shared understanding emerges that successful transformation requires the coordinated development of technological, organizational, and human capabilities.

Despite this methodological maturity, existing research has largely treated digital transformation and sustainability transformation as separate phenomena. Digital maturity models predominantly focus on technological readiness, digital innovation, and organizational agility, whereas sustainability maturity models emphasize environmental performance, sustainability governance, and organizational responsibility (Abraham & Dao, 2017; del Socorro Encinas-Grijalva et al., 2024). Breiter et al. (2024) represent an important step toward bridging these perspectives by developing a holistic capability maturity model for twin transformation, yet their model does not explicitly address sustainability-related data as the connecting resource between digital and sustainability transformation. This gap is particularly significant because sustainability transformation increasingly depends on data. Organizations require capabilities not only to collect sustainability-related data but also to integrate, govern, analyze, share, and strategically leverage these data across organizational boundaries (Krasikov & Legner, 2023; J. Wang et al., 2025). Existing data maturity models focus primarily on data quality, governance, architecture, and integration (Aiken et al., 2007; CMM Institute, 2020; Harguem & Boubaker, 2023), whereas sustainability maturity models rarely address the underlying data foundations that sustainability transformation requires. Consequently, current approaches provide limited guidance on how organizations can systematically orchestrate sustainability-related data as a strategic resource. Research Paper #2 addresses this gap by investigating the following research question:

> *How can sustainability data be used to enable proactive sustainability management, moving beyond mere reporting to create strategic value?*

Building on resource orchestration theory, the paper conceptualizes sustainability-related data as a latent strategic resource whose value emerges through organizational capabilities that structure, bundle, and leverage sustainability-related information (Heess et al., 2026). Following the maturity model development procedure proposed by Becker et al. (2009), the study develops the SDM-MM through a Design Science Research process involving a structured literature review, a focus group, two rounds of expert interviews with 17 practitioners, and evaluation across three organizational use cases in real estate, coffee wholesale, and housing management. The resulting model comprises four dimensions, namely *Infrastructure*, *Data*, *Management*, and *People*, encompassing thirteen capability areas and five maturity levels (cf. Table 2.1). These dimensions reflect the core logic of resource orchestration theory. The Infrastructure dimension captures the technological foundations required to collect, integrate, and process sustainability-related data. The Data dimension addresses the quality, availability, accessibility, and governance of sustainability-related information. The Management dimension focuses on the organizational mechanisms through which sustainability-related data are embedded into strategy, decision-making, and governance structures. The People dimension, finally, captures the skills, knowledge, and cultural capabilities required to utilize sustainability-related data effectively. Together, these dimensions provide a holistic framework for assessing how organizations transform sustainability-related data into sustainability value.

A key insight emerging from the evaluation of the SDM-MM is that organizational maturity rarely develops uniformly across dimensions. Organizations frequently possess sophisticated

Table 2.1: The Sustainability Data Management Maturity Model (SDM-MM) comprising four dimensions, 13 capability areas, and five maturity levels (Heess et al., 2026).

	Capability Area	Question	Optimized Maturity
Infrastructure	**Digital Infrastructure & IT Systems**	How modern and scalable is your organization's IT infrastructure for collecting, storing, and managing sustainability data?	A fully centralized, cloud-based, scalable infrastructure is in place. All interfaces and data pipelines have been fully implemented.
	Connected Systems & Integration	To what extent are systems networked with each other to enable the integration of data across systems?	Systems are networked with each other and with internal and external data sources.
	Automation & Process Digitization	How extensively are sustainability-related processes mapped and automated in your organization?	All relevant sustainability processes have been fully digitized and automated.
Data	**Data Collection & Availability**	How systematically and consistently is sustainability data collected across all organizational units, and how readily available is this data for analysis?	All sustainability data is systematically and automatically collected from every unit. This data is standardized and made available in real time for analysis and decision-making purposes.
	Data Storage & Access Management	How clear and compliant is your organization's data storage and access management with regard to internal and external sustainability data?	Sustainability data is stored in secure, scalable systems. There are formal guidelines for versioning, archiving, and retention. Robust access management ensures seamless handling of internal and external approvals.
	Data Analytics & Presentation	How advanced and comprehensive are your organization's analytical activities with regard to sustainability data, and how is this data prepared for decision-making purposes?	Future-oriented analyses are used systematically. The results are visualized in a user-friendly manner to support targeted decision-making at all levels.
	Data Quality & Verification	To what extent are data standards, verification procedures, and responsibilities for sustainability data established to ensure quality, consistency, and reliability?	Comprehensive data standards and verification procedures have been integrated. Clear responsibilities ensure the reliability of sustainability data.
Management	**Strategy**	To what extent are sustainability efforts anchored in strategic goals, and to what extent is data used for this purpose?	The use of sustainability data is firmly rooted in the strategy, which has clear objectives. Insights from this data guide long-term planning, innovation, and business model adjustments.
	Leadership	To what extent do managers promote sustainability data projects, for example by providing resources?	Managers actively promote a data-driven culture and allocate resources to develop advanced capabilities for using sustainability data in a value-adding way.
	Governance & Collaboration	How clearly are the roles, responsibilities, guidelines, and cooperation between data management and sustainability management defined?	Roles, responsibilities, and guidelines are clearly defined and transparently implemented. Data is shared systematically internally and externally to promote cross-functional collaboration, process improvements, and innovation.
People	**Transformation Management**	To what extent are sustainability data used and how are employees made aware of them, in order to identify and promote opportunities for improvement and transformation?	Sustainability data is an integral part of all improvement and transformation initiatives. Comprehensive change management increases employee awareness of these processes.
	Employees & Expertise	Do employees have sufficient expertise, and are there systematic recruiting and training measures in place to ensure that sustainability data is handled in a way that adds value?	Data literacy is broadly established. Experts and comprehensive training measures ensure data-driven decision-making and cross-functional linking of data and sustainability.
	Culture	To what extent does the organizational culture promote data-driven decisions for sustainability, and how important are data and transparency?	The organizational culture prioritizes data-driven sustainability decisions. Data and transparency are core values that promote trust and continuous improvement.

technical infrastructures while lacking governance structures, sustainability expertise, or data-driven decision-making cultures. This finding resonates with Sirmon et al. (2011), who elaborate that the relative importance of different orchestration activities shifts as organizational capabilities mature over time. Consequently, sustainability-related data management maturity cannot be reduced to technological sophistication alone. Instead, maturity reflects an organization's ability to progressively structure, bundle, and leverage sustainability-related data resources across technological, managerial, and human domains. The model therefore functions as both a diagnostic instrument and a roadmap for capability development, providing twenty concrete action recommendations that support organizations in advancing their maturity across all four dimensions.

While the SDM-MM provides a generic capability framework applicable across organizational contexts, maturity research also highlights the importance of contextualization. Different industries face distinct sustainability challenges, operational realities, and regulatory requirements, and capability development trajectories therefore often require domain-specific operationalization. A generic model provides orientation, but it cannot fully account for the particular measurement logics, emission sources, and decarbonization pathways that characterize individual sectors. This need is especially pronounced in the manufacturing sector, which accounts for a substantial share of global carbon emissions and therefore plays a decisive role in decarbonization (Z. Liu et al., 2023). Manufacturers exert direct control over the emissions arising from their own operations and purchased energy, i.e., Scope 1 and Scope 2 in the terminology of the GHG Protocol, which typically constitute the majority of their carbon footprint, particularly in energy-intensive industries (Hertwich & Wood, 2018). IS are pivotal in addressing these emissions: by monitoring energy-related data and analyzing production processes, they render inefficiencies and improvement opportunities visible and thereby enable targeted abatement. Yet despite this potential, systematic guidance on how manufacturers can assess and advance their use of IS for decarbonization has remained scarce, as existing maturity models tend to address isolated aspects, e.g., green business process management or Industry 4.0 readiness, instead of the integrated, data-driven decarbonization that twin transformation requires. Research Paper #3 addresses this gap through a sector-specific extension of the maturity perspective, asking:

> *How can discrete manufacturers leverage IS for decarbonization concerning Scope 1 and Scope 2 carbon emissions?*

Following the Design Science Research framework proposed by Peffers et al. (2007), Meuser et al. (2024) develop the IS-based industrial decarbonization maturity model (ISbid-MM) on the basis of a structured literature review and nine expert interviews with practitioners from the manufacturing sector (cf. Table 2.2). The resulting model organizes capabilities along a strategic, tactical, and operational dimension, reflecting the differing time horizons over which decarbonization decisions are made, ranging from long-term climate transition planning to daily monitoring of energy data.

The resulting model comprises three dimensions, namely *Strategic*, *Tactical*, and *Operational*, nine subdimensions, and five maturity levels. It describes how manufacturing firms progress from

Table 2.2: Strategical Perspective of the IS-based Industrial Decarbonization Maturity Model (ISbid-MM) (Meuser et al., 2024).

	Level 1: Decarbonization Novice	**Level 2: Decarbonization Explorer**	**Level 3: Holistic Decarbonization Advocate**	**Level 4: Data-Driven Decarbonization Trailblazer**	**Level 5: Green Production Leader**
Climate transition plan	A climate transition plan is designed without using energy-related data or the support of an IS.	A company-level climate transition plan uses aggregated historical energy data and IS for formulation. It provides strategic guidance but lacks quantitative progress-tracking measures.	A climate transition plan includes more detailed energy data and first insights into operations. It measures the success of a company's climate transition by quantifying the decarbonization progress.	IS and digital technologies enable insights into operations. A data-driven climate transition plan provides strategic guidance at the divisional level. Automated measurement of decarbonization progress.	Adv. IT tools gain energy-related insights at the machine level and calculate a site-specific decarbonization roadmap for multiple years. A climate transition plan is developed and monitored automatically.
Carbon accounting and KPI reporting	Emissions are calculated based on approximations and general information about operations. No energy-related KPIs exist.	Emissions are calculated based on historical production data, and KPIs can be calculated based on annual averages of historical production data and overall energy use.	Emissions and decarbonization-related KPIs are calculated by utilizing monitored energy data. Compare progress against climate-related corporate targets.	Emissions calculation is partly automated through monitored energy data and integrated carbon accounting tools within the company's IS, allowing for detailed KPIs.	Carbon accounting tools integrate monitored energy data with advanced IT for automated carbon footprint calculation. Fine-grained KPIs can be calculated, and scenarios can be predicted using extensive data.
Strategic decarbonization decisions	Decision-makers do not use digital technology to make decisions.	Decision makers use aggregated historical production data to find potential decarbonization solutions.	Decision makers use energy data integrated into industrial IT tools for strategic decarbonization-related decisions.	Decision makers use advanced IT tools to execute strategic decarbonization-related decisions based on real-time emission and energy data.	Decarbonization strategy and decision-making are automated using predictive tools fed with real-time data without human intervention.

fragmented and manually estimated emissions data toward fully integrated, automated, and real-time decarbonization management. In doing so, the model translates the generic sustainability data management capabilities established in Research Paper #2 into a specific transformation context characterized by complex operational processes, capital-intensive assets, and ambitious decarbonization objectives. The progression across maturity levels therefore reflects technological development as much as the gradual alignment of strategic priorities, operational processes, and human capabilities that decarbonization in the manufacturing sector requires.

Together, Research Papers #2 and #3 follow a deliberate progression from a generic to a context-specific perspective. The SDM-MM establishes an organization-wide capability framework for sustainability data management (Heess et al., 2026), whereas the ISbid-MM demonstrates how these capabilities can be operationalized within a specific sustainability challenge (Meuser et al., 2024). Both models share the underlying premise that sustainability transformation depends not merely on the availability of data but on the organizational capabilities required to orchestrate these data resources effectively. This shared premise connects both contributions to the theoretical logic of resource orchestration theory and to the broader argument of this dissertation.

Viewed through the lens of twin transformation, the two maturity models demonstrate how digital transformation enables sustainability transformation through capability development. Digital technologies generate unprecedented amounts of sustainability-relevant data, but these data only become transformative when organizations develop the capabilities required to structure, interpret, govern, and leverage them. Maturity assessment provides a mechanism for making these capabilities visible, measurable, and continuously improvable. Together with the conceptual foundation established in Research Paper #1, Research Papers #2 and #3 therefore complete the enabling perspective of this dissertation by explaining how sustainability-related data can be transformed into actionable sustainability value.

3 Guiding – Sustainability Transformation Guides Digital Transformation

Chapter 2 examined the first direction through which the twin transformation unfolds. It illustrated that digital transformation enables sustainability transformation not primarily through digital technology itself, but through the sustainability-related data it generates, structures, and makes available for organizational use. When digital technologies are complemented by the organizational capabilities required to orchestrate these data, ecological and social objectives become manageable. From this perspective, sustainability appears as an outcome of digital transformation: as something that organizations can pursue more effectively when richer data resources and stronger data-related capabilities are in place.

This chapter turns to the converse direction of this relationship. If digital transformation can be mobilized in the service of sustainability, sustainability can also shape the trajectory of digital transformation. Thus, the coupling between the two transformations is reciprocal (Graf-Drasch et al., 2023). This perspective resonates with long-standing calls to consider social, technical, economic, and ecological dimensions in a more holistic and integrative manner (Ketter et al., 2018; Recker et al., 2025; Staudt et al., 2019; Watson et al., 2010). In line with the triple-bottom-line principle (Elkington & Rowlands, 1999) and the broader movement towards integrated reporting, organizations are increasingly expected to consider financial and sustainability-related information on equal footing when assessing past performance, strategic direction, and organizational risks (Seidel et al., 2017). The argument advanced in this chapter is that sustainability enters IS not only as an outcome to be documented retrospectively, but as an objective in its own right (Kotlarsky et al., 2023). It is thus positioned alongside the economic objectives that have traditionally guided systems design and optimization. While IS have long been associated with improving managerial decision-making, productivity, and economic performance, their potential to advance organizational sustainability requires a broader understanding of what digital systems are designed to achieve (Seidel et al., 2017). Once ecological goals are incorporated as first-order criteria, they begin to influence what is measured and optimized, and ultimately how digital systems are designed and operated.

IS have been shown to play an instrumental role in organizational and sectoral decarbonization efforts. This premise is central to the field of energy informatics, which conceptualizes information and the systems that process it as key levers for reducing the resource intensity of physical processes (Goebel et al., 2014; Staudt et al., 2019). In the energy sector, decarbonization depends not only on expanding renewable generation capacity, but also on the intelligent coordination of supply and demand (Michaelis et al., 2025). This coordination challenge is further intensified

by climate change itself, which affects both energy demand and renewable energy supply and thereby alters the temporal and spatial match between local wind or solar generation and electricity demand (L. Liu et al., 2023). It is in this context that IS make a distinctive contribution: they render the electricity grid observable and controllable at a previously unattainable level of granularity (Ketter et al., 2018), transform data from smart metering infrastructures into a basis for operational decision-making (Y. Wang et al., 2018), and enable the demand-side flexibility on which the integration of volatile renewable generation depends (Fridgen et al., 2016). The same logic extends beyond grid operation to the broader demand side of sustainability, where digital systems mediate the adoption of low-carbon technologies in households and organizations (Wunderlich et al., 2019) and support the electrification of energy services as a central prerequisite for deep decarbonization (Sheikh & Callaway, 2019). From this perspective, information and communication technology (ICT) is not merely compatible with sustainability objectives. Instead, it constitutes an operational infrastructure through which such objectives can be translated into measurement, coordination, and optimization.

This potential, however, is not self-realizing, and its limitations are analytically important. The environmental role of ICT remains ambivalent, as digital technologies affect the natural environment through three distinct pathways: directly, through the energy and material resources required for their production, operation, and disposal; indirectly, through the substitution, coordination, and optimization effects they enable; and systemically, through rebound dynamics that may offset, or even exceed, initially achieved efficiency gains (Dedrick, 2010; Gholami et al., 2016; N. P. Melville, 2010). The rebound effect is central to this ambivalence. When efficiency improvements reduce the effective cost of a service, the demand for that service may increase, thereby consuming part of the expected environmental benefit through additional use (Borenstein, 2015; Sedlmeir et al., 2020). Moreover, efficiency gains do not necessarily translate into emission reductions when the emissions intensity of the resources used to realize these gains remains unaccounted for. A system may reduce energy use, costs, or operational inefficiencies in one dimension while shifting activity towards more carbon-intensive resources or time periods, thereby increasing overall emissions despite apparent efficiency improvements. Exemplary, contemporary building energy management systems (EMSs) therefore need to move beyond optimizing solely for cost or energy efficiency and incorporate dynamic greenhouse gas emissions, for instance by considering the time-varying CO_2 intensity of electricity (Ahlrichs et al., 2023; Fiorini & Aiello, 2018). This mechanism helps explain why EMSs that optimize for cost alone reach their limits as instruments of decarbonization, a limitation that the empirical analysis in Section 3.1 illustrates directly. The ambivalent character of ICT therefore challenges the assumption that more digitalization necessarily leads to more sustainability. Instead, it shifts attention to the objectives, criteria, and constraints according to which digital systems are designed and operated.

It is against this backdrop that the conceptual vocabulary of the field has shifted. Early work on Green IT was concerned primarily with the negative environmental footprint of computing itself, that is, with reducing the energy and material resources consumed by IT infrastructures, devices, and operations. In this sense, Green IT focuses on making IT less environmentally harmful.

The subsequent broadening toward Green IS shifts the analytical focus from the environmental performance of IT assets to the role of IS in enabling environmentally sustainable business processes, products, and organizational practices (Loeser, 2013). This distinction is important because it marks a movement from mitigation to enablement: from reducing the footprint of digital technologies to using digital systems as instruments for ecological improvement.

More recent work on sustainable ICT extends this trajectory further by reframing digital technologies not merely as sources of environmental impact to be managed, but as active components of sustainability-oriented transformation (Kotlarsky et al., 2023). The papers embedded in this chapter belong to this later, solution-oriented strand. They share the premise articulated in the recent call for action on smart sustainable systems, namely that IS research should treat sustainability as a constitutive design goal and direct its methods toward measurable environmental and behavioral outcomes (Ketter et al., 2023). Read in this light, the appropriate response to ICT's ambivalence is not to optimize inherited objective functions more aggressively, but to install sustainability as a co-equal objective that guides systems design from the outset.

The chapter develops this thesis on two complementary levels. Section 3.1 addresses the systemic and environmental level. It situates the argument within energy informatics and the broader electrification of energy systems, where sector coupling links electricity, heating, and mobility into a shared field of digital coordination and optimization (Fridgen et al., 2020). As these domains become more tightly interconnected, the resulting coordination problem has become a central concern of both IS and energy systems research (Molzahn et al., 2017). Against this background, the section asks what changes when the objective function of an EMS is shifted from cost minimization to carbon minimization. The two embedded Research Papers #4 and #5 examine this question cumulatively within the same building context. Research Paper #4 investigates this shift in the case of an eco-friendly hotel by comparing cost-minimizing and carbon-minimizing EMS configurations across multiple operational scenarios and temporal horizons (L. Valett et al., 2026). It illustrates that carbon-oriented energy management can achieve substantial emission reductions at comparatively limited additional cost, while also revealing that such optimization depends on real-time carbon intensity data, smart metering infrastructures, and supportive regulatory frameworks. Research Paper #5 extends this perspective by integrating electric mobility through a vehicle-to-building function (L. Valett et al., 2024). It examines how guest mobility behavior and the availability of bidirectional electric vehicles affect the relationship between cost-efficient and carbon-efficient hotel energy management. Together, these papers illustrate how sustainability objectives can reconfigure the design and operation of digital EMSs. Instead of treating emissions as outcomes to be assessed after optimization has taken place, they demonstrate how carbon-based performance criteria can be embedded directly into the optimization logic of IS.

Section 3.2 turns from the systemic to the individual level. It situates the argument within the socio-technical tradition of IS research, where digital transformation cannot be understood without considering the users whose practices, decisions, and responses shape its effects (Legner et al., 2017). This perspective has gained renewed relevance as questions of accountability, responsibil-

ity, and the societal consequences of digital systems have moved to the center of the discipline's agenda (Recker et al., 2025; Trier et al., 2023). Against this background, the section asks how sustainability can guide IS design when the relevant transformation depends on technical optimization as much as on behavioral adoption and trust. Here, sustainability enters digital systems through the behavioral data that make demand patterns explicable and actionable, and through the digitally mediated sustainability information on which individual decisions increasingly depend. The embedded Research Papers #6 and #7 examine this question cumulatively from the perspective of users and consumers. Research Paper #6 investigates how machine learning and explainable AI can be used to analyze station-based carsharing data in a smaller urban context and reveal the factors that shape users' travel behavior (Baumgarte et al., 2022). By identifying the influence of personal, temporal, vehicle-related, and environmental features on trip distance, the paper indicates how behavioral data can support a more differentiated understanding of sustainable mobility services and their use. Research Paper #7 extends this perspective from behavioral explanation to behavioral decision-making (Geist et al., 2026). It examines how different forms of sustainability information, namely manufacturer claims, third-party certification, and digital verification, shape consumer trust and choice when the environmental quality of a product cannot be observed directly but must be taken on credence (Akerlof, 1978). Together, these papers illustrate that sustainability-guided IS do not operate only by optimizing physical processes. They also shape the informational conditions under which individuals adopt and trust sustainability-related alternatives. In this sense, verifiability becomes the point at which the chain from sustainability-related data to behavioral effect is closed.

Across both levels, data remains the connecting resource at the center of this dissertation. In Chapter 2, data enabled sustainability transformation by making sustainability-related phenomena visible, measurable, and manageable. In this chapter, the same resource assumes a different role: it guides digital transformation by translating ecological objectives into the criteria, constraints, and decision logics through which IS are designed and operated. The chapter's movement from systemic optimization, cf. Section 3.1, to individual trust, cf. Section 3.2, therefore outlines how sustainability can become embedded in digital systems at multiple points of intervention: in objective functions that govern operational decisions (L. Valett et al., 2024, 2026), in behavioral data that make patterns of use explicable (Baumgarte et al., 2022), and in verifiable information that shapes individual evaluation and adoption (Geist et al., 2026). This argument also prepares the transition to the institutional perspective developed in Chapter 4, where sustainability-related data extends beyond individual decision-making and becomes part of the networked practices through which entire sectors organize, coordinate, and transform.

3.1 Environmental Impact

The systemic level on which sustainability guides digital transformation is most clearly visible in the energy system. Climate mitigation requires far-reaching reductions in greenhouse gas emissions, yet recent assessments indicate that global mitigation efforts remain insufficient to reliably

align current trajectories with long-term climate targets (Heckenhahn et al., 2026). At the same time, the solution space for decarbonization has changed substantially. While key clean technologies such as solar photovoltaics, wind power, and battery storage have experienced significant cost reductions and performance improvements, other long-considered mitigation options, including carbon capture and carbon dioxide removal, remain subject to considerable uncertainty regarding their scalability and diffusion (van de Ven et al., 2025). This places particular emphasis on those sectors and technologies in which emission reductions can be achieved through near-term deployment, operational coordination, and more effective use of existing infrastructures.

The energy system is central to this challenge because it is both a major source of emissions and a key enabler of decarbonization in other sectors. In Germany, for instance, electricity and heat producers accounted for 35% of CO_2 emissions in 2023, making them the largest emitting sector (International Energy Agency, 2026). A fundamental asymmetry characterizes the transformation: electricity can be produced from low-carbon renewable sources at comparatively low cost, whereas non-electric energy services in transport, industry, and buildings remain more difficult to decarbonize (Luderer et al., 2022). Deep decarbonization therefore requires not only a cleaner electricity supply, but also the electrification of end uses and the coordination of when, where, and with which emissions intensity electricity is consumed. In this context, emissions are not determined solely by the total amount of energy used, but also by the carbon intensity of the energy resources drawn upon at specific points in time. Reducing energy consumption or cost may therefore be insufficient, and in some cases even misleading, if the underlying emissions intensity of the resources used remains outside the decision logic of the system.

It is against this background that IS research has developed a comprehensive understanding of how digital coordination can be directed toward ecological objectives. The field of energy informatics formalizes this contribution by treating information as a primary lever for reducing the resource intensity and emissions intensity of energy use (Goebel et al., 2014; Staudt et al., 2019; Watson et al., 2010). Its trajectory within the discipline has been one of steady consolidation, from early agenda-setting to an established research program with its own theories, artifacts, and evaluation standards (Kossahl et al., 2012). The decarbonization of electricity supply, however, does not follow from renewable generation alone. As the share of volatile renewable sources rises, the balancing of supply and demand becomes a coordination problem (Rosales-Asensio et al., 2024). Digital systems are central to this task because they render the grid observable and controllable at the temporal granularity required for carbon-sensitive coordination (Ketter et al., 2018; Molzahn et al., 2017). Smart metering infrastructures convert consumption into data that can inform operational decisions (Y. Wang et al., 2018), and the resulting demand-side flexibility is understood as a resource that IS can provide to the grid (Fridgen et al., 2016).

The same logic extends beyond electricity. Since deep decarbonization rests on the electrification of energy services and on the household- and organization-level adoption of low-carbon technologies, digital systems mediate the transition from fossil-based end uses to flexible, data-driven, and electricity-based alternatives (Sheikh & Callaway, 2019; Wunderlich et al., 2019). As supply becomes more volatile and demand becomes more flexible (Michaelis et al., 2025), the

coupling of electricity, heating, and mobility emerges as a central structural response. IS occupy an integrating role within this transformation by connecting smart-grid technologies, metering infrastructures, optimization models, and communication layers that allow demand to respond automatically to system conditions (Feuerriegel et al., 2012; Fridgen et al., 2020; Körner et al., 2022). In this sense, the environmental relevance of IS lies less in making energy systems more efficient than in enabling emissions-aware coordination across increasingly interconnected sectors.

Within this broader energy-system transformation, the building sector constitutes a particularly relevant application domain. Buildings account for a substantial share of energy-related emissions, and meeting sectoral climate targets requires a drastic reduction of operational emissions from heating, cooling, lighting, and electricity use (International Energy Agency, 2023; United Nations Environment Programme, 2022). Their decarbonization therefore requires more than reducing aggregate energy demand. It also requires the rapid integration of renewable energy sources and the flexibilization of consumption patterns to make use of volatile renewable generation when it is available (Ali et al., 2024; Hao et al., 2012; Li et al., 2021). In this context, energy use must be aligned with the time-varying emissions intensity of electricity and heat, because reductions in cost or consumption do not necessarily translate into proportional emission reductions when the carbon intensity of the underlying energy resources remains unaccounted for (Glenk, 2024; Körner, Michaelis, et al., 2023). This makes buildings a critical site for digital intervention. A broad range of digital approaches already seeks to reduce building emissions through smart metering, building automation, demand-side management, anomaly detection, the integration of renewable energy sources, and the coordination of storage and flexible loads (Alfaverh et al., 2023; Bonilla et al., 2018; Han et al., 2011). Yet these approaches only become instruments of decarbonization when their optimization logic is aligned with ecological objectives rather than with efficiency or cost alone.

Within this landscape, the EMS constitutes an artifact through which the abstract notion of an objective function becomes operationally concrete. An EMS processes information from users, appliances, local generation assets, storage systems, and grid operators in order to realize, adapt, and coordinate specific patterns of energy generation and consumption (Ma et al., 2021; Marinakis et al., 2020). In doing so, it provides the decision support on which flexible building operation depends. Its tasks range from automated demand-side management and anomaly detection to the coordination of small-scale generation, storage, and flexible loads (Bonilla et al., 2018; Han et al., 2011). What such a system achieves, however, is determined less by the mere availability of digital technology than by the objective it is configured to pursue.

Historically, this objective has been predominantly economic. Prevailing EMS designs typically seek to minimize energy costs by shifting consumption toward cheaper hours or by reducing grid purchases through on-site generation and storage (Ayón et al., 2017; Kim et al., 2019). Under fixed-price contracts, which are still common for smaller consumers, this optimization logic leaves the carbon intensity of the consumed electricity largely outside the decision model. This is precisely where the systemic ambivalence of digitalization, outlined in the introduction of Chap-

ter 3, becomes operative. An EMS implemented to increase efficiency or reduce costs does not, by itself, reduce emissions. Where efficiency gains free up budgetary or operational capacity for additional consumption, rebound effects in the building sector may even erode the savings that originally motivated the investment (Bourrelle, 2014). The decisive question is therefore not whether a building is digitally managed, but which objective its digital management pursues.

The embedded Research Paper #4 addresses this question directly by keeping the technical system constant and varying the objective according to which it is optimized (L. Valett et al., 2026). To answer the research question,

> *How does a paradigm shift from cost-centric approaches to a carbon-minimizing energy management approach affect hotel energy use?*

Research Paper #4 develops a mixed-integer optimization model of a real-world EMS for an eco-certified hotel in the Allgäu region of southern Germany. This empirical setting is particularly suitable because hotels combine high and volatile energy demand with on-site generation and storage capacities that make operational flexibility actionable (Maleviti et al., 2012; Xing et al., 2015). Hotels are also a revealing context for the broader twin transformation argument. They operate at the intersection of the building and tourism sectors and therefore both contribute to emissions and offer decarbonization leverage across sectoral boundaries (Tsai et al., 2014). At the same time, they remain underrepresented in the energy management literature, where only a small fraction of building-related studies explicitly considers hotel buildings (Lee & Cheng, 2016).

Against this background, Research Paper #4 contrasts the prevailing cost-minimizing objective with a carbon-minimizing objective that incorporates the time-varying emission factor of the electricity mix. Using real consumption, generation, and emission data, it evaluates both objectives across different operational scenarios, cf. scenario *VE_Median_15* in Figure 3.1. Its central finding is that changing the objective function does not primarily constitute a trade-off between economic and ecological performance. Conversely, it reallocates existing flexibility. When the same system is re-optimized for carbon reduction, it achieves a daily reduction of 51.48 kg of CO_2, corresponding to approximately 1,471 kg of CO_2 over one week, at a marginal cost of only €0.09 per kilogram avoided. These savings do not result from additional equipment, but from scheduling consumption and storage toward periods in which the electricity mix is less carbon-intensive. This option remains invisible to a cost-minimizing system because electricity price and carbon intensity are not perfectly aligned.

In this way, L. Valett et al. (2026) provide empirical support for the theoretical argument developed above. More aggressive efficiency or cost optimization is not sufficient to turn digital energy management into an instrument of decarbonization. What matters is whether carbon is incorporated as an objective in the system's decision logic. At the same time, Research Paper #4 illustrates that the limits of carbon-aware operation are not located solely within the firm or the optimization model. Its full potential depends on time-granular carbon signals from the grid (Hanny et al., 2022), market mechanisms that make such signals actionable, and digital infras-

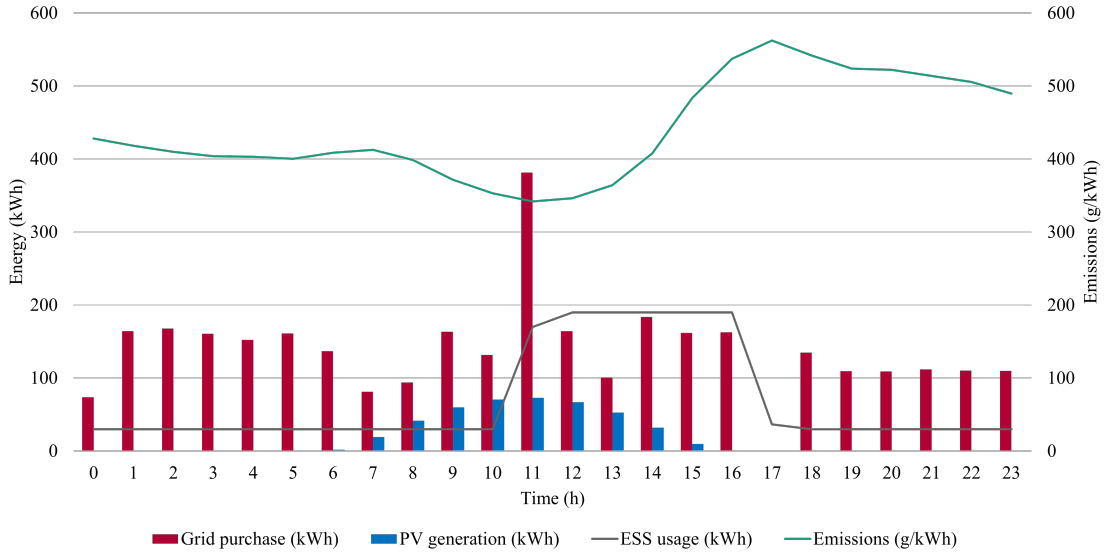


Figure 3.1: Energy purchase and energy storage system utilization under the carbon-minimization objective for the electricity-mix scenario with median share of renewable energy sources (i.e., scenario *VE_Median_15* in L. Valett et al. (2026)).

tructures that enable their exchange (Körner et al., 2022). The boundary conditions of the artifact are therefore regulatory and institutional as much as they are technical.

This dependence on external signals also shifts attention to the quality, credibility, and verifiability of the underlying data. A carbon-minimizing objective can only be as reliable as the emission factors and provenance information on which it relies. The systemic case therefore connects directly to emerging instruments for verifiable environmental accounting. Digital carbon measurement, reporting, and verification reframes emissions data as information that must be substantiated rather than merely asserted (Körner et al., 2025). Mechanisms such as digital product passports and cryptographic certificates of origin extend this logic across organizational boundaries by allowing the carbon content of energy and materials to travel with them in tamper-evident form (Heeß, Rockstuhl, et al., 2024; Sedlmeir, Völter, & Strüker, 2021; Ströher et al., 2025). In the building context, this body of work has begun to demonstrate how verifiable data can support decarbonization decisions, offering more than just post-facto emissions documentation (Körner et al., 2024). For the present argument, this means that the guiding role of sustainability does not end at the optimization model. It extends into the data infrastructure that makes carbon-aware optimization possible in the first place, and thus returns to the central resource of this dissertation: sustainability-related data.

The embedded Research Paper #5 extends the systemic case from the building to its coupling with electric mobility. This extension is consequential because the electrification of transport is a central component of climate mitigation and sector coupling. In Germany, as in the European Union more broadly, the transformation of the transport sector is closely linked to the expansion of electric vehicles, which are expected to replace fossil-based mobility while increasing electricity demand in the process (Fridgen et al., 2020; Staudt et al., 2018). Electric mobility can contribute

to emission reductions when the electricity used for charging is supplied by renewable sources. Yet it also introduces new coordination problems for the energy system, since uncoordinated charging may reinforce load peaks and increase stress on grid infrastructure (Brandt et al., 2017; Staudt et al., 2018). The contribution of electric vehicles to decarbonization therefore depends not only on their diffusion, but also on how their charging and storage capacities are integrated into the wider energy system.

This is where vehicle-to-X integration becomes relevant. Electric vehicles are not merely additional loads. Because private vehicles remain idle for large parts of the day, their batteries can also serve as distributed storage resources that help buffer volatile renewable generation (Brandt et al., 2017). Through intelligent charging, vehicles can absorb electricity when renewable supply is high. Through bidirectional concepts such as vehicle-to-grid and vehicle-to-building, they can also discharge electricity back to the grid or to a building when this creates economic or ecological value (Després et al., 2017; C. Liu et al., 2013; Zhou et al., 2019). These concepts open up new business model opportunities, for example by allowing vehicle owners, aggregators, parking operators, or building operators to provide grid-stabilizing services, reduce energy costs, or improve the local use of renewable generation (Brandt et al., 2017). At the same time, their viability depends on digital coordination: IS are needed to match vehicle availability, charging needs, electricity prices, grid conditions, and emissions intensities in operational decision-making (Bollenbach et al., 2024, 2025).

Research Paper #5 takes up this logic in the hotel context. Prior IS research has examined intelligent charging, plug-in flexibility, fleet demand response, and vehicle-to-grid applications, typically within residential (Fridgen et al., 2016), office (Eisel et al., 2015), or industrial settings (Bayer & Pruckner, 2023). However, they often prioritize cost and grid services over carbon-aware building operation (Förster et al., 2023; Pearre & Ribberink, 2019). More importantly, much of this literature treats vehicle availability as a technical parameter, although the flexibility that an electric vehicle can provide is ultimately determined by human mobility behavior (Bollenbach et al., 2025). This abstraction is particularly problematic in hotels, where vehicle availability follows tourist movement patterns as opposed to regular commuting routines (Bursa et al., 2022). L. Valett et al. (2024) therefore ask:

> *What are the environmental and economic potentials of integrating a Vehicle-to-Building concept in a hotel energy management system (EMS), taking into account the mobility behavior of hotel guests?*

To address this question, Research Paper #5 integrates vehicle-to-building operation into the same hotel EMS as L. Valett et al. (2026) and parameterizes vehicle availability with specific guest mobility patterns. Building on a behavioral typology of tourist movement, it distinguishes guest groups whose absences determine when electric vehicles can serve as flexible storage resources (Lau & McKercher, 2006). Across seasonal scenarios and cost- and carbon-based objectives, vehicle-to-building operation expands the flexibility available to the system and improves performance relative to a baseline without bidirectional electric vehicles. Depending on the sea-

son, it reduces electricity costs by 25.04% to 33.78% and lowers emissions by up to 4.07%. Under the carbon-minimizing objective, the strongest result occurs on the spring day, where emissions fall by 152.84 kg of CO_2 at an additional cost of only €8.86 (cf. Figure 3.2). The central insight, however, is not merely that additional storage improves optimization outcomes. Instead, the ecological value of vehicle-to-building depends on whether the vehicles are available during periods of high solar generation and low emission intensity. L. Valett et al. (2024) thus illustrate that the optimization of coupled energy systems cannot treat users as external to the system. In carbon-aware energy management, human mobility behavior becomes part of the digital system's effective flexibility and therefore part of its decarbonization potential.

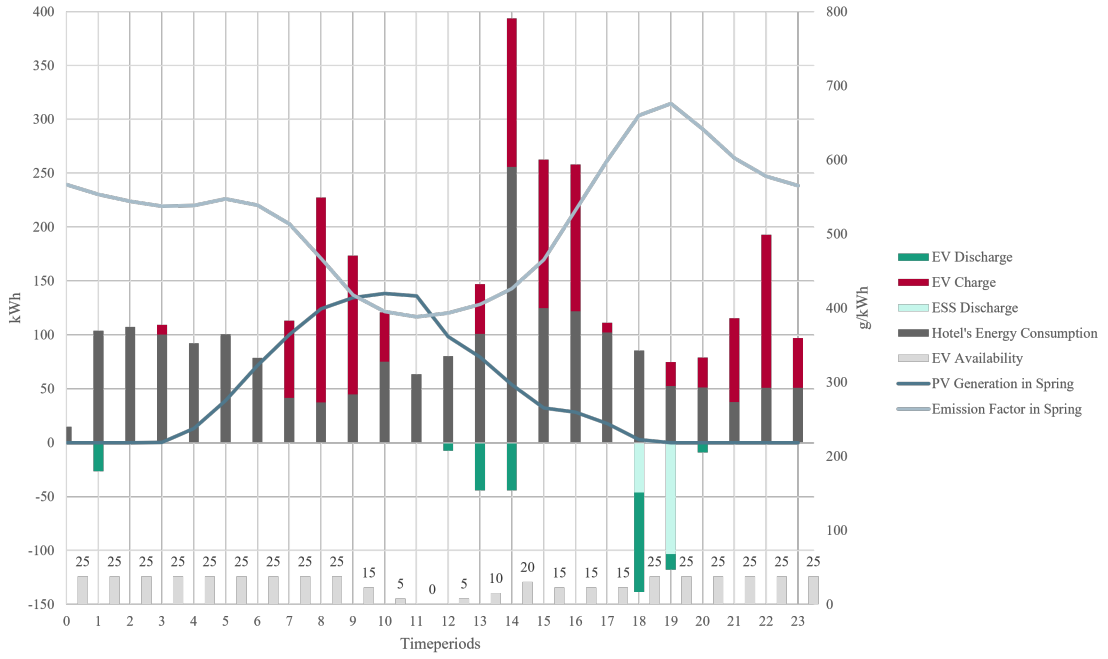


Figure 3.2: Energy flows of carbon-based optimization in spring with electric vehicle availability (L. Valett et al., 2024).

Taken together, the two studies form a complementary pair within a single empirical setting. Research Paper #4 demonstrates that an EMS can be redirected toward decarbonization when carbon, rather than cost alone, is incorporated into its objective function (L. Valett et al., 2026). Research Paper #5 extends this logic by coupling the building with electric mobility and demonstrating that additional flexibility can be mobilized through vehicle-to-building operation (L. Valett et al., 2024). Read along the trajectory of sector coupling, the two studies trace a movement from a single building responding to grid conditions to a coupled system in which the building, its storage assets, and its guests' vehicles jointly participate in carbon-aware energy management.

At the same time, this extension makes visible the limits of a purely systemic account. The ecological value of digital optimization does not depend only on technical assets, data infrastructures, or objective functions. It also depends on whether and when individuals make flexible resources available. Once the effectiveness of carbon-guided IS is shaped by human mobility patterns, user behavior can no longer be treated as an external boundary condition. This observation motivates

the transition to the following section, which shifts from the system to the individual level and from the optimization of physical energy flows to the behavioral data, adoption processes, and trust mechanisms on which sustainability-oriented digital transformation also depends.

3.2 Behavioral Adoption

The preceding section elaborated that the ecological value of carbon-guided IS depends as much on whether and when individuals make flexible resources available as on technical assets and data infrastructures. User behavior can therefore no longer be treated as an external boundary condition. Instead, it becomes part of the phenomenon that this section sets out to explain, marking a corresponding shift in the argument developed here. The preceding section focused primarily on the environmental dimension of sustainability, that is, on the "E" in ESG and the ecological dimension of the triple bottom line (Kotlarsky et al., 2023). The following section retains this environmental orientation, but approaches it through the social conditions, i.e. the "S" in ESG, under which sustainability-oriented digital systems are adopted, used, and trusted.

This shift is consistent with the self-understanding of IS as a socio-technical discipline (Legner et al., 2017). From this perspective, technical artifacts and human conduct are not separable domains, but mutually constitutive elements of digital transformation (Pagnozzi et al., 2025). It also resonates with work on sustainable smart districts, which find that sustainability-oriented digital infrastructures depend on design principles that organize participation, coordination, and value creation among the actors involved, just as much as on technical integration (Keller et al., 2019). Recent debates in the field similarly emphasize questions of responsibility, accountability, and the societal consequences of digital systems (Recker et al., 2025; Trier et al., 2023). At this level, sustainability informs IS design differently than it does at the systemic level. It does so through behavioral data that make demand patterns explicable and actionable (cf. Research Paper #6), and through digitally mediated sustainability information on which adoption, practice, and trust depend (cf. Research Paper #7). The chapter therefore moves from the question of how behavior can be made visible and operationally relevant to the question of when sustainability claims embedded in digital systems are perceived as credible and acted upon.

The intellectual backdrop of this chapter is the long-standing tradition of technology acceptance and adoption research in IS. This literature has provided the field with its canonical explanations of why individuals adopt, use, or resist technologies, ranging from the theory of reasoned action (Fishbein & Ajzen, 1975) and the theory of planned behavior (Ajzen, 1991) to the technology acceptance model (Davis, 1989) and the diffusion of innovations (Rogers, 2003). These frameworks remain an important reference point for research on sustainable technologies because they direct attention to the beliefs, expectations, and social conditions under which technological alternatives become behaviorally effective. At the same time, sustainability-oriented adoption cannot be reduced to perceived usefulness or individual utility alone, as studies on smart energy technology highlight that adoption is also shaped by attitude and environmental concern (Gimpel et al., 2020). The value-belief-norm tradition further emphasizes that pro-environmental behavior

is influenced by personal values, normative beliefs, and perceived moral obligations (Lind et al., 2015; Wunderlich et al., 2019).

Two aspects of this literature are particularly relevant to the argument developed here. First, adoption research has produced extensive insights into the beliefs, attitudes, intentions, and contextual conditions that shape whether individuals accept and use digital technologies (Berger et al., 2025; Bhattacherjee, 2001; Schleich, 2019). For the purpose of this chapter, however, the relevant question shifts from whether sustainable technologies are accepted to how sustainability-related behavior unfolds in concrete use contexts and what insights can be derived from these behavioral patterns. Second, much adoption research relies on stated preferences, intentions, or survey-based self-reports (Neves et al., 2022; Wunderlich et al., 2019). Such approaches are valuable for explaining acceptance and intention formation, but they provide only limited insight into behavioral patterns that emerge in actual use and can be inferred from large-scale digital trace data. The two embedded research papers address these aspects from complementary directions. Research Paper #6 shifts from observed behavior to explanation by using behavioral data to make patterns of sustainable mobility use visible and interpretable (Baumgarte et al., 2022). Research Paper #7 moves from a designed choice setting to the credibility conditions of sustainability information by examining when digitally mediated environmental claims are trusted and acted upon (Geist et al., 2026).

Mobility provides a particularly suitable setting for the first step in this argument because it links sustainability-related behavior with the digital traces through which such behavior becomes observable. As mobility services are increasingly organized through digital platforms, the use of these services leaves detailed data traces that document when, where, and how mobility is actually practiced. These data are not merely operational by-products of digital business models. They can become a valuable resource for sustainable mobility transitions when they are analyzed with the aim of understanding demand patterns and adapting services accordingly. Prior research on carsharing has outlined, for instance, how business analytics can support providers in improving operational decisions and service configurations (Wagner et al., 2016). Similarly, location intelligence has been used to support carsharing decision-making by linking spatial usage patterns to operational planning (Willing, Klemmer, et al., 2017). Beyond carsharing alone, work on intermodal mobility has demonstrated how digital services can support the coordination of different transport modes and thereby contribute to more integrated mobility systems (Willing, Brandt, & Neumann, 2017). More recent studies extend this data-driven perspective by using analytics and simulation to assess the sustainability potential of shared, autonomous, and electric mobility systems (Dlugosch et al., 2022) and by examining how carsharing can be strengthened through mobility-as-a-service concepts (Röhrich et al., 2024). Taken together, this literature illustrates that mobility data become valuable not simply because they are available, but because they can be translated into decisions that align platform-based services, user behavior, and public sustainability goals.

Carsharing is a type of digitally mediated mobility service. Its basic premise is that a vehicle fleet is made available to members on a per-trip basis, thereby providing individualized mobility

without requiring private car ownership (Ferrero et al., 2018). In dense urban areas, carsharing has been shown to reduce the number of private cars and to contribute to more resource-efficient mobility patterns (T. D. Chen & Kockelman, 2016; Migliore et al., 2020; Riggs & Appleyard, 2020; Te & Lianghua, 2020). These effects are not only environmental. By reducing pollution, congestion, and parking pressure, carsharing can also improve the quality of life in urban areas and generate broader social benefits (Baumgarte et al., 2021; Boldrini et al., 2019; Wong et al., 2020). For users, it may additionally offer cost savings and convenience, which helps explain why carsharing has expanded alongside broader mobility trends of digitalization, sustainability, and the sharing economy (S. Shaheen & Cohen, 2020; S. A. Shaheen & Cohen, 2007).

At the same time, the sustainability potential of carsharing does not follow automatically from the existence of the service. It depends on how the service is embedded in local mobility systems, how users actually integrate it into their everyday practices, and how operators and public actors respond to these usage patterns. Prior research has generated valuable insights into carsharing attitudes, membership, and use behavior: Survey-based studies have highlighted the relevance of pro-environmental attitudes among actual and potential users (Acheampong & Siiba, 2020; Ramos et al., 2020), while other work points to the role of socioeconomic factors such as education, income, household structure, and car ownership in shaping carsharing membership (Coll et al., 2014; Kopp et al., 2015). A related stream has used operational and spatial data to examine vehicle choice, demand patterns, and user clusters in large urban contexts such as Paris (Boldrini et al., 2016), Vancouver (Alencar et al., 2021), Montreal (Kashani & Trépanier, 2020; Morency et al., 2012), and Québec (Leclerc et al., 2013).

However, this literature remains concentrated on metropolitan contexts. This is problematic because the transition to sustainable mobility is often more difficult in smaller urban areas, where public transport is less dense, residents remain more dependent on private cars, and demand for carsharing is harder to establish (Albrecht et al., 2025; Rotaris & Danielis, 2018). Smaller urban areas therefore require a more fine-grained understanding of how carsharing is actually used under conditions that differ from those of large cities. In such settings, behavioral data can provide insights that are difficult to obtain through stated preferences alone. They make it possible to observe how users translate a digitally mediated mobility service into concrete travel practices and, in doing so, create a basis for adapting carsharing systems to local sustainability needs.

Research Paper #6 addresses this issue by shifting the analytical focus from reported intentions to observed mobility behavior (Baumgarte et al., 2022). More specifically, it examines:

> *What factors affect the trip's distance of carsharing in small urban environments?*
> *How do these factors influence carsharing distance traveled?*

It analyzes 118,407 trips from a station-based carsharing service collected over a period of more than two years in a German city of approximately 300,000 inhabitants. The distance travelled per trip serves as the central behavioral outcome because it is directly relevant for pricing, fleet composition, vehicle availability, and the operator's economic viability. At the same time, it provides insight into how users actually integrate carsharing into their mobility practices in a smaller ur-

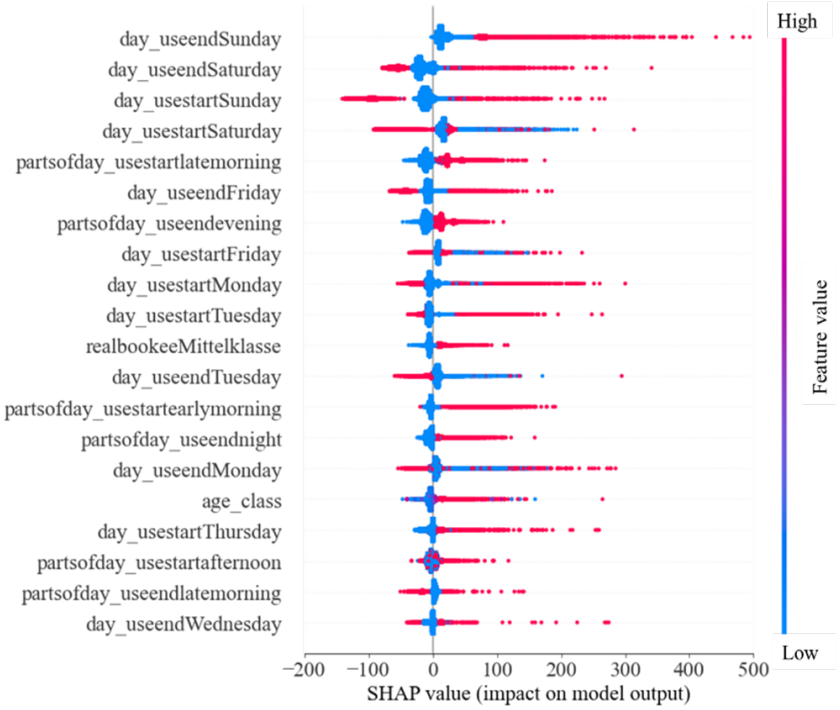


Figure 3.3: SHAP summary plot with CatBoost (Baumgarte et al., 2022).

ban context. Methodologically, Research Paper #6 combines gradient-boosting models, namely CatBoost and XGBoost, with an explainable AI layer based on SHAP values (T. Chen & Guestrin, 2016; Lundberg & Lee, 2017; Lundberg et al., 2018; Prokhorenkova et al., 2018). This approach allows the analysis to both predict trip distance and identify which features shape this prediction as well as how they affect the expected distance traveled. The results highlight that time-related features dominate the explanation of trip distance, accounting for more than 84% of aggregate feature importance, while weather, season, and users' place of residence play a more limited role (cf. Figure 3.3). The analysis further illustrates that organizational and private users rely on the same carsharing infrastructure in partially complementary ways. Organizational users tend to travel longer distances on weekdays and are more strongly influenced by car-related features, which points to work-related trips and heterogeneous vehicle requirements. Private users, by contrast, display more differentiated temporal patterns, including shorter weekday trips, longer Saturday trips, and anti-cyclical use among younger users and students during evening and night hours.

The wider significance of Research Paper #6 lies in outlining how behavioral mobility data can become actionable when they are interpreted in relation to sustainability-oriented design. The explainable AI layer is central to this contribution because it transforms a predictive model from a black-box forecasting instrument into a source of interpretable decision support (Baumgarte et al., 2022). For carsharing operators, such insights can inform decisions about fleet composition, station planning, vehicle availability, and service design by linking operational choices to observed patterns of use. The relevance of these findings, however, extends beyond the operator.

For users, the same insights can support services that better correspond to actual mobility practices instead of assumed preferences. Because carsharing is embedded in local mobility systems, explainable usage patterns can inform public infrastructure planning and help municipalities identify where shared mobility services can contribute to sustainable mobility transitions. In this sense, Research Paper #6 underscores that digital behavioral data do not generate sustainability value merely by being collected. They become valuable when they are made interpretable and translated into decisions that align platform-based business models, user needs, and public sustainability goals.

This is also the point at which the limits of internal behavioral data become apparent and the argument turns from understanding behavior to influencing it. Research Paper #6 illustrated how digital trace data can make mobility behavior visible, interpretable, and actionable. Yet explaining behavior with a firm's own data is only one part of sustainability-oriented digital transformation. When digital systems seek to influence choices through sustainability information based on sustainability-related data, their effectiveness depends on whether this information is perceived as credible. This is particularly important because digital data environments do not eliminate uncertainty. Rather, they often shift it into new forms of data quality, interpretation, and trust (Bendler et al., 2014). The question is therefore no longer only what behavioral data reveal, but under which conditions sustainability-related information can guide behavior in the first place.

This problem is especially pronounced for environmental claims. Greenhouse-gas accounting remains characterized by inconsistent methods, incomplete inventories, and uncertainty in the measurement and attribution of emissions, particularly when indirect emissions, supply chains, or offsets are involved (Glenk, 2024; Luers et al., 2022). As a result, sustainability information is not simply given as an objective fact that consumers can inspect directly. It has to be calculated, communicated, and trusted. This creates a structural information asymmetry between those who provide sustainability claims and those who are expected to act upon them (Bougherara & Grolleau, 2005; Perrini et al., 2010). The controversy surrounding Verra-certified rainforest carbon credits illustrates the consequences of this asymmetry: investigative reporting and subsequent academic debate questioned whether many certified offsets represented the emission reductions claimed, while Verra publicly disputed these allegations (Verra, 2023; West et al., 2023). The case reveals that where sustainability information cannot be independently checked, even certification-based claims may become contested and may undermine confidence in voluntary carbon markets. From an agency-theoretical perspective, such asymmetries create the need for verifiability, because the party relying on the information cannot fully observe whether the underlying claim has been produced correctly or whether the promised environmental quality has actually been delivered (M. C. Jensen & Meckling, 2019; Zwede et al., 2025). In economic terms, the environmental quality of a product is therefore a credence attribute: consumers cannot fully verify it even after purchase or use, which makes markets for such attributes vulnerable to the adverse selection that quality uncertainty can produce (Akerlof, 1978).

Conventional credibility mechanisms, such as eco-labels and third-party certification, reduce this asymmetry but do not remove it (Grunert et al., 2014; Spence, 1973; Thøgersen et al., 2010). Their

effectiveness depends on the legitimacy, recognition, and trustworthiness of the certifying institution, and their proliferation may itself create new uncertainty through label fatigue and consumer skepticism (Röös & Tjärnemo, 2011). This is why the Green IS literature has turned to digital mechanisms that seek to establish credibility through system integrity rather than through institutional assurance alone. Distributed ledgers, digital product passports, cryptographic certificates of origin, and zero-knowledge proofs can make sustainability claims more tamper-evident, verifiable, and privacy-preserving (Babel et al., 2022, 2025; Heeß, Rockstuhl, et al., 2024; Körner et al., 2025; Sedlmeir, Smethurst, et al., 2021). Related work on verifiable and privacy-preserving data sharing further underscores how such mechanisms can address information asymmetries in contexts where sustainability-relevant claims, such as the provision of energy flexibility, have to be demonstrated rather than merely asserted (Zwede et al., 2025).

Despite the conceptual prominence of these mechanisms, it remains insufficiently understood whether digitally verifiable sustainability information actually affects individual decision-making. This is the gap addressed by Research Paper #7, which shifts the argument from the interpretation of observed behavior to the credibility conditions under which sustainability information becomes behaviorally effective.

Research Paper #7 addresses this gap by examining whether digitally verifiable carbon information changes consumer decision-making (Geist et al., 2026). It does so by asking:

> *How does digitally verifiable carbon information affect consumer preferences relative to manufacturer claims and third-party certifications under varying price conditions?*

Grounded in random utility theory (McFadden, 1974), Research Paper #7 conceptualizes the mechanism through which a carbon claim is substantiated as an observable credibility signal that enters the systematic utility of a product alternative. It compares digital verification with two established forms of sustainability communication, namely manufacturer claims and third-party certification, and analyzes how these signals perform under varying price conditions. Empirically, Research Paper #7 uses a best-worst scaling experiment with 122 participants in Germany and considers two product categories that differ in involvement and price sensitivity: headphones and t-shirts. The resulting preference structure is estimated through a multinomial logit model (Louviere et al., 2000; McFadden, 1974).

The results illustrate that digital verifiability generates significantly higher perceived utility than manufacturer claims and even exceeds third-party certification, which represents the strongest conventional credibility signal in the study (cf. Figure 3.4). Price sensitivity moderates this effect for low-involvement products, but it does not overturn the overall ordering of the verification mechanisms. Thereby, digital verification can enhance perceived utility through which sustainability information gains behavioral relevance. It does not merely add another label to sustainability communication, but changes the conditions under which a claim becomes credible. In this sense, Green IS can shift sustainability communication from a declarative mode, where environmental claims are merely asserted, to a verifiable mode that substantiates them through the design of IS itself (Körner et al., 2025).

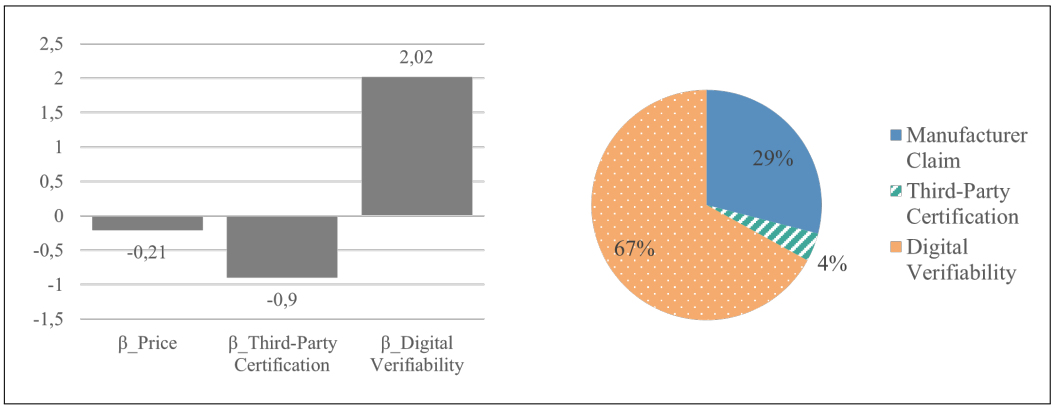


Figure 3.4: Estimated β-coefficients (left) and predicted choice probabilities (right) for the headphone model in Geist et al. (2026).

Research Paper #7 thus concludes the behavioral part of the chapter by linking sustainability-related data, IS design, and individual choice (Geist et al., 2026). The preceding analysis highlighted that sustainability information can only become behaviorally relevant when its credibility is not merely asserted, but established through the way in which the information is verified. Digital verification provides one mechanism for doing so. It shifts trust from the organization that issues a claim to the technical and informational infrastructure that makes the claim verifiable. The paper therefore demonstrates that consumers do not respond to sustainability information in isolation. They also respond to the credibility architecture through which this information is substantiated and made verifiable.

Read together, the two studies trace the behavioral counterpart to the systemic arc developed in Section 3.1. Whereas the preceding section examined how sustainability can guide the optimization of energy and mobility-related systems, this section underscored how sustainability-oriented digital transformation also depends on individual behavior and decision-making. Research Paper #6 demonstrated that the behavioral data generated by digital platforms can be made interpretable and translated into design-relevant knowledge for sustainable mobility services (Baumgarte et al., 2022). Research Paper #7 extended this perspective by outlining that sustainability information becomes behaviorally consequential only when individuals perceive it as credible and sufficiently substantiated (Geist et al., 2026). Taken together, the two studies suggest that behavioral adoption is not a fixed precondition but an outcome that digital systems can actively shape, whether through the interpretability of behavioral data or the credibility of the information they convey.

This behavioral perspective also marks the social dimension of the chapter's ESG logic. After the preceding section focused primarily on the environmental dimension, the present section turned to the individual and social conditions under which sustainability-oriented digital systems become effective in practice. Yet this individual-level account has its limits. The behavioral patterns and credibility signals examined here operate through specific users, consumers, and choices, while the broader transformation of sustainability-related data also depends on institutional arrangements, governance structures, and interorganizational coordination (Legner &

Lefebvre, 2026). At this level, sustainability-related data no longer matter only because they inform individual decisions, but because they become part of shared infrastructures, routines, and interpretive practices through which organizations coordinate action across boundaries (Auschra & Sydow, 2023). This shifts the analytical focus from the availability or credibility of individual data points to the question of how sustainability-related data, and particularly ESG data, are collectively mobilized for strategic and sustainability-related purposes (Günther et al., 2022; Seidel et al., 2013). The strategic value of twin transformation becomes visible in this mobilization: digital transformation provides the infrastructure, data practices, and analytical capabilities through which sustainability-related data can be organized. Meanwhile, sustainability transformation gives direction to these capabilities by defining what is relevant, accountable, and value-creating. This shift from individual behavior and verifiability to institutional and network-level interaction is the terrain of Chapter 4, which examines how sustainability-related data are mobilized within a financial-sector network and how enabling and guiding capabilities shape twin transformation across organizations.

4 Synergies – The Strategic Value of Twin Transformation

The previous two chapters examined the coupling of digital and sustainability transformation one direction at a time. Chapter 2 examined the enabling direction and illustrated how digital transformation supports sustainability transformation by creating the data foundations (cf. Zwede et al. (2026)) and organizational capabilities (cf. Heess et al. (2026) and Meuser et al. (2024)) needed to make sustainability-related phenomena visible, measurable, and actionable. Chapter 3 followed the guiding direction and demonstrated how sustainability enters IS as a first-order objective that reorients how IS are designed (cf. L. Valett et al. (2026)), what they optimize (cf. L. Valett et al. (2024)), and which forms of outcome they are expected to create (cf. Baumgarte et al. (2022) and Geist et al. (2026)). Considered separately, each direction already demonstrates how one transformation can shape the other. Yet this separation was analytical rather than empirical. In organizations, digital and sustainability transformation rarely unfold as sequential or isolated processes. They proceed concurrently, condition one another, and become intertwined in the same organizational practices, data infrastructures, and strategic decisions.

This chapter brings these two directions together and shifts the focus from directional influence to strategic value creation. Its central argument is that twin transformation creates value not simply because digital and sustainability initiatives coexist, but because they become mutually reinforcing through shared data foundations, organizational capabilities, and coordinated practices. This perspective builds on the notion of twin transformation as the value-adding interplay between digital and sustainability transformation efforts (Christmann et al., 2024; Graf-Drasch et al., 2023; Tabares et al., 2025). The underlying premise is that treating both transformations separately limits their strategic potential, whereas their deliberate integration can unlock synergies that remain inaccessible under separate management (Auweiler et al., 2025). In this dissertation, this thesis is further developed and evaluated against reality.

Recent research has begun to conceptualize the interplay between digitalization and sustainability as a capability problem (Breiter et al., 2024). The enabling and guiding directions have already been developed in the preceding chapters: the former through the orchestration of sustainability-related data in Chapter 2 and the latter through the incorporation of sustainability objectives into digital system design in Chapter 3. Enabling and guiding capabilities have been located within the dynamic-capability tradition, where they describe how organizations renew their resource base in response to the dual demands of digitalization and sustainability (Breiter et al., 2024; Christmann et al., 2024). This literature provides an important theoretical vocabulary for understanding twin transformation as a mutually reinforcing relationship instead of two independent transformation agendas. What remains less visible, however, is how this relationship becomes productive in concrete organizational and interorganizational practices. The strategic value of twin transformation cannot be inferred from the availability of digital technologies,

sustainability-related data, or conceptual capabilities alone. It depends on how these resources are mobilized, embedded in routines and decision processes, and coordinated across organizational boundaries (Huber et al., 2024). This argument resonates with a broader stream of IS research on data-based value creation (Fast et al., 2023). From a resource-based perspective, data do not create value simply because they exist as organizational assets. Their value depends on the capabilities through which organizations combine and deploy them in relation to other organizational resources (Ahlemann et al., 2021; Yoo et al., 2010). This is particularly relevant in the data economy, where data evolve from operational by-products into strategic assets that can be shared across organizational boundaries (Lefebvre et al., 2025; Loebbecke & Picot, 2015; Otto & Aier, 2013). At the same time, data value creation is not uniform. It can take different forms, ranging from the improvement of internal processes and decision-making to the development of reusable data-based products (Kakuschke et al., 2025). Which form of value can be realized depends on the specific use case and on the extent to which sustainability-related data are meaningfully interpreted within the organization (Seidel et al., 2013) and embedded in sociotechnical practices (Parmiggiani et al., 2022). This use-case orientation is important because the strategic potential of data remains difficult to capture and justify in organizational practice. Data initiatives require investments in data assets, technological resources, and human capabilities, while their created values may vary substantially across application contexts (Grover et al., 2018; Kakuschke et al., 2025; Zolnowski et al., 2017). Recent work on data products addresses this challenge by emphasizing that data need to be provided in ways that make them accessible for specific user groups and recurring consumption patterns (Hasan et al., 2026). This perspective shifts attention from data as a static resource to data as an object of continuous provision, interpretation, and reuse. It is therefore particularly relevant for sustainability-related data, whose value depends less on their availability than on whether they can be translated into decision-relevant information for different actors.

Data ecosystems and data spaces extend this value logic beyond the boundaries of the single firm. Unlike many other resources, data may increase in value when they are used repeatedly and combined with complementary data held by other actors (Jarke et al., 2019; Richter & Slowinski, 2019). Data ecosystems therefore create settings in which data providers, data consumers, and intermediaries coordinate access, use, and reuse in order to generate joint value from shared data assets (Jussen et al., 2023; Lefebvre et al., 2025; Oliveira et al., 2019). This is especially relevant for sustainability-related data, because the phenomena they describe rarely stop at organizational boundaries. Emissions, supply-chain risks, regulatory obligations, and sustainability-related investment decisions depend on information that is distributed across institutional contexts. The strategic value of sustainability-related data therefore emerges not only from internal data management, but from the coordinated practices through which heterogeneous sustainability-related data are made comparable, reusable, and actionable across organizational boundaries (Ixmeier et al., 2024; Püchel et al., 2024).

At the same time, the chapter responds to a limitation in the current twin transformation literature. While existing work has established the conceptual relationship between digital and sustainability transformation and has begun to specify the capabilities required to integrate them

(Breiter et al., 2024; Christmann et al., 2024; Graf-Drasch et al., 2023), the reciprocal and mutually shaping relationship at the heart of the twin transformation idea has rarely been examined directly in empirical settings (Hammerschmidt et al., 2026). The chapter therefore turns to empirical use cases as examples in which the strategic value of twin transformation can be observed. This empirical orientation is consistent with the broader concern of IS research with situated analyses of sociotechnical phenomena, where the effects of digitalization depend on the organizational settings, actors, infrastructures, and data practices through which they are enacted (Benbasat et al., 1987; Rosemann & Vessey, 2008). Since the strategic value examined in this chapter is fundamentally data-based, this empirical orientation also requires a closer look at how data create value when they are used across organizational boundaries.

The chapter addresses this through two complementary studies. Research Paper #8 turns to the financial sector and examines how sustainability-related data, particularly ESG data, acquire strategic value within an interorganizational network. It illustrates that such value does not arise from data availability alone, but from coordinated practices through which ESG data are mobilized for sustainability-related and strategic purposes (Auweiler et al., 2026). Research Paper #9 then broadens the perspective and tests the twin transformation relationship across organizations. It examines whether digital and sustainability transformation are reciprocally related and whether enabling and guiding capabilities operate as distinct mechanisms through which their mutual reinforcement becomes strategically productive (Zilmans et al., 2026). Read together, the two studies move from observing twin transformation in a concrete network-level use case to assessing its reciprocal structure across organizations. In doing so, the chapter specifies how data-based synergies emerge and under which conditions they contribute to the strategic value of twin transformation.

4.1 Mobilizing Data for Strategic Value

The strategic value of twin transformation becomes visible where digital and sustainability transformation are not only aligned in principle, but translated into organizational practices that change how decisions are made, resources are allocated, and value is created. Digital transformation has long been associated with new forms of efficiency, innovation, and business model development (N. Melville et al., 2004; Vial, 2021; Wessel et al., 2021). Sustainability transformation broadens this understanding of value by directing organizational attention toward ESG-related outcomes and by linking long-term competitiveness to accountability, resilience, and societal contribution (Dorninger et al., 2020; Dyllick & Muff, 2016; Porter & Kramer, 2018). The value proposition of twin transformation lies in connecting these two logics: digital capabilities become strategically relevant for sustainability when they help organizations act on sustainability-related data, while sustainability objectives give direction to digital initiatives by defining what forms of value they should support (Auweiler et al., 2025; Graf-Drasch et al., 2023). Against this background, the following section focuses on strategic value because the subsequent studies examine how sustainability-related data inform the long-term orientation of organizations and

interorganizational networks. Sustainability-related data are not valuable simply because they are collected, stored, or disclosed. Their strategic relevance depends on whether organizations can translate them into decision-relevant information and make them usable across recurring organizational and interorganizational contexts. This focus links the section's twin transformation argument to research on data-based value creation and data products, which highlights that data create value only when they are made usable for specific information needs, recurring use contexts, and concrete organizational purposes (Hasan et al., 2026; Kakuschke et al., 2025).

The financial sector provides a revealing setting for examining this transition from data availability to data mobilization. Regulatory requirements have compelled European financial institutions to build ESG-data infrastructures at scale (Bundesanstalt für Finanzdienstleistungsaufsicht, 2024; European Banking Authority, 2025; European Commission, 2022). Consequently, the collection of sustainability-related data, and particularly ESG data, has become widespread, even where sustainability transformation is initially compliance-driven and not yet value-driven (Agnese et al., 2023; Ballnat et al., 2026). This creates a productive tension. ESG data are increasingly available, yet many institutions still struggle to use them beyond retrospective disclosure. Therefore, their potential for risk management and strategic planning often remains only partially realized (Ixmeier et al., 2024; Kotsantonis & Serafeim, 2019). The obstacle is not simply a lack of data, but fragmented formats, heterogeneous quality, disconnected systems, and divergent interpretations that prevent ESG data from becoming actionable (Teracino et al., 2026; J. Wang et al., 2025). Research Paper #8 takes this tension as its point of departure and examines how ESG data can be moved from a reporting-oriented asset to a value-creating resource within an interorganizational network. Therefore, Auweiler et al. (2026) ask

> *How can organizations mobilize ESG data to create strategic value through transformative sustainable organizing in financial-sector networks?*

In doing so, it connects the twin transformation argument of this dissertation with the broader IS literature on data-based value creation: value arises from the practices through which data are selected, shared, and translated into action. The financial sector is therefore not merely an empirical context in which ESG data are abundant. It is a setting in which regulatory pressure, digital infrastructure, and sustainability-related decision needs converge around the same data resource. This setting is examined through a single case study of an *ESG-Data&Analytics* platform within the Genossenschaftliche FinanzGruppe, a cooperative network of 672 financial institutions in Germany. Empirically, the study draws on expert interviews, focus groups, and extensive documentary material, which are analyzed using the Gioia methodology (Gioia et al., 2013). The case is particularly suitable for examining data-based value creation in twin transformation because it combines network-level coordination with the need to make sustainability-related data usable across a large group of organizationally distinct but institutionally connected actors.

Theoretically, the study interprets the platform through a network resourcing perspective (Feldman, 2004; Howard-Grenville, 2007). From this perspective, an asset becomes valuable through the practices in which actors enact, adapt, reproduce, and transform it (Auschra & Sydow, 2023;

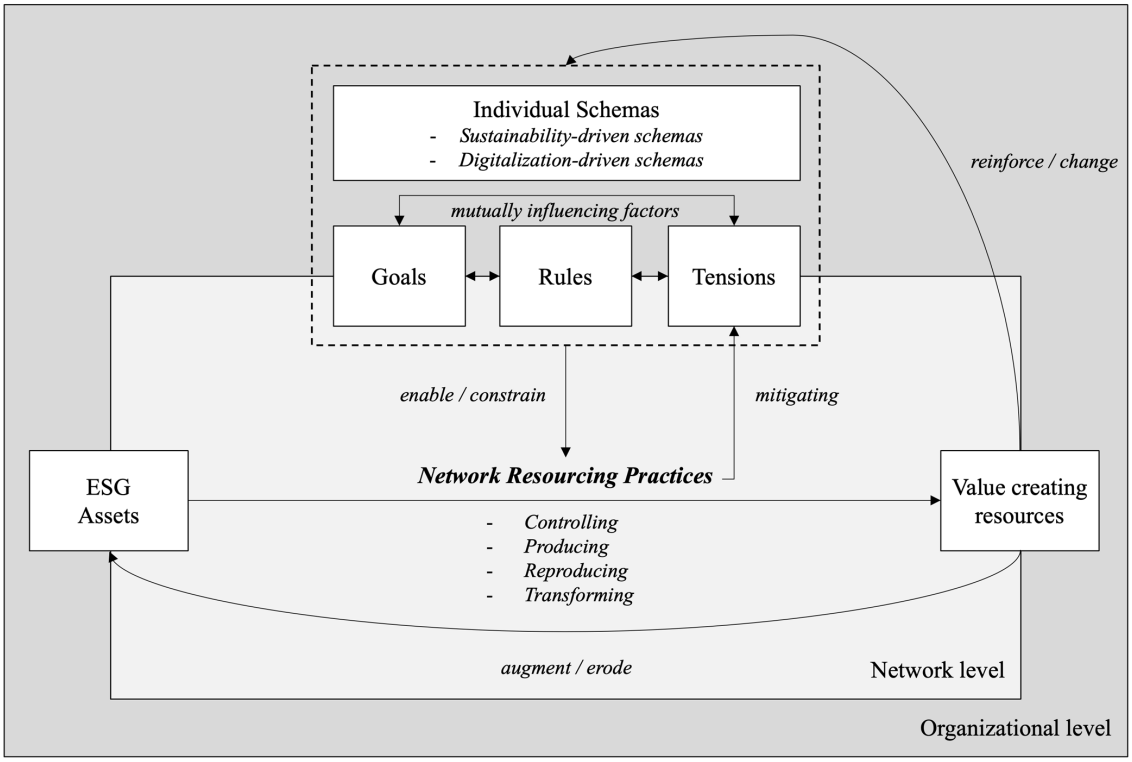


Figure 4.1: The Model of ESG-Data Resourcing based on Auschra and Sydow (2023) (Auweiler et al., 2026).

Feldman, 2004). Applied to ESG data, this means that data do not become a strategic resource simply because they have been collected or stored in a platform. They become resourceful when actors use them in coordinated practices across the network, for instance by aligning interpretations, standardizing data flows, and supporting decision processes.

The central finding is that the platform creates value by making such resourcing practices scalable at the network level (cf. Figure 4.1). It turns ESG data that would otherwise remain fragmented across individual institutions into a shared informational resource that can be mobilized collectively. At the same time, the study outlines that this process is not purely technical and does not unfold uniformly across all actors. Whether ESG data become transformative also depends on the interpretive schemas through which users engage with the platform, including their data literacy, technological confidence, and sustainability-related values. In this sense, the platform is not only a data repository or analytical tool. It functions as an infrastructure that reshapes how financial actors understand their own role in sustainability transformation and how they imagine the strategic relevance of ESG data for future financial organizing (Gümüsay & Reinecke, 2024).

Auweiler et al. (2026) advance the chapter's central argument by showing how the synergy of twin transformation becomes visible in the mobilization of ESG data across an interorganizational network. The two directions traced separately in the preceding chapters converge in the ESG data and analytics platform. On the one hand, the platform represents the enabling direction developed in Chapter 2: it provides the digital infrastructure through which fragmented ESG data are structured, shared, and rendered usable across the network. On the other hand,

it also reflects the guiding direction developed in Chapter 3: the platform is designed around the sustainability-related purposes of transparency, accountability, and strategic ESG data use. Its value therefore cannot be attributed to digitalization or sustainability transformation in isolation. It emerges from the coordinated pursuit of both, through which sustainability-related data are transformed from dispersed reporting inputs into a shared resource for strategic action.

In this sense, the study makes the chapter's synergy claim empirically tangible. It underscores that the strategic value of twin transformation is realized when digital infrastructures, sustainability objectives, and network-level practices are aligned. Such value remains limited when ESG data are managed only as compliance inputs or when digital platforms are treated merely as technical repositories. It becomes visible when actors use the platform to coordinate interpretations, standardize data practices, and mobilize ESG data for decisions that no single institution could support in the same way alone. Research Paper #8 therefore demonstrates that the strategic value of sustainability-related data depends on the joint management of digital and sustainability transformation, and on the practices through which this joint management becomes embedded in an interorganizational network (Auweiler et al., 2026).

What Research Paper #8 demonstrates within one interorganizational network, Research Paper #9 examines across organizations more broadly. The case study in Auweiler et al. (2026) demonstrated how the strategic value of twin transformation can become visible when ESG data are mobilized through shared infrastructures and coordinated practices. Yet a single case cannot establish whether the reciprocal relationship between digital and sustainability transformation also holds as a more general organizational pattern. Research Paper #9 therefore subjects the twin transformation relationship itself to a firm-level empirical examination (Zilmans et al., 2026). More specifically, it asks:

> *How are digital transformation and sustainability transformation reciprocally related, and what role do enabling and guiding capabilities play in shaping this interplay within the context of twin transformation?*

In doing so, the study moves from observing data-enabled value creation in a specific network to examining the organizational mechanisms through which the mutual reinforcement of both transformations can be explained (Breiter et al., 2024; Christmann et al., 2024; Graf-Drasch et al., 2023; Hammerschmidt et al., 2026).

Conceptually, Research Paper #9 provides the capability-theoretic link between the two directions based on Breiter et al. (2024) and further developed throughout this dissertation. Building on the idea that organizations need dynamic capabilities to renew and reconfigure their resource base under changing environmental conditions (Teece, 2007; Teece et al., 1997), it conceptualizes enabling capabilities as the organizational capacity to use existing digital resources for sustainability-related purposes, and guiding capabilities as the capacity to let sustainability objectives shape the further development of digital resources (Breiter et al., 2024; Christmann et al., 2024). This provides the analytical bridge back to the preceding chapters. The enabling capability corresponds to the orchestration of sustainability-related data examined especially in

Section 2.2, where the dissertation drew on resource-based, resource-orchestration, and maturity perspectives to explain how sustainability-related data become manageable and actionable (Barney, 1991; Becker et al., 2009; Sirmon et al., 2011; Teece et al., 1997). The guiding capability corresponds to the incorporation of sustainability objectives into digital system design examined especially in Section 3.1, where sustainability was positioned not merely as an outcome of IS, but as a design objective that shapes what systems measure and optimize (Ketter et al., 2023; N. P. Melville, 2010; Watson et al., 2010). Research Paper #9 therefore recasts the dissertation's two analytical directions as distinct organizational capacities whose reciprocal relationship can be examined empirically (cf. Figure 4.2).

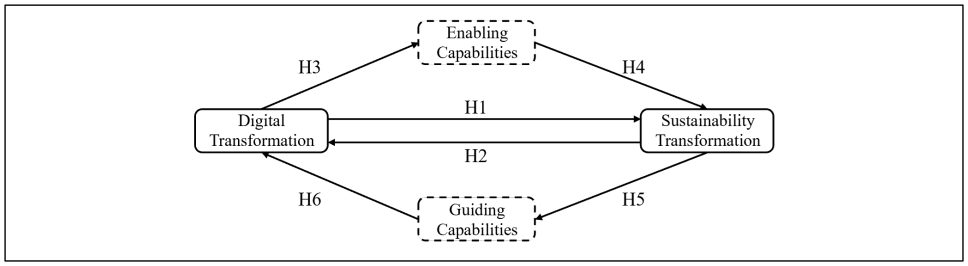


Figure 4.2: Conceptual twin transformation framework based on Graf-Drasch et al. (2023) (Zilmans et al., 2026).

Empirically, Research Paper #9 investigates this relationship through a sequential explanatory design that combines survey-based hypothesis testing with qualitative expert insights. Digital transformation and sustainability transformation are operationalized through parallel maturity constructs. The study tests six hypotheses based on survey data from 27 organizations. To complement these quantitative results, 17 expert interviews provide deeper insight into how organizations enact enabling and guiding capabilities in practice. The findings support the reciprocal relationship between digital and sustainability transformation. Both transformations are positively and significantly associated. This symmetry suggests that neither transformation is merely subordinate to the other. The capability pathways specify how this reciprocity unfolds: digital transformation strengthens enabling capabilities through which existing digital resources can be directed toward sustainability-related purposes, whereas sustainability transformation strengthens guiding capabilities through which sustainability objectives shape the ongoing development of digital transformation.

The qualitative findings further qualify this reciprocal relationship by outlining that enabling and guiding capabilities are constrained by different organizational conditions. Enabling capabilities are constrained where organizations lack reliable sustainability-related data foundations, integrated systems, common standards, and analytical capacities. Here, the constraint is not merely technical, but concerns the organizational conditions under which sustainability-related data become usable. Respondents pointed to missing supplier and emissions data, fragmented data sources, inconsistent definitions, limited interoperability, and disconnected reporting and operational systems. These challenges make it difficult to move from data collection to data mobilization, because sustainability-related data often remain tied to compliance-oriented reporting rather than being embedded in recurring analytical routines and decision processes. This echoes

the broader literature on sustainability-related data, which emphasizes their heterogeneity and limited interoperability (Ixmeier et al., 2024; Kotsantonis & Serafeim, 2019; Teracino et al., 2026; J. Wang et al., 2025). It also resonates with the resource-based and resource-orchestration perspective developed in Chapter 2: data become valuable only when organizations structure, bundle, and leverage them through appropriate capabilities (Barney, 1991; Sirmon et al., 2011; Teece et al., 1997). Guiding capabilities, by contrast, are constrained by the difficulty of translating sustainability objectives into system requirements, governance arrangements, and investment decisions. The qualitative findings illustrate that this translation is demanding because sustainability objectives often remain formulated at a strategic or regulatory level, while digital transformation decisions are made through concrete IS architectures, performance metrics, and project portfolios. Respondents pointed to high reporting burdens, regulatory inconsistencies, limited resources, economic pressure, and uncertainty around the productive and responsible use of AI as obstacles to aligning digital development with sustainability objectives. As a result, sustainability may inform organizational ambition without necessarily shaping the design and prioritization of digital systems. This links back to Chapter 3, where sustainability was positioned not merely as an outcome of IS, but as a design objective that shapes what systems measure, optimize, communicate, and make accountable (Ketter et al., 2023; Seidel et al., 2013).

This differentiation between enabling and guiding capabilities constitutes the study's principal contribution to the argument of this dissertation. By establishing a positive reciprocal relationship between digital and sustainability transformation, the study supports the view that twin transformation is more than a rhetorical pairing of two contemporary transformation agendas (Auweiler et al., 2025; Breiter et al., 2024; Christmann et al., 2024; Graf-Drasch et al., 2023). At the same time, the qualitative evidence shows that this reciprocity is not automatic. Enabling and guiding capabilities follow different developmental logics and are constrained by different organizational conditions. The strategic value of twin transformation therefore depends on whether organizations can proactively manage sustainability-related data (Teracino et al., 2026) and translate sustainability objectives into the digital systems, infrastructures, and decision practices (Kotlarsky et al., 2023) through which both transformations become mutually reinforcing.

Read together, the two studies specify the strategic value of twin transformation from complementary perspectives. Research Paper #8 illustrates how sustainability-related data become strategically valuable in an interorganizational financial-sector network when they are mobilized through shared digital infrastructure and coordinated practices (Auweiler et al., 2026). Research Paper #9 broadens this view by examining how the enabling and guiding directions relate across organizations and how their reciprocal relationship depends on distinct organizational capabilities (Zilmans et al., 2026). The chapter therefore illustrates that the synergy of twin transformation is neither automatic nor merely conceptual. It becomes visible where sustainability-related data, digital capabilities, sustainability objectives, and organizational practices are configured in ways that create strategic value. The concluding Chapter 5 takes up the broader theoretical and practical implications that follow from this insight.

5 Conclusion

This dissertation set out from the observation that digital transformation and sustainability transformation have become two defining transformation agendas for organizations, economies, and societies. Both address fundamental pressures of the present: the pervasive diffusion of digital technologies on the one hand (Vial, 2021; Wessel et al., 2021), and the need to respond to ecological degradation, social accountability, and long-term value creation on the other (Dyllick & Muff, 2016). Yet the relationship between these two transformations remains insufficiently understood (Ologeanu-Taddei et al., 2025). Digital transformation is often assumed to enable sustainability, while sustainability transformation is often treated as a normative or regulatory demand that organizations must accommodate. Such perspectives capture important aspects of the relationship, but they treat digital and sustainability transformation as largely separate processes, leaving open how the two actually interact in practice. This unresolved relationship is commonly addressed under the notion of *twin transformation*, which challenges the separation of digital and sustainability transformation and foregrounds their potential for integrated and mutually reinforcing development (Balta et al., 2022; Ollagnier et al., 2021).

This dissertation places data at the center of this mutual reinforcement. Sustainability-related data constitute the connective resource through which digital and sustainability transformation can be linked. Digital technologies generate, process, and exchange data that make sustainability-related phenomena measurable, comparable, and actionable (Püchel et al., 2024; Teracino et al., 2026). At the same time, sustainability objectives define which data are important, how they should be governed and how they should be integrated into digital infrastructures and decision-making processes (Gholami et al., 2016; Lehnhoff et al., 2021). Data therefore do not merely support one transformation from the outside. They form the medium through which the two transformations become coupled.

The overarching research question guiding this dissertation was: *How do data drive digital and sustainability transformation to become mutually reinforcing?* To answer this question, the dissertation approaches the relationship between digital and sustainability transformation from three complementary analytical perspectives.

Chapter 2 addressed the enabling direction, illustrating how digital transformation enables sustainability transformation by making sustainability-related data manageable. Within this chapter, Section 2.1 laid the conceptual foundation by examining how sustainability-related data can be systematically characterized. Research Paper #1 developed a taxonomy of ESG data and thereby elaborated that ESG data constitute a distinct and heterogeneous object of IS research (Zwede et al., 2026). Section 2.2 then shifted from conceptualization to maturity assessment and examined how organizations can develop the capabilities required to use sustainability-related data effectively. Research Paper #2 developed a maturity model for sustainability data management (Heess et al., 2026), while Research Paper #3 contextualized this maturity logic for industrial decarbonization and outlined how IS can support the reduction of Scope 1 and Scope 2 emissions

in discrete manufacturing (Meuser et al., 2024).

Subsequently, Chapter 3 examined the guiding direction, demonstrating how sustainability transformation guides digital transformation by changing what IS optimize, how they are designed, and under which conditions they become behaviorally effective. As part of that, Section 3.1 addressed this guiding logic at the systemic level of environmental impact. Research Paper #4 underscored how a shift from cost-minimizing to carbon-minimizing energy management changes the sustainability outcomes of a real-world IS (L. Valett et al., 2026), while Research Paper #5 extended this case by integrating vehicle-to-building operations and guest mobility behavior into carbon-aware energy management (L. Valett et al., 2024). Section 3.2 then turned to behavioral adoption and examined the individual and social conditions under which sustainability-oriented IS become effective in practice. Research Paper #6 illustrated how behavioral mobility data can be made interpretable through machine learning and explainable AI to support sustainable carsharing services (Baumgarte et al., 2022), while Research Paper #7 demonstrated that digitally verifiable carbon information can increase the credibility and behavioral relevance of sustainability claims in consumer decision-making (Geist et al., 2026).

In the following, Chapter 4 brought the enabling and guiding directions together and examined the synergies that emerge when digital and sustainability transformation are jointly organized through shared data foundations, coordinated practices, and organizational capabilities. Research Paper #8 demonstrated how ESG data can be mobilized for strategic value in an interorganizational financial-sector network (Auweiler et al., 2026). Research Paper #9 broadened this perspective by empirically examining the reciprocal relationship between digital and sustainability transformation across organizations and by outlining how enabling and guiding capabilities facilitate this relationship (Zilmans et al., 2026).

Drawing on these nine research papers, the dissertation develops a cumulative argument about the role of data in shaping the relationship between digital and sustainability transformation. It illustrates, first, that sustainability-related data require conceptual specification as heterogeneous, context-dependent, and purpose-bound objects of management before they can be meaningfully governed, integrated, and used (cf. Zwede et al. (2026)). It then demonstrates that the transformative potential of these data depends on organizational capabilities through which they are structured, governed, analyzed, and mobilized for sustainability-oriented action (cf. Heess et al. (2026) and Meuser et al. (2024)). The dissertation further elaborates that sustainability objectives can reorient digital transformation when they are embedded in the design and operation of IS, whether through carbon-oriented objective functions (cf. L. Valett et al. (2024, 2026)), the interpretation of behavioral data (cf. Baumgarte et al. (2022)), or digitally mediated mechanisms of credibility and verification (cf. Geist et al. (2026)). At the strategic level, it demonstrates that value emerges when data, infrastructures, sustainability objectives, and organizational capabilities are configured in ways that allow digital and sustainability transformation to reinforce one another (cf. Auweiler et al. (2026) and Zilmans et al. (2026)).

The dissertation thereby contributes to IS research by developing a sociotechnical perspective on the role of data in digital and sustainability transformation. It conceptualizes this relation-

ship as neither automatic nor unidirectional, but as a reciprocal interplay that depends on the data foundations, system designs, organizational capabilities, and interorganizational practices through which both transformations are enacted. Digital transformation enables sustainability transformation by generating data that make sustainability-related phenomena measurable and manageable. Sustainability transformation, in turn, guides digital transformation by defining which objectives IS should incorporate and which forms of accountability they need to support. Data are therefore not merely inputs to technical systems or managerial decisions. They are the medium through which sustainability becomes organizationally and technically actionable, and through which the mutual reinforcement of digital and sustainability transformation becomes theoretically and practically comprehensible.

5.1 Theoretical Contributions

Across its nine research papers, this dissertation contributes to the broader Green IS research stream by examining how IS can support sustainability-oriented transformation through data. Its overarching theoretical contribution is to identify sustainability-related data as the central resource through which digital and sustainability transformation become orchestrated as twin transformation. Whereas prior research has largely examined digital and sustainability transformation as separate phenomena, this dissertation develops data as the underlying mechanism that connects both transformations across the individual, organizational, and interorganizational levels at which they unfold. The following contributions specify this mechanism from complementary theoretical perspectives, i.e., data management, organizational capabilities, energy informatics, sociotechnical system design, data-based value creation, and twin transformation, while keeping sustainability-related data as the common analytical focus.

First, the dissertation contributes to Green IS research by specifying the informational foundations of sustainability-oriented IS. While Green IS has shown how IS can support measurement, coordination, sensemaking, and intervention for sustainability (N. P. Melville, 2010; Seidel et al., 2013; Watson et al., 2010), this dissertation foregrounds the data through which such activities become possible. By conceptualizing sustainability-related data, and ESG data in particular, as heterogeneous, context-dependent, and purpose-bound objects of management in Research Paper #1, it provides a vocabulary for analyzing the data foundations on which sustainability-oriented IS depend (Ballnat et al., 2026; Ixmeier et al., 2024; Krasikov & Legner, 2023; J. Wang et al., 2025).

Second, the dissertation contributes to data management and capability research by theorizing sustainability-related data as latent strategic resources. Drawing on the resource-based view and resource orchestration theory (Barney, 1991; Sirmon et al., 2007, 2011), it illustrates that the value of these data does not reside in their availability alone, but in the capabilities through which organizations structure, govern, analyze, and mobilize them for sustainability-oriented action (cf. Research Paper #2). The maturity perspective outlined in the dissertation specifies these capabilities as multidimensional and developmental (cf. Research Paper #3), thereby extending IS

research on data-based value creation to the particular conditions of sustainability transformation (Kakuschke et al., 2025; Püchel et al., 2024).

Third, the dissertation advances energy informatics by specifying how sustainability objectives can guide the design and operation of IS. It highlights that sustainability is not only an external outcome against which IS are evaluated, but can become an internal design criterion that shapes what systems optimize, which data they require, and how their performance is assessed (cf. Research Papers #4 and #5). By making this guiding role analytically concrete, the dissertation underscores how ecological objectives become operational within digital artifacts, optimization logics, and decision processes (Goebel et al., 2014; Ketter et al., 2023; Staudt et al., 2019).

Fourth, the dissertation extends sociotechnical IS research by integrating behavioral data, explainability, verifiability, and trust into the study of sustainability-oriented digital transformation (cf. Research Papers #6 and #7). It highlights that IS contribute to sustainability not only through optimization and automation, but also through their capacity to make behavioral patterns interpretable and sustainability claims credible. This links Green IS with research on sociotechnical design, sustainability information, credence attributes, and digital verification (Körner et al., 2025; Recker et al., 2025).

Finally, the dissertation contributes to the emerging theory of twin transformation by indicating that the mutual reinforcement of digital and sustainability transformation is not enacted within single organizations alone. As illustrated in Research Paper #8, it can also depend on interorganizational coordination, shared data foundations, and resourcing practices through which sustainability-related data become usable across organizational boundaries (Jussen et al., 2023; Lefebvre et al., 2025; Oliveira et al., 2019). Building on this interorganizational perspective, the dissertation empirically specifies the reciprocal relationship between digital and sustainability transformation across organizations (cf. Research Paper #9). It provides evidence that both transformations are positively related, while also underscoring that this relationship is not a simple symmetric feedback loop. Enabling and guiding capabilities follow different developmental logics and are constrained by different organizational conditions. This refines the capability-based understanding of twin transformation by highlighting that mutual reinforcement becomes strategically productive only when organizations deliberately manage and govern the data connecting both transformations.

Taken together, the nine research papers illustrate the two directional mechanisms at the core of twin transformation (cf. Figure 1.1 in Chapter 1): digital transformation enables sustainability transformation by making sustainability-related data available and actionable, while sustainability transformation guides digital transformation by shaping what IS are designed to measure, optimize, and make credible.

Across the five contributions outlined above, this mechanism operates at three interrelated levels: at the individual level, sustainability-related data become meaningful only once they are interpreted, trusted, and acted upon by individuals (Research Papers #6 and #7). At the organizational level, data become strategic resources through the informational foundations, capabilities, and design decisions that structure and mobilize them (Research Papers #1 through #5). And at the

interorganizational level, data connect otherwise separate actors into shared infrastructures of coordination and value creation (Research Papers #8 and #9). By specifying how sustainability-related data operate as this connective mechanism across levels, the dissertation contributes to IS research by identifying data as the central resource through which digital and sustainability transformation are orchestrated as twin transformation, moving beyond accounts that treat the two transformations as separate or merely parallel agendas.

5.2 Practical Implications

The findings of this dissertation have several practical implications for organizations seeking to realize the strategic potential of digital and sustainability transformation. The central implication is that both transformations should not be managed as separate agendas that are only later aligned through reporting, communication, or isolated technology projects. Their mutual reinforcement depends on the data foundations, capabilities, system designs, and governance arrangements through which digital resources can support sustainability objectives and sustainability objectives can guide digital development.

First, organizations need to establish conceptual clarity and governance structures for sustainability-related data. Such data differ in their sources, temporal references, aggregation levels, verification requirements, ownership structures, and usage purposes (Püchel et al., 2024). Treating them as a homogeneous input for reporting or compliance risks obscuring the differences that determine whether they can be integrated, exchanged, and used effectively. Organizations should therefore develop a shared vocabulary for sustainability-related data across sustainability, IT, finance, risk, operations, and strategy functions. The taxonomy developed in Research Paper #1 provides a practical starting point for distinguishing different types of ESG and sustainability-related data and for deriving appropriate governance requirements from their characteristics (cf. Zwede et al. (2026) in Section 2.1).

Second, organizations should treat sustainability-related data as strategic resources whose value depends on organizational capabilities. Data availability alone does not create sustainability-oriented value. Organizations need capabilities to structure, govern, analyze, and mobilize such data in decision-making. This includes reliable data infrastructures, clear responsibilities, data quality routines, analytical competences, and management practices that connect sustainability-related data to operational and strategic decisions (Teracino et al., 2026; J. Wang et al., 2026). The maturity models developed in Research Papers #2 and #3 support this task by helping organizations identify capability gaps, prioritize development needs, and contextualize sustainability data management for specific transformation goals such as industrial decarbonization (cf. Heess et al. (2026) and Meuser et al. (2024) in Section 2.2).

Third, organizations should embed sustainability objectives into the design and operation of IS. Digital optimization does not automatically generate sustainability benefits. Its effects depend on the objectives and constraints incorporated into IS design (Gholami et al., 2016; Lehnhoff et al., 2021). Organizations should therefore integrate sustainability criteria into system configuration,

performance measurement, and investment decisions from the outset. Research Papers #4 and #5 demonstrate this implication in the context of energy management, where carbon-oriented objective functions, vehicle-to-building integration, and mobility behavior change the sustainability outcomes of digital optimization (cf. L. Valett et al. (2024, 2026) in Section 3.1). Research Papers #6 and #7 further underscore that sustainability-oriented IS also depend on behavioral and credibility-related conditions, including interpretable behavioral data and verifiable sustainability information (cf. Baumgarte et al. (2022) and Geist et al. (2026) in Section 3.2).

Fourth, organizations need governance arrangements that make the relationship between digital and sustainability transformation actionable within and beyond organizational boundaries. Many sustainability challenges depend on data distributed across multiple actors, including suppliers, financial institutions, and regulators. Organizations should therefore develop shared definitions, interfaces, access rights, and verification procedures for interorganizational data use (Legner & Lefebvre, 2026; Möller et al., 2025). Research Paper #8 outlines how sustainability-related data can be mobilized for strategic value in an interorganizational financial-sector network (cf. Auweiler et al. (2026) in Chapter 4). Research Paper #9 further demonstrates that the reciprocal relationship between digital and sustainability transformation depends on distinct enabling and guiding capabilities, which need to be deliberately developed rather than assumed as an automatic consequence of parallel transformation efforts (cf. Zilmans et al. (2026) in Chapter 4).

Taken together, the practical value of this dissertation lies in outlining how organizations can move from data availability to data mobilization (cf. Chapter 2), from digital optimization to sustainability-oriented system design (cf. Chapter 3), and from isolated transformation initiatives to a mutually reinforcing relationship between digital and sustainability transformation (cf. Chapter 4). Across the nine research papers, the dissertation provides guidance for making this relationship actionable by clarifying sustainability-related data, developing the capabilities to use them, embedding sustainability objectives into IS, accounting for behavioral and credibility-related conditions, coordinating data across organizational boundaries, and deliberately managing the reciprocal relationship between both transformations.

5.3 Limitations and Future Research

The argument developed in this dissertation is inevitably shaped by the empirical contexts, theoretical choices, and methodological designs through which it was pursued. Having shown that sustainability-related data constitute a connective resource through which digital and sustainability transformation can become mutually reinforcing, the remainder of this chapter reflects on the boundaries of this argument and identifies the questions it leaves open for future research.

A first limitation concerns the types of sustainability-related data examined in this dissertation. Across the nine papers, the empirical focus lies primarily on structured, quantifiable data, including energy and emissions data (L. Valett et al., 2024, 2026), mobility data (Baumgarte et al., 2022; L. Valett et al., 2024), behavioral trace data (Baumgarte et al., 2022), and digitally verifi-

able carbon information (Geist et al., 2026), while less structured forms of sustainability-related data, such as qualitative disclosures, narrative reporting, or stakeholder communication, receive comparatively less attention. Future research could examine whether the enabling and guiding capabilities identified in this dissertation extend to these less structured forms of sustainability-related data, and how organizations mobilize them for decision-making.

A second limitation follows from the empirical and sectoral contexts of the included studies. The dissertation examines settings such as sustainability data management (Heess et al., 2026; Zilmans et al., 2026), industrial decarbonization (Meuser et al., 2024), hotel energy management (L. Valett et al., 2024, 2026), station-based carsharing (Baumgarte et al., 2022), digitally verifiable carbon information (Geist et al., 2026), and interorganizational data mobilization in the financial sector (Auweiler et al., 2026). These contexts make different aspects of the dissertation's argument visible, but the findings should not be interpreted as context-independent. Future research should therefore examine how the identified mechanisms vary across industries, regulatory environments, geographical regions, and organizational forms. Comparative studies could deepen the understanding of how data foundations, capability requirements, and system design choices differ across sustainability domains.

A third limitation concerns the development and effects of sustainability data capabilities. The maturity models developed in this dissertation make capability requirements visible and actionable (Heess et al., 2026; Meuser et al., 2024), but maturity-based approaches can imply more linearity than transformation processes actually exhibit (Becker et al., 2009; Pöppelbuß & Röglinger, 2011; Röglinger et al., 2012). Future research should therefore complement maturity perspectives with longitudinal studies that trace how sustainability data management capabilities emerge, stabilize, or erode over time. This would further connect sustainability data management with capability-oriented IS research and resource orchestration perspectives (Barney, 1991; Sirmon et al., 2007, 2011). Relatedly, more research is needed on how such capabilities translate into measurable sustainability outcomes. While the dissertation outlines how IS can support carbon-aware energy management (L. Valett et al., 2026), vehicle-to-building integration (L. Valett et al., 2024), and sustainable mobility (Baumgarte et al., 2022), the causal link between data-enabled interventions and long-term environmental or social outcomes remains difficult to establish. Future Green IS and energy informatics research should therefore examine these causal pathways through longitudinal study designs (Goebel et al., 2014; Ketter et al., 2023; Staudt et al., 2019).

A fourth limitation concerns the temporal and institutional dynamics of the relationship between digital and sustainability transformation. The dissertation provides evidence that both transformations are positively related and that enabling and guiding capabilities constitute distinct mechanisms in this relationship (Zilmans et al., 2026). However, the empirical examination of this reciprocity is based on cross-sectional survey data complemented by qualitative interviews, and therefore reflects the specific sample and institutional context from which the data were drawn. Future research on twin transformation should therefore study this relationship longitudinally to examine whether digital transformation first creates data foundations for sustainability transformation, whether sustainability objectives subsequently redirect digital investments,

or whether both processes co-evolve from the outset (Christmann et al., 2024; Graf-Drasch et al., 2023). Such research should also move beyond the organizational level and examine how public policy, market design, standards, and digital public infrastructure shape the conditions under which both transformations can reinforce one another (Beverungen et al., 2022; Legner & Lefebvre, 2026; Otto & Jarke, 2019). In this context, future studies could more explicitly investigate how sustainability-related data support risk management and resilience across different actors, including firms, supply-chain partners, financial institutions, regulators, and consumers. This would help explain how data-enabled digital and sustainability transformation can improve the capacity of organizations and networks to anticipate sustainability-related risks, respond to disruptions, and adapt to changing ecological, regulatory, and market conditions.

Finally, future research could examine not only synergies, but also tensions and failure modes in the relationship between digital and sustainability transformation. This dissertation illustrates how both transformations can become mutually reinforcing through data, capabilities, infrastructures, and practices. Yet this relationship may also be constrained by data fragmentation, limited interoperability, regulatory burden, resource constraints, misaligned objectives, organizational silos, rebound effects, and insufficient governance (Ologeanu-Taddei et al., 2025). Future studies could therefore investigate when digital transformation undermines sustainability, when sustainability objectives redirect or constrain digital innovation, and when organizations symbolically align both agendas without changing underlying routines or decision logics. Such work could also examine how different actors manage the risks associated with data-enabled sustainability transformation. For example, firms may focus on operational, reputational, and compliance risks; financial institutions on transition and exposure risks; regulators on transparency and accountability; and consumers on trust, privacy, and the credibility of sustainability claims. Addressing these actor-specific risk perspectives would refine the emerging literature on twin transformation by treating mutual reinforcement not as an assumption, but as an outcome that depends on specific organizational, technological, institutional, and resilience-related conditions.

Taken together, these limitations clarify the scope of the dissertation, but they also reinforce the relevance of the problem from which it began. In a context of mutually reinforcing crises, digitalization cannot be treated as a neutral force of progress, nor can sustainability be reduced to a matter of reporting. The dissertation has shown that the relationship between digital and sustainability transformation must be actively organized through data that make sustainability visible and actionable across different levels of social and economic life. This perspective is particularly important in times of polycrisis, where societies, organizations, and individuals depend on more reliable ways of understanding and responding to the pressures they face. By explaining how sustainability-related data can connect digital capabilities and IS design with sustainability objectives, the dissertation offers an optimistic view of IS research: digital transformation does not have to reinforce unsustainable trajectories, but can contribute to more informed, coordinated, and resilient responses. The future relevance of this research therefore lies in its capacity to support forms of organizing that are data-enabled and oriented toward long-term sustainability.

Use of writing assistance *Please note that I have utilized various writing assistance software programs (e.g., ChatGPT, Claude, and DeepL) to enhance the language and readability of this work. The use of these tools was guided by ethical considerations and standards of academic integrity, in accordance with the guidelines of the Executive Committee of the Deutsche Forschungsgemeinschaft (DFG / German Research Foundation) on the influences of generative models of text and image creation on science and the humanities as well as on the DFG's funding activities. Nevertheless, I take full responsibility for its content and have thoroughly reviewed and edited the material as necessary.*

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A Overview of Research Papers

A.1 Research Papers Included in This Dissertation

Research Paper 1: From Fragments to Conceptual Clarity: A Taxonomy for Effective ESG Data Management

Zwede, T., Valett, L., Körner, M.-F., Schneider, M., & Strüker, J. (2026). From Fragments to Conceptual Clarity: A Taxonomy for Effective ESG Data Management. *Outlet hidden due to the double-blind review process* (VHB-JQ3[1]: A, VHB-JQ4[2]: A)

Research Paper 2: Enabling Organizational Sustainability Data Management for Strategic Value Creation: A Maturity Model Approach

Heess, P., Körner, M.-F., Strüker, J., & Valett, L. (2026). Enabling Organizational Sustainability Data Management for Strategic Value Creation: A Maturity Model Approach. *Outlet hidden due to the double-blind review process* (VHB-JQ3: B, VHB-JQ4: B)

Research Paper 3: Navigating Digital Transformation towards Sustainability: A Maturity Model for Industrial Decarbonization

Meuser, B., Valett, L., Wagon, F., & Weibelzahl, M. (2024). Navigating Digital Transformation towards Sustainability: A Maturity Model for Industrial Decarbonization. *AMCIS 2024 Proceedings* (VHB-JQ3: D, VHB-JQ4: C)

Research Paper 4: From Cost to Carbon Efficiency through Digitalization: A Quantitative Case Study in Sustainable Tourism

Valett, L., Keller, R., Körner, M.-F., Leinauer, C., & Strüker, J. (2026). From Cost to Carbon Efficiency through Digitalization: A Quantitative Case Study in Sustainable Tourism. *Sustainability Analytics and Modeling* (VHB-JQ3: -, VHB-JQ4: B)

Research Paper 5: Empowering Sustainable Hotels: A Guest-Centric Optimization for Vehicle-To-Building Integration

Valett, L., Bollenbach, J., & Keller, R. (2024). Empowering Sustainable Hotels: A Guest-Centric Optimization for Vehicle-To-Building Integration. *Energy Informatics*, *7*(1), 91 (VHB-JQ3: -, VHB-JQ4: C)

Research Paper 6: Revealing Influences on Carsharing User's Trip Distance in Small Urban Areas

Baumgarte, F., Keller, R., Röhrich, F., Valett, L., & Zinsbacher, D. (2022). Revealing Influences on Carsharing User's Trip Distance in Small Urban Areas. *Transportation Research Part D: Transport and Environment*, *105*, 103252 (VHB-JQ3: B, VHB-JQ4: B)

[1] VHB-JQ3: VHB-JOURQUAL3
[2] VHB-JQ4: VHB Publication Media Rating 2024

Research Paper 7: From Data to Sustainable Decisions: The Impact of Verifiable Carbon Information on Consumer Behaviour
Geist, A., Körner, M.-F., Strüker, J., Valett, L., & Zwede, T. (2026). From Data to Sustainable Decisions: The Impact of Verifiable Carbon Information on Consumer Behaviour. *ECIS 2026 Proceedings* (VHB-JQ3: B, VHB-JQ4: A)

Research Paper 8: Mobilizing ESG-Data for Value Creation: A Single Case Study of a Data Platform from the European Financial Sector
Auweiler, S., Heess, P., Valett, L., Körner, M.-F., & Strüker, J. (2026). Mobilizing ESG-Data for Value Creation: A Single Case Study of a Data Platform from the European Financial Sector. *Outlet hidden due to the double-blind review process* (VHB-JQ3: C, VHB-JQ4: B)

Research Paper 9: Leveraging the Interplay of Digital and Sustainability Transformation: An Empirical Study of Twin Transformation in Corporate Practice
Zilmans, C., Valett, L., & Strüker, J. (2026). Leveraging the Interplay of Digital and Sustainability Transformation: An Empirical Study of Twin Transformation in Corporate Practice. *Outlet hidden due to the double-blind review process* (VHB-JQ3: B, VHB-JQ4: B)

A.2 Index of Further Papers

Beyond the work presented in this dissertation, I authored or co-authored the following additional research papers, studies, and books during the course of my doctoral studies. These are not part of this dissertation.

Heger, S., Thim, H., Valett, L., Schröder, J., & Gimpel, H. (2020). Value Stream Model and Notation-Digitale Transformation von Wertströmen. *Internationale Tagung Wirtschaftsinformatik (WI) 2020*

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Heeß, P., Körner, M.-F., Strüker, J., Valett, L., Wolf, L., Pulvermüller, B., & Richard, P. (2024). Grundlagen und Bedeutung von Datenräumen für die Energiewirtschaft. Retrieved June 23, 2026, from https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2024/Grundlagen_und_Bedeutung_von_Datenraeumen_fuer_die_Energiewirtschaft.pdf

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Leinauer, C., Valett, L., Körner, M.-F., Strüker, J., & Gust, G. (2026). Digital Product Passports for Reducing Uncertainty in Carbon Information: A Path to Better Carbon Accounting and Carbon Management. *In preparation for submission to Nature Sustainability*

Strüker, J., Valett, L., & Zimmermann, F. (2026). Twin Transformation bei Hidden Champions: Wie Digitalisierung und Nachhaltigkeit zusammen Mehrwert schaffen. *In preparation for publication by Springer Gabler*

A.3 Individual Contribution to the Included Research Papers

This cumulative dissertation comprises nine research papers, all co-authored with multiple collaborators. This section details the context and outlines my contributions to each of the papers.

Research Paper 1 entitled "From Fragments to Conceptual Clarity: A Taxonomy for Effective ESG Data Management" (Zwede et al., 2026, Section B.1) was written by a team of five authors. Together with one co-author, I served as one of the two lead authors of this paper. We jointly developed the conceptual design and the methodological approach, conducted the data analysis, wrote the original draft of the manuscript, created the visualizations, and administered the project. We were both also involved in reviewing and editing the manuscript. The remaining co-authors contributed to the conceptualization, the methodological approach, and the formal analysis, provided supervision throughout the research process, and were involved in reviewing and editing the manuscript.

Research Paper 2 entitled "Enabling Organizational Sustainability Data Management for Strategic Value Creation: A Maturity Model Approach" (Heess et al., 2026, Section B.2) was written by a team of four authors. I contributed to this paper as a substantially involved co-author. Together with the lead author, I jointly developed the core research idea and the overall research design, and we shared the workload of the literature review. I further supported the development of the paper throughout the research process and contributed to the writing and revision of the manuscript. The lead author initiated and coordinated the research project, conducted the majority of the expert interviews, and contributed a substantial share of the writing of the manuscript. The remaining two co-authors provided supervision and continuous scientific feedback.

Research Paper 3 entitled "Navigating Digital Transformation towards Sustainability: A Maturity Model for Industrial Decarbonization" (Meuser et al., 2024, Section B.3) was written by a team of four authors. Together with another co-author I contributed to this paper in a supervisory capacity. My involvement included supporting the establishment of the research idea, providing continuous feedback on the manuscript throughout the research process, and assisting in the writing of the paper. One of the co-authors was responsible for the primary execution of the research, including the conceptualization, data collection, and the drafting of the manuscript. The remaining co-author provided supervision throughout the research process, and was involved in reviewing and editing the manuscript.

Research Paper 4 entitled "From Cost to Carbon Efficiency through Digitalization: A Quantitative Case Study in Sustainable Tourism" (L. Valett et al., 2026, Section B.4) was written by a team of five authors. As the lead author, I was primarily responsible for this paper. I developed the conceptual design of the study together with my co-authors and was responsible for curating and preparing the data, developing the methodological approach, conducting the formal analysis, and implementing the required software. Furthermore, I administered the project, created the visualizations, and wrote the original draft of the manuscript. Another co-author contributed to the conceptualization, supported the visualization of the results, and was likewise involved in drafting the original manuscript. The remaining co-authors contributed to the conceptualization of the study and provided supervision throughout the research process as well as reviewed and edited the manuscript.

Research Paper 5 entitled "Empowering Sustainable Hotels: A Guest-Centric Optimization for Vehicle-To-Building Integration" (L. Valett et al., 2024, Section B.5) was written by a team of three authors. As the lead author, I was primarily responsible for this paper. I administered the project, developed the conceptual design of the study together with my co-authors, and was responsible for the design. Furthermore, I wrote the original draft of the manuscript and was substantially involved in its review and editing. Another co-author contributed to the conceptualization of the study and to the review and editing of the manuscript. The remaining co-author contributed to the conceptualization, provided supervision throughout the research process, and was likewise involved in reviewing and editing the manuscript.

Research Paper 6 entitled "Revealing Influences on Carsharing User's Trip Distance in Small Urban Areas" (Baumgarte et al., 2022, Section B.6) was written by a team of five authors. Together with one co-author, I served as one of the two lead authors of this paper. We jointly developed the conceptual design and the methodological approach, conducted the formal analysis and the investigation, wrote the original draft of the manuscript, created the visualizations, and administered the project; we were both also involved in reviewing and editing the manuscript and contributed in a supervisory capacity. The remaining co-authors contributed to the conceptualization, the methodological approach, and the formal analysis, provided supervision throughout the research process, and were involved in reviewing and editing the manuscript.

Research Paper 7 entitled "From Data to Sustainable Decisions: The Impact of Verifiable Carbon Information on Consumer Behaviour" (Geist et al., 2026, Section B.7) was written by a team of five authors. I contributed to this paper in a supervisory capacity. My involvement included supporting the establishment of the research idea, providing continuous feedback on the manuscript throughout the research process, and assisting in the writing of the paper. One of the co-authors was responsible for the primary execution of the research, including the conceptualization, survey development, and the drafting of the manuscript. The remaining co-authors provided supervision throughout the research process, and were involved in reviewing and editing the manuscript.

Research Paper 8 entitled "Mobilizing ESG-Data for Value Creation: A Single Case Study of a Data Platform from the European Financial Sector" (Auweiler et al., 2026, Section B.8) was writ-

ten by a team of five authors. I contributed to this paper in a supervisory capacity. My involvement included supporting the establishment of the research idea, providing continuous feedback on the manuscript throughout the research process, and assisting in the writing of the paper. One of the co-authors was responsible for the primary execution of the research, including the conceptualization, data collection, analysis, and the drafting of the manuscript. The remaining co-authors provided supervision throughout the research process, and were involved in reviewing and editing the manuscript.

Research Paper 9 entitled "Leveraging the Interplay of Digital and Sustainability Transformation: An Empirical Study of Twin Transformation in Corporate Practice" (Zilmans et al., 2026, Section B.9) was written by a team of three authors. I developed the core research idea and the overall research design, and I conducted all the expert interviews. One co-author contributed a substantial share of the writing of the manuscript, whom I supported in the writing and development of the paper throughout the process. The remaining co-author provided supervision and continuous scientific feedback.

B Research Papers

B.1 Research Paper 1: From Fragments to Conceptual Clarity: A Taxonomy for Effective ESG Data Management

Authors:
T. Zwede, L. Valett, M.-F. Körner, M. Schneider, and J. Strüker

Submitted to:
Outlet hidden due to the double-blind review process

Extended Abstract[1]:
Environmental, social, and governance (ESG) data have become increasingly important for organizations seeking to address sustainability requirements, support managerial decision-making, and respond to growing demands for transparency (Kotsantonis & Serafeim, 2019; Püchel et al., 2024). At the same time, their effective management remains challenging because ESG data encompass heterogeneous information that differs in origin, structure, scope, temporal characteristics, and intended use. Regulatory initiatives such as the Corporate Sustainability Reporting Directive (CSRD) and the European Banking Authority's ESG risk management guidelines further increase the variety and volume of data that organizations need to manage (European Banking Authority, 2025; European Parliament & European Council, 2022). Existing Information Systems (IS) research addresses individual aspects of ESG data management, yet provides limited conceptual guidance for systematically distinguishing and structuring ESG data across organizational contexts (Krasikov & Legner, 2023; Wang et al., 2024, 2025). This study addresses this gap by developing a taxonomy that provides a structured conceptual basis for understanding and managing ESG data.

Following the taxonomy development method of Kundisch et al. (2021), which extends the approach of Nickerson et al. (2013), the taxonomy was developed through an iterative combination of conceptual and empirical-to-conceptual design activities. A structured literature review of 73 relevant publications provided the initial conceptual foundation. This was complemented by 22 semi-structured interviews with practitioners from diverse industries, an expert workshop with six IS experts, and the analysis of 180 ESG data objects originating from academic, regulatory, and organizational contexts. Across four development iterations, the taxonomy was progressively refined against objective and subjective ending conditions. A subsequent evaluation with four additional practitioners, who independently classified ESG data objects from their professional contexts, confirmed the applicability, comprehensiveness, and practical relevance of the resulting taxonomy.

The final taxonomy comprises three meta-dimensions - *Context*, *Data Management*, and *Data Us-*

[1] At the time of writing, this research paper is under review for acceptance at an academic conference. Therefore, an extended abstract is provided here.

age - which encompass 17 dimensions and 63 characteristics. The *Context* meta-dimension captures characteristics such as data classification, source, type, temporality, scope, aggregation, and sector. *Data Management* describes how ESG information is structured, formatted, collected, processed, analysed, and verified. Finally, *Data Usage* captures the organizational purposes and stakeholder contexts in which ESG data are employed, including reporting and compliance, performance and optimization, strategy and development, and communication and engagement. Together, these dimensions provide a structured representation of ESG data that accounts for both their inherent heterogeneity and their organizational context.

The application of the taxonomy to 180 ESG data objects further indicates that the functional purpose of ESG data plays a particularly important role in determining how data are interpreted and managed. For example, operational data used for performance optimization tend to require frequent collection and automated processing, whereas data supporting regulatory reporting place greater emphasis on verification, standardization, and traceability. Data intended for external communication, such as product carbon footprints, additionally require comparability and credible translation of sustainability impacts into stakeholder-relevant information. These findings reinforce the notion that data acquire meaning and organizational value through their context and use (Seidel et al., 2013).

The study contributes to IS research in three ways. First, it consolidates fragmented knowledge on ESG data into a systematic conceptual structure, establishing a common vocabulary for future research. Second, it complements process-oriented perspectives on sustainability data management (Chua et al., 2022; Wang et al., 2024) by focusing on the characteristics of the data objects that organizations need to manage. Third, the taxonomy provides a diagnostic basis for data governance, classification, interoperability, and cross-organizational data exchange (Khatri & Brown, 2010; Möller et al., 2024). Overall, the study positions ESG data not merely as reporting inputs but as organizational resources whose characteristics and intended use jointly determine how they can be managed and leveraged for sustainability-related value creation.

Keywords:
ESG Data; Data Management; Taxonomy Development; Sustainability

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Krasikov, P., & Legner, C. (2023). Introducing a data perspective to sustainability: How companies develop data sourcing practices for sustainability initiatives. *Communications of the Association for Information Systems*, *53*, 162–188.

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Püchel, L., Wang, C., Buhmann, K., Brandt, T., von Schweinitz, F., Edinger-Schons, L. M., vom Brocke, J., Legner, C., Teracino, E., & Mardahl, T. D. (2024). On the pivotal role of data in sustainability transformations. *Business & Information Systems Engineering*, *66*(6), 831–848. https://doi.org/10.1007/s12599-024-00904-4

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Wang, J., Teracino, E., & Legner, C. (2024). Towards data management for navigating the dynamic landscape of sustainability regulations and standards. *Proceedings of the International Conference on Information Systems Bangkok, Thailand*.

Wang, J., Teracino, E. A., & Legner, C. (2025). From puzzle pieces to principles for sustainability reporting and disclosure: A design theory. *ICIS 2025 Proceedings*.

B.2 Research Paper 2: Enabling Organizational Sustainability Data Management for Strategic Value Creation: A Maturity Model Approach

Authors:

P. Heess, M.-F. Körner, J. Strüker, and L. Valett

Under Revision in:

Outlet hidden due to the double-blind review process

Extended Abstract[2]:

Amid ongoing policy debates on the prioritization of sustainability measures, increasing regulatory requirements compel organizations to systematically collect and report sustainability data (Körner et al., 2025). Beyond compliance, these data offer opportunities to enhance transparency, support managerial decision-making, and enable sustainability-oriented innovation (Krasikov & Legner, 2023). Yet many organizations struggle to translate sustainability data into strategic value due to inadequate data infrastructures, data quality deficiencies, and limited organizational capabilities. While information systems (IS) research has emphasized the role of IS in advancing environmental and social objectives (Gholami et al., 2016), it provides limited guidance on how organizations can systematically manage and orchestrate sustainability data for strategic value creation (Püchel et al., 2024).

Drawing on Resource Orchestration Theory (ROT) (Sirmon et al., 2007, 2011), this study conceptualizes sustainability data as a latent resource whose value depends on effective orchestration through technological, managerial, and cultural capabilities. The development of a Sustainability Data Management Maturity Model (SDM-MM) operationalizes this perspective by specifying the interdependent capabilities required to structure, bundle, and leverage sustainability data for organizational transformation. Following an established maturity model development approach (Becker et al., 2009) and grounded in design science research principles (Hevner et al., 2004), the model was developed and evaluated through a multi-method, iterative process. A systematic literature review conducted in line with Webster and Watson (2002) screened relevant papers on data-related maturity models, providing the conceptual foundation for an initial model structure. Building on this foundation, a focus group with experts from IT and sustainability consulting and academia, following the procedure of Wilkinson (1998), informed an Alpha version of the model, which was subsequently refined across two rounds of semi-structured expert interviews with experts from academic, consulting, and corporate sustainability contexts (Myers & Newman, 2007). Iterative qualitative coding supported the development of Beta and Gamma versions of the model. The resulting SDM-MM was implemented as an interactive online self-assessment tool and evaluated in three organizational use cases across commercial real estate, coffee wholesale, and housing management.

[2]At the time of writing, this research paper is under revision for publication in a scientific journal. Therefore, an extended abstract is provided here.

The SDM-MM comprises four interrelated dimensions - *Infrastructure, Data, Management,* and *People* - and specifies five maturity stages ranging from *Initial* to *Optimized*. These stages characterize the progression from fragmented and reactive data practices toward institutionalized and transformation-oriented sustainability data management. Based on identified maturity gaps, the study derives 20 action recommendations that provide organizations with concrete starting points for capability development. By linking ROT with sustainability data management, this study contributes a theoretically grounded and empirically evaluated maturity model that conceptualizes the organizational capabilities for strategically leveraging sustainability data. The SDM-MM and its action recommendations provide practical guidance for identifying maturity gaps and progressing from retrospective compliance reporting toward proactive sustainability action and data-driven transformation.

Keywords:
Maturity Model; Data Management; Resource Orchestration Theory; Sustainability; Capabilities

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B.3 Research Paper 3: Navigating Digital Transformation towards Sustainability: A Maturity Model for Industrial Decarbonization

Authors:
B. Meuser, L. Valett, F. Wagon, and M. Weibelzahl

Published as:
Meuser, B., Valett, L., Wagon, F., & Weibelzahl, M. (2024). Navigating Digital Transformation towards Sustainability: A Maturity Model for Industrial Decarbonization. *AMCIS 2024 Proceedings*

Abstract:
With the ever-growing need to increase environmental sustainability, industrial companies are at the forefront of a global transformation towards decarbonization. Therefore, it is imperative for manufacturers to adopt a systematic decarbonization approach. Leveraging Information Systems to drive a holistic industrial decarbonization and digitalization – which is increasingly referred to as 'twin transformation' – presents both a key challenge and a gateway to new opportunities for manufacturers. To effectively navigate the twin transformation, manufacturers need to assess and advance their maturity in applying Information Systems for decarbonization in their business practices. Against this background, this study follows the design science research paradigm and presents a maturity model that allows manufacturers to systematically leverage Information Systems' capabilities to actively increase sustainability efforts in terms of Scope 1 and Scope 2 carbon emission reductions.

Keywords:
Information Systems; Industrial Decarbonization; Maturity Model; Twin Transformation

B.4 Research Paper 4: From Cost to Carbon Efficiency through Digitalization: A Quantitative Case Study in Sustainable Tourism

Authors:
L. Valett, R. Keller, M.-F. Körner, C. Leinauer, and J. Strüker

Published as:
Valett, L., Keller, R., Körner, M.-F., Leinauer, C., & Strüker, J. (2026). From Cost to Carbon Efficiency through Digitalization: A Quantitative Case Study in Sustainable Tourism. *Sustainability Analytics and Modeling*

Abstract:
Decarbonizing the tourism sector requires a shift in energy policy that integrates digital technologies to enhance energy management. Hotel buildings, with their fluctuating and high energy demand, present a critical opportunity for targeted policy interventions. This study introduces a novel comparative optimization approach to explore the role of Energy Management Systems (EMSs) in supporting regulatory frameworks that enable a transition from cost-driven to carbon-adaptive energy management. We develop and analyze cost-minimizing and carbon-minimizing EMS approaches using real-world data from an eco-friendly hotel in Germany. Using a quantitative case study, we evaluate nine operational scenarios against three objectives and different temporal horizons to reflect the complexity of energy management in practice. Our findings highlight that prioritizing carbon reduction in EMS operations can lead to significant emission savings - 51.48 kg CO_2 per day or 1,471.24 kg CO_2 per week - at minimal additional cost (0.09 EUR/kg per day; 0.49 EUR/kg per week). However, regulatory gaps hinder effective implementation of such EMSs. We derive from our case study that policymakers should foster the development of dynamic electricity pricing and real-time carbon intensity tracking through digital grid infrastructure and smart metering. Strengthening energy policies to enhance real-time data exchange will empower hotels to align with climate goals and ensure energy sovereignty while advancing affordable and clean energy. Finally, our work underscores the necessity of integrating digital EMSs and corresponding policy initiatives to facilitate a shift from sole energy efficiency to carbon-based performance indicators in the building and tourism sector.

Keywords:
Energy Management Systems; Decarbonization; Sustainable Tourism; Hotel Buildings; Renewable Energy; Optimization

B.5 Research Paper 5: Empowering Sustainable Hotels: A Guest-Centric Optimization for Vehicle-To-Building Integration

Authors:
L. Valett, J. Bollenbach, and R. Keller

Published as:
Valett, L., Bollenbach, J., & Keller, R. (2024). Empowering Sustainable Hotels: A Guest-Centric Optimization for Vehicle-To-Building Integration. *Energy Informatics*, *7*(1), 91

Abstract:
In light of global warming, hotels account for one of the highest energy demands within the building sector, offering great decarbonization potential. As electrification increases, so does the demand for electric vehicles (EVs) charging stations at hotels and the proportion of Vehicle-to-Building-capable EVs. Therefore, the study explores the potential of guest-centric energy management. To accomplish this, we develop an optimization model for an energy management system that focuses on either cost-efficiency or carbon dioxide equivalents (CO_2)-efficiency, grounded in a real-world case study. Through scenario analyses considering seasons as well as different guest mobility behaviors, this study discusses the expenses associated with CO_2 savings using digital solutions. It emphasizes the currently perceived conflict between cost reduction and decarbonization goals to achieve a sustainable design of information systems. Thereby, this study highlights the critical importance of individual mobility behavior in enabling sustainable energy management for hotels.

Keywords:
Energy Management System; Hotel Energy Use; Guest Mobility Behavior; Mobility Patterns; Vehicle-to-Building; Sustainable Tourism; Sustainable Hospitality

B.6 Research Paper 6: Revealing Influences on Carsharing User's Trip Distance in Small Urban Areas

Authors:
F. Baumgarte, R. Keller, F. Röhrich, L. Valett, and D. Zinsbacher

Published as:
Baumgarte, F., Keller, R., Röhrich, F., Valett, L., & Zinsbacher, D. (2022). Revealing Influences on Carsharing User's Trip Distance in Small Urban Areas. *Transportation Research Part D: Transport and Environment*, *105*, 103252

Abstract:
Carsharing is an essential part of the transformation towards sustainable mobility in smaller urban areas. To expand their services and the positive social and environmental benefits, carsharing operators must understand their user's travel behavior. To accelerate this understanding, we analyze usage data of a station-based carsharing service from a small city in Germany with machine learning and explainable artificial intelligence to reveal influencing factors on the trip distance. The resulting four overarching groups are personal characteristics, time-related, car-related, and environmental features. We further analyze the driving distance of several subgroups split by personal and time-related features. Our findings highlight the importance of time-related features for the trip distance of carsharing users in all subgroups. We also discuss the influence of non-time-related features on the user groups. With these results, we derive valuable insights for research and carsharing operators by understanding patterns in individual user behavior in smaller urban areas.

Keywords:
Carsharing; User Behavior; Trip Distance; Machine Learning; Explainable Artificial Intelligence; Feature Importance

B.7 Research Paper 7: From Data to Sustainable Decisions: The Impact of Verifiable Carbon Information on Consumer Behaviour

Authors:
A. Geist, M.-F. Körner, J. Strüker, L. Valett, and T. Zwede

Published as:
Geist, A., Körner, M.-F., Strüker, J., Valett, L., & Zwede, T. (2026). From Data to Sustainable Decisions: The Impact of Verifiable Carbon Information on Consumer Behaviour. *ECIS 2026 Proceedings*

Abstract:
Climate crisis demands credible sustainability communication, yet consumers struggle to assess the reliability of products' environmental claims. This study examines how different verification mechanisms – manufacturer claims, third-party certification, and digital verification – shape consumer decision-making and perceived utility. Drawing on Random Utility Theory, a Best-Worst Scaling experiment with 122 participants compares preferences across two product types. Quantitative results show that digitally verifiable carbon information significantly boosts perceived utility and choice likelihood, with attribute weights favouring digital verification (β=2.02 | 0.81) over manufacturer claims (reference) and third-party certifications (β=-0.9 | -1.86). We also find that price sensitivity (β=-0.21 | -0.41) constrains this impact for low-involvement goods. The study contributes to Information Systems (IS) research on cognition and human behaviour by showing that digital verification acts as a credibility signal, shaping cognitive evaluation and decision-making. It links these insights to Green IS and digital trust, demonstrating how algorithmic verifiability may reduce information asymmetry and enhance credibility in sustainability communication.

Keywords:
Digital Verifiability; Carbon Information; Random Utility Theory; Consumer Behaviour

B.8 Research Paper 8: Mobilizing ESG-Data for Value Creation: A Single Case Study of a Data Platform from the European Financial Sector

Authors:
S. Auweiler, P. Heess, L. Valett, M.-F. Körner, and J. Strüker

Submitted to:
Outlet hidden due to the double-blind review process

Extended Abstract[3]:
As central actors in capital allocation and risk management, European financial institutions have increasingly collected environmental, social, and governance (ESG) data in response to regulatory requirements (Ballnat et al., 2026; Bundesanstalt für Finanzdienstleistungsaufsicht, 2024; European Commission, 2022). While these compliance-driven infrastructures create extensive data resources, their potential for strategic value creation beyond reporting remains underexplored (Ixmeier et al., 2024; Püchel et al., 2024). This raises the question of how ESG-data can be mobilized to support strategic decision-making and sustainability transformation. Drawing on a resourcing perspective (Feldman, 2004; Howard-Grenville, 2007) extended to network-level contexts (Auschra & Sydow, 2023), we examine how ESG-data can be transformed from compliance-oriented assets into resources for transformative sustainable organizing.

We investigate this question through a single case study (Benbasat et al., 1987; X. Wang et al., 2024) of *ESG Data&Analytics*, a shared digital platform within the Genossenschaftliche FinanzGruppe, a cooperative network comprising 672 financial institutions. Following established multi-source case study procedures (Eisenhardt, 1989; J. Wang et al., 2024), we draw on 11 semi-structured interviews with stakeholders from project partners, technology providers, and member banks, complemented by focus groups, practice-talk sessions, and extensive project documentation collected over a 12-month engagement. Data were analyzed using the three-step Gioia methodology (Gioia et al., 2013), iteratively developing first-order concepts, second-order themes, and aggregate dimensions, with saturation assessed in line with established qualitative research standards (Charmaz, 2014).

Our findings show that coordinated, network-level data practices - conceptualized as controlling, producing, reproducing, and transforming (Auschra & Sydow, 2023) - enable organizations to transform ESG-data from dispersed assets into value-creating resources. Standardized KPIs, peer benchmarking, and scenario-based simulations, for example, enable institutions to reassess climate-related financial risks and develop decarbonization roadmaps. By repurposing ESG-data infrastructures initially established for compliance, network actors enact new forms of sustainability management that extend beyond reporting-oriented approaches (Krasikov & Legner, 2023) and enable more anticipatory, future-oriented forms of decision-making and sus-

[3]At the time of writing, this research paper is under review for publication in a scientific journal. Therefore, an extended abstract is provided here.

tainable organizing (Gümüsay & Reinecke, 2024).

Theoretically, our study extends the resourcing perspective by conceptualizing shared digital ESG platforms as strategic infrastructures through which sustainability-related resources are coordinated, interpreted, and mobilized across organizational boundaries. We further identify individual digitalization- and sustainability-driven schemas - such as data literacy, trust in technology, and sustainability value - as conditions shaping how actors engage with the platform and whether ESG-data is mobilized for strategic value creation and transformative change. In doing so, the study complements the network-level perspective on resourcing (Auschra & Sydow, 2023) by highlighting the role of individual-level interpretations in enabling or constraining network-level resource mobilization. Overall, the study demonstrates how financial institutions can repurpose compliance-driven ESG-data infrastructures to inform strategic decision-making and contribute to more desirable and sustainable futures.

Keywords:
ESG-data; Sustainability Transformation; Digital Infrastructures; Resourcing Perspective; Strategic Value Creation; Cooperative Networks

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B.9 Research Paper 9: Leveraging the Interplay of Digital and Sustainability Transformation: An Empirical Study of Twin Transformation in Corporate Practice

Authors:
C. Zilmans, L. Valett, and J. Strüker

Submitted to:
Outlet hidden due to the double-blind review process

Extended Abstract[4]:
Digital transformation (DT) and sustainability transformation (ST) increasingly constitute simultaneous strategic priorities for organizations, requiring substantial investments in technologies, capabilities, and organizational change (Apata, 2024; Gökalp & Martinez, 2021; Latino, 2025). Their joint pursuit, commonly described as twin transformation (TT), suggests that digitalization and sustainability can reinforce each other: digital technologies can provide means for advancing sustainability, while sustainability considerations can influence the direction of digital investments and organizational change (Christmann et al., 2024; Graf-Drasch et al., 2023). Despite this potential, the empirical foundation of TT research remains limited. Existing studies predominantly conceptualize the relationship or emphasize the contribution of DT to sustainability, whereas the reciprocal influence of both transformations and the organizational capabilities underlying it remain insufficiently understood (Auweiler et al., 2025; Hammerschmidt et al., 2026; Shajari & David, 2025).

This study investigates the interplay between DT and ST through a sequential explanatory mixed-methods design (Creswell & Plano Clark, 2007). The quantitative component draws on a survey of 27 organizations engaged in both transformations. DT and ST are operationalized through maturity measures capturing the degree to which transformation-related practices have become established within organizations. Linear regression analyses are used to examine their relationship and the role of two capability pathways: enabling capabilities, which allow organizations to employ digital technologies in support of sustainability objectives, and guiding capabilities, which direct digital transformation activities toward sustainability-related goals. To explain the quantitative findings and provide insight into their organizational foundations, the study additionally draws on 17 semi-structured expert interviews with practitioners experienced in managing digital and sustainability transformation.

The quantitative results indicate a positive association between DT and ST, with evidence supporting a reciprocal relationship between the two transformations. The findings further provide empirical support for both capability pathways. The qualitative analysis reveals, however, that enabling and guiding capabilities do not develop according to the same organizational logic. Enabling capabilities tend to arise alongside the operational advancement of digitalization, as or-

[4]At the time of writing, this research paper is under review for publication in a scientific journal. Therefore, an extended abstract is provided here.

ganizations accumulate digital infrastructure, technological expertise, and data-related resources that can subsequently be leveraged for sustainability purposes. Guiding capabilities, in contrast, require more intentional organizational development. They depend particularly on governance arrangements, cross-functional coordination, and mechanisms that incorporate sustainability considerations into digital decision-making. Compared with enabling capabilities, these capabilities appear more exposed to competing organizational priorities and resource constraints.

The study contributes to the emerging TT literature in three ways. First, it provides firm-level empirical evidence that DT and ST are positively and reciprocally associated, thereby extending a literature that has largely examined their relationship conceptually or from a predominantly one-directional perspective (Del Socorro Encinas-Grijalva et al., 2024; Sepasgozar, 2021). Second, it distinguishes enabling and guiding capabilities as structurally different mechanisms through which the two transformations can become mutually reinforcing, extending prior conceptual work on the role of organizational capabilities in TT (Breiter et al., 2024). Third, by combining quantitative evidence with qualitative explanations, the study advances understanding of not only whether the two transformations are connected, but also how organizations develop the capabilities required to integrate them. For practice, the findings suggest that organizations should complement digital investments with deliberate governance and coordination mechanisms that allow sustainability objectives to shape digital transformation while ensuring that digital capabilities can be leveraged for sustainability-related change.

Keywords:
Twin Transformation; Digital Transformation; Sustainability Transformation; Capabilities; Survey; Expert Interviews; Mixed-Methods

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