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The digital-environmental tension: Managerial attention to digital transformation and energy consumption in healthcare organizations

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ABSTRACT

Digital transformation is broadly recognized as a promising approach to solving complex and longstanding organizational challenges. However, its environmental implications, particularly within the public sector, remain underexplored. Drawing on the attention-based view, this study addresses this gap by investigating how managerial attention to digital transformation impacts organizational environmental performance. We utilize a fixed-effects model approach to conduct the analysis based on a sample of 118 NHS Foundation Trusts in England between 2016 and 2021. The results show that managerial attention to digital transformation is positively related to energy consumption intensity. Building on core assumptions from the behavioral theory of the firm, we further investigate the moderating role of R&D income intensity discrepancy on the link between digital transformation attention and energy consumption intensity. Our findings indicate that positive R&D income intensity discrepancy weakens the positive relationship between digital transformation attention and energy consumption, whereas negative discrepancy does not have any impact. This study contributes to the extant literature by advancing the understanding of the intersection between digital transformation and sustainability, while extending the theoretical applications of the attention-based view and behavioral theory of the firm within the public sector. The findings also offer insights for policymakers and practitioners seeking to mitigate unintended environmental consequences and promote more sustainable initiatives to digital transformation.

1. Introduction

Digital technologies have long been regarded as instrumental in enhancing organizational efficiency and delivering performance gains in the public sector (Rodgers et al., 2019). In the English healthcare context, for instance, digital healthcare initiatives launched in recent years have aimed to address rising costs and increasing demand for healthcare, as well as to improve service delivery and increase operational efficiency (Herrmann et al., 2018; Rodgers et al., 2019). Nevertheless, a critical dimension of digital transformation that has received considerably less scholarly attention is its impact on organizational environmental performance (OEP) in the public sector (Plekhanov et al., 2023; Wu and Xie, 2024; Könnölä and Unruh, 2007; Thanh, 2022). Illustrating this trend, the English healthcare system is, for example, actively pursuing the adoption of one of the most prominent emerging technologies - artificial intelligence (AI) - to improve patient care and support through service chatbots and other digital tools designed for disease screening and treatment (Shelmerdine et al., 2024; Bloomfield et al., 2021). Nevertheless, as highlighted by recent studies in the private sector, the rapidly escalating energy demands and electronic waste generated by the intensive computational requirements of AI models and servers can lead to significant environmental consequences (Alzoubi and Mishra, 2024; Wang et al., 2024).

The literature focusing on the intersection of digital transformation and OEP remains limited and offers inconclusive findings (Maroufkhani et al., 2022; Plekhanov et al., 2023). Some believe that digital transformation is essential for advancing sustainable operations and practices. This could be achieved through the creation of low-emission innovations and improvements in operational efficiency (Cao et al., 2024; Yang et al., 2023; Zheng et al., 2024). Others consider digital transformation to be a direct driver of increased energy consumption (Buldeo Rai et al., 2019; Wang et al., 2022). Scholars have found, for example, that digital transformation initiatives often necessitate associated digital infrastructures, such as data centers and communication networks, which typically consume a substantial amount of additional electricity and generate related waste (Axenbeck et al., 2024). Prior

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research in this field has predominantly concentrated on the private sector, yielding mixed findings that highlight both positive and negative impacts of digital transformation (Maroufkhani et al., 2022; Plekhanov et al., 2023). The knowledge gap is even more pronounced in the public sector, where empirical studies investigating the relationship between digital transformation and OEP are notably lacking.

However, directly extrapolating insights derived from profit-oriented firms to the public sector may result in misleading conclusions (Cardinaels and Soderstrom, 2013). Existing research suggests that public sector organizations operate in distinct institutional and organizational environments (Nicolini and Korica, 2021; Salge, 2012). Consequently, the drivers and outcomes of digital transformation for environmental performance in the public sector are likely to differ substantially from those observed in the private sector. For instance, rather than being profit-driven, public sector entities are shaped by unique stakeholder demands and are primarily focused on meeting social needs and delivering public value (Pratici et al., 2025; Erin et al., 2024). In contrast to their private sector counterparts, where environmental outcomes are often tied to market incentives and profitability, public sector organizations typically prioritize activities aligned with social objectives and frequently operate under centralized policy mandates, resource scarcity, and conditions of emergency response (Benzidia et al., 2024; Pratici et al., 2025). An illustrative example is the introduction of centralized policy initiatives, such as mandates to replace obsolete IT systems, designed to spearhead advancements in healthcare service delivery (Clarke et al., 2015; Burns, 2024; Irani et al., 2023). Unlike the private sector, where IT upgrades are normally incremental, policy-driven IT replacements usually lead to large-scale hardware retirements, creating concentrated spikes of e-waste (Liebman and Mahoney, 2017; Bob et al., 2017; Robertson et al., 2011). As such, there is a public sector-specific need to better understand the link between digital transformation and environmental outcomes.

Accordingly, this study aims to advance knowledge by exploring the potential impacts of digital transformation on OEP within English National Health Service (NHS) Foundation Trusts (FTs). The NHS is a publicly funded healthcare system, responsible for delivering both specialist and generalist medical care, as well as mental health, community, and ambulance services (Wright and Turner, 2021). As one of the largest healthcare systems in the world and the biggest employer in Europe, the NHS delivers approximately 17 million inpatient admissions and 270 million appointments annually, and the numbers are increasing (Tennison et al., 2021). Owing to its scale and influence, the NHS has been identified as a major contributor to England's carbon emissions and is increasingly recognized as a key actor in achieving both national and global emission reduction targets (Brown et al., 2012; Tennison et al., 2021).

As a central component of the English NHS, FTs play a critical role in the system and, through their operational practices, share responsibility for both contributing to and reducing its environmental impact (McAllister et al., 2024; Kirkpatrick et al., 2017). FTs are semi-autonomous entities established in the early 2000s as part of corporatization reforms (Kirkpatrick et al., 2017). They combine public service obligations with private-sector-like features, operating under partial state control but with independent revenues, managerial autonomy, and the ability to retain surpluses (Kirkpatrick et al., 2017; Andrews et al., 2020). This autonomy provides FTs with greater flexibility to adopt digital innovations that can enhance both operational efficiency and environmental performance (Wright and Turner, 2021; McAllister et al., 2024). Indeed, many FTs have already implemented advanced information technology solutions to address operational challenges (Phiri et al., 2023). Given their central role in shaping environmental impacts, as well as their established efforts in digital innovation, NHS FTs provide an ideal setting to examine how digital transformation may influence environmental performance in public sector organizations.

We are specifically interested in addressing two questions. First, drawing from the Attention-Based View (ABV), we posit that decision-makers repeatedly face a large volume of issues, yet their attention is selectively allocated due to cognitive limitations, time constraints, and subjective judgments of the salience of the issues faced (Cai and Canales, 2024; Ocasio, 1997). Furthermore, ABV suggests that managerial decisions are shaped by the specific issues and solutions their attention is focused on (Brielmaier and Friesl, 2023). Applying these theoretical assumptions to our research context, we are particularly concerned with examining how a decision-maker's digital transformation attention (DTA) impacts OEP in the public sector, specifically within the NHS FT setting. As such, the first requestion (RQ) in our study is formulated as follows:

RQ1. - Does digital transformation attention of NHS Foundation Trusts impact their organizational environmental performance?

Additionally, based on the Behavioral Theory of the Firm (BTOF), this study further investigates the moderating role of R&D income intensity discrepancy (RDIID) on the relationship between DTA and OEP. R&D income intensity discrepancy here serves as a performance-feedback proxy for innovation outcomes relative to organizational aspirations. Although ABV is rooted in BTOF's behavioral assumptions, contemporary applications of ABV often understate BTOF's core insight regarding performance feedback as a driver of adaptive shifts in managerial attention and organizational priorities (Gavetti et al., 2007; Gavetti et al., 2012; Washburn and Bromiley, 2012). According to BTOF, when performance deviates from aspiration levels, it triggers re-evaluation and reallocation of managerial attention and resources (Cyert and March, 1963; Salge, 2011; Greve, 2003b). In this study, we distinguish two types of R&D income intensity discrepancy as internal performance feedback signals, namely positive and negative discrepancies, reflecting respectively higher/lower income generated from innovation. Accordingly, we formulate our second research question as follows:

RQ2. - How does R&D income intensity discrepancy moderate the relationship between digital transformation attention and organizational environmental performance in NHS Foundation Trusts?

Utilizing multiple data sources over the 6-year period from 2016 to 2021, we obtained a sample of 118 FTs with available information on their DTA, for a total of 638 observations. A year-region fixed effects model was then used to perform the analysis. Contrary to the conventional understanding in the private sector (Bokrantz et al., 2017; Bürger et al., 2019; Plekhanov et al., 2023; Bai et al., 2023), we observed that DTA is positively related to energy consumption intensity. Further analysis indicated that R&D income intensity discrepancy plays a significant role in moderating the relationship between DTA and energy consumption. Specifically, a positive R&D income intensity discrepancy weakens the positive relationship between DTA and energy consumption intensity. In contrast, a negative R&D income intensity discrepancy does not have any statistically significant impact on the relationship between DTA and energy consumption intensity.

Thus, this study makes three distinct yet interconnected contributions. *First*, extant research on digital transformation's environmental implications remains theoretically fragmented and empirically contradictory, with findings predominantly derived from private sector settings (Zhang et al., 2025; Fang and Liu, 2024; Li et al., 2022; Cao et al., 2024). Our empirical investigation of NHS FTs shows that managerial attention to digitalization significantly increases energy consumption intensity, thereby answering scholarly calls for sector-specific sustainability investigations and extending the theoretical understanding of digitalization's environmental consequences in public sector settings (Guandalini, 2022; Ologeanu-Taddei et al., 2025; Kotlarsky et al., 2023). *Second*, ABV has been predominantly operationalized in relation to private sector organizational behavior, with its explanatory power in the public sector context remaining substantially undertheorized (Alshahrani et al., 2022; Kumar and Thakur, 2024; Born et al., 2024). By establishing that managerial attention to digitalization directly influences environmental performance measures in public healthcare organizations, our study validates ABV's theoretical boundaries beyond conventional applications and demonstrates its applicability to sustainability outcomes and public sector strategic decision-making processes (Brielmaier and Friesl, 2023; Born et al., 2024; Tang et al., 2018). *Third*, a critical theoretical disconnection persists between ABV and its foundational roots in BTOF, particularly regarding how performance feedback processes reconfigure attention mechanisms (Gavetti et al., 2007; Gavetti et al., 2012; Ocasio, 2011; Li et al., 2022). Our findings on the moderating effects of R&D income intensity discrepancies empirically illustrate how positive discrepancy in performance-aspiration gaps reshape managerial attention allocation toward efficiency optimization (Cyert and March, 1963; Greve, 2003b; Greve, 2003a; Salge, 2011).

2. Theoretical background

2.1. Digital transformation and environmental performance in the public sector

In an increasingly digitalized world, the growing significance and relevance of digital transformation have become evident to both scholars and practitioners (Brown and Hartley, 2021; Sharma et al., 2022; Reis et al., 2018; Kraus et al., 2021). Historically, digital transformation has been used as an umbrella term encompassing a wide range of technologies, including innovations such as blockchain, artificial intelligence, virtual reality, and others (Gong and Ribiere, 2021). However, as the literature highlights, digital transformation extends beyond the mere deployment of digital technologies, such as launching or implementing mobile apps or websites, but it also encompasses the strategic use of resources and capabilities aimed at enhancing its value proposition (Gong and Ribiere, 2021). Accordingly, consistent with the current literature, this study defines digital transformation as a process aimed at improving an organization by strategically deploying technological innovations that trigger significant changes in operations and value creation (Vial, 2021).

OEP, on the other hand, broadly reflects the extent to which an organization fulfills its environmental obligations to protect and preserve the earth (Kleindorfer et al., 2005; Layaoen et al., 2023). Specifically, it gauges how effectively the organization addresses and exceeds public expectations for protecting the environment (Judge and Douglas, 1998; Paillé et al., 2023). In the context of NHS FTs, direct measures of environmental performance, such as an environmental score, are not publicly available, and other commonly used indicators vary considerably in both availability and standardization (Tennison et al., 2021). However, energy consumption significantly influences greenhouse gas emissions, serving as a practical proxy for environmental performance, a relationship as evidenced by the notable impact of the UK's decarbonization strategies on reducing NHS emissions (MacNeill et al., 2021). Indeed, as part of broader sustainability and environmental performance objectives, considerable attention has been given to reducing energy consumption in the whole of the NHS in recent years, including optimizing building performance, transitioning to low-carbon energy sources, and electrifying transport (Andersen et al., 2023). Therefore, this study operationalizes OEP through energy consumption metrics to enable robust and comparable assessments across NHS FTs.

The intersection of digital transformation and OEP has emerged as an increasingly important yet underexplored area (Plekhanov et al., 2023; Sangadji and Islami, 2024). This is typically the case within health systems and hospital settings. However, direct investigations into the relationship between digital transformation and OEP in healthcare remain scarce as the existing literature in the field has predominantly focused on the private sector (Plekhanov et al., 2023). On one side, digital transformation is associated with improvements in resource efficiency and the optimization of energy consumption and distribution (Bokrantz et al., 2017; Bürger et al., 2019; Plekhanov et al., 2023; Bai et al., 2023). It is argued that digital transformation enables organizations to reduce carbon emissions through the integration of intelligent equipment, automation, and data-driven operational practices, which contribute to improved efficiency and minimized material waste (Cao et al., 2024). Meanwhile, digital transformation as an enabler of low-carbon and green technologies, fostering operational efficiency and contributing to reductions in carbon emissions (Yang et al., 2023; Zheng et al., 2024). Conversely, other scholars argue that digital transformation often results in unintended environmental consequences (Li, 2024; Wang et al., 2022). For example, a frequently debated concern involves the proliferation of online platforms and e-services (Al Mashalah et al., 2022). The growing use of e-services is complicated by evolving customer behaviors, particularly in logistics, where an increasing dependence on delivery services contributes to higher overall carbon emissions (Van Loon et al., 2015; Buldeo Rai et al., 2019). Axenbeck et al. (2024) also highlighted that digitalization often leads to increased energy use, driven by rising electricity demand. The expansion of digital infrastructure, including communication networks, data centers, and the proliferation of smart devices, substantially elevates electricity consumption in support of these energy-intensive systems.

Academic debates in the field highlight the inconsistency in the findings regarding digital transformation and OEP, with both positive and negative effects being observed. Indeed, scholars caution that the relationship between digital transformation and OEP has become complex and highly context-dependent (Li, 2024, Wang et al., 2022). The underlying mechanisms also remain theoretically fragmented and empirically underexplored. Meanwhile, as mentioned earlier, prior studies have predominantly focused on private-sector organizations. Surprisingly, limited attention has been directed toward understanding how digital transformation can contribute to sustainability outcomes within healthcare systems and hospital settings. Given the NHS's substantial contribution to England's overall carbon emissions, the lack of knowledge and understanding in this area is particularly concerning, especially in light of its societal significance as a public institution (Brown et al., 2012; Tennison et al., 2021). Hence, this study leverages insights from ABV to examine the potential relationship between digital transformation and OEP within the public healthcare context.

2.2. Digital transformation and the attention-based view

Introduced by Ocasio (1997), ABV conceptualizes attention as the process of noticing, encoding, interpreting, and focusing time and effort on emerging issues of organizations as well as the relevant responses to these issues. The attention-based perspective recognizes constrained attentional focus as a precursor to flawed decision-making and, hence, highlights how the concept of attention structures the allocation of focus across issues, ultimately shaping organizational decisions (Ocasio, 1997; Brielmaier and Friesl, 2023). A crucial metatheoretical principle that influences attention allocation within an organization underscores the significance of the “focus of attention” (Li et al., 2022; Brielmaier and Friesl, 2023). This principle posits that individuals selectively direct their attention toward specific situations and responses, thereby shaping their actions (Brielmaier and Friesl, 2023). Consequently, organizational behavior can be understood as an aggregation of individual attentional choices, meaning that what organizations do is contingent upon what their decision-makers pay attention to.

In relation to digital transformation, ABV has long been utilized as the foundation for understanding the effect of digital transformation on organizational performance. There is increasing scholarly interest in emphasizing attention to emerging technological innovations as a mechanism for directing managerial focus toward digital transformation (Noura et al., 2023; Li et al., 2022). Indeed, recent literature in the field has demonstrated the effectiveness of using DTA to capture changes in performance across diverse contexts, and it has been widely used as a direct indicator of digital transformation (Zhang et al., 2025; Fang and Liu, 2024; Cao et al., 2024). Empirical evidence has supported the relevance of DTA in shaping firm performance, with ABV as its primary theoretical background. For example, Li et al. (2022) highlight DTA as a driver of international sales growth. Furthermore, Kim et al. (2016) show that alternating attention between open and closed innovation balances absorptive capacity and enhances innovation of firms. Rhee and Leonardi (2018) report that attention within social networks shapes innovation outcomes of firms, while Zhang et al. (2025) find that digital transformation increases attention to stakeholders, reducing corporate social responsibility inconsistencies. Moreover, Yadav et al. (2007) find that the chief executive's attention to future and external events improves long-term innovation, and Chen et al. (2015) similarly link top management attention on innovations to greater innovation activities of manufacturing firms. Nevertheless, across all these studies, one interesting fact is that the relevant research in combining managerial attention to digital transformation predominantly focuses on the private sector, where profit-related outcomes are the primary concern (Cao et al., 2024; Li et al., 2022). Hence, the mechanisms through which managerial attention operates within the public sector remain insufficiently explored, particularly in relation to how they diverge from those in private firms due to variations in institutional goals, organizational structures, and resource constraints.

As Ocasio (1997) highlighted, "what issues and answers decision-makers focus on, and what they do, depends on the particular context or situation they find themselves in". How the managers and decision-makers allocate and distribute their attentions also largely depends on the particular context they operate (Ocasio, 1997). These factors can decisively redirect managerial attention, sometimes even at the expense of primary organizational objectives (Brielmaier and Friesl, 2023). This dynamic is especially relevant in public sector organizations, where attention is not solely determined by internal strategic priorities but is strongly influenced by external pressures such as policy mandates, ethical obligations, regulatory frameworks, cultural expectations, and the imperative of maintaining legitimacy and public trust (Alshahrani et al., 2022). Public organizations operate under unique structural configurations, professional logics, and accountability frameworks that impose unique patterns and constraints on the allocation and distribution through which managerial attention is allocated and distributed (Nicolini and Korica, 2021). Although healthcare organizations like NHS FTs are highlighted to enjoy great autonomy with a notable degree of managerial and financial independence, scholars have noted that the healthcare organizations are still highly fragmented, with multiple important external actors that significantly shape their managerial attentions, and hence, are subject to the critical juncture of the external context (Nicolini and Korica, 2021; Salge, 2012; Van den Broek et al., 2014).

In contrast to private firms, which are characterized by an emphasis on profit maximization and market competition (Denicolò and Panunzi, 2025; Gartenberg and Serafeim, 2023), managerial attention in public organizations is shaped and constrained by the need to demonstrate accountability to government and the public, a requirement that extends well beyond the efficient delivery of services (Modell, 2012; Almquist et al., 2013). In particular, public sector managers operate within dense oversight networks, where their decisions and strategic actions are systematically documented, subjected to scrutiny, and assessed by a wide range of stakeholders. As a result, they must balance their attentions not only toward operational efficiency, but also to ensure that their strategies generate positive outcomes for communities and society at large (Schillemans, 2016). Similarly, understanding the influence of regulatory compliance and budget constraints is essential, as these factors also shape managerial priorities (Schillemans, 2016). In the public sector, organization priorities often place greater emphasis on regulatory compliance than on other objectives, even when this comes at the expense of social goals or community needs (Schillemans, 2016; Bovens et al., 2014). Collectively, these contextual differences suggest that managerial attention in the public sector tends to be fragmented, politically sensitive, and procedurally constrained compared to profit-oriented firms. Nevertheless, scholarly understanding of managerial attention through the lens of ABV remains limited. Extending ABV to the public sector is therefore theoretically significant, as it broadens a framework originally rooted in the private sector context and enhances its explanatory power in settings where attention is shaped by distinct institutional conditions and external demands.

Accordingly, this study seeks to explore the intersection between digital transformation and ABV within the public sector, with a particular focus on NHS FTs. We concentrate on attention intensity, defined as the overall amount of managerial attention devoted to digital transformation efforts (Yang et al., 2023; Li et al., 2022; Rizov et al., 2022; Tian et al., 2023). Building upon the notion of "focus of attention," scholars have emphasized the significance of attention intensity as a critical dimension for defining and quantifying the attention focus of managers (Brielmaier and Friesl, 2023). It refers to the depth and sustained cognitive effort directed toward a particular issue and has been shown to play a pivotal role in shaping organizational outcomes, particularly in complex and innovation-intensive contexts (Chen et al., 2015; Brielmaier and Friesl, 2023). Thus, attention intensity provides a relevant theoretical basis for examining how managerial attention influences strategic choices and outcomes (Brielmaier and Friesl, 2023; Chen et al., 2015). Accordingly, we apply ABV perspective, incorporating attention intensity as a key construct to explore how digital transformation influences sustainability performance within NHS FTs.

While ABV is grounded in the behavioral foundations of BTOF, much of the existing research has focused primarily on the interpretation and application of ABV-specific concepts, with limited attention to its theoretical roots in BTOF (Gavetti et al., 2007; Gavetti et al., 2012; Ocasio, 2011; Li et al., 2022). In particular, the intersection between attention and one of BTOF's core mechanisms—the idea that attention is dynamically reshaped through performance feedback—has been largely overlooked (Gavetti et al., 2007; Gavetti et al., 2012; Washburn and Bromiley, 2012). BTOF suggests that performance feedback is not merely an evaluative mechanism but directs managerial attention, shapes interpretative frames, and reconfigures organizational priorities. It posits that attention priorities are not static, shifting when organizational performance exceeds or falls below aspiration levels, potentially influencing patterns of resource allocation (Cyert and March, 1963; Salge, 2011; Greve, 2003b). In the healthcare sector, the relevance of BTOF is underscored by Cyert and March (1963) seminal book, which reviewed Eckstein's (1958) early studies of the English NHS and noted that its decision-making patterns resemble those of business firms, highlighting the applicability of behavioral theory in public sector contexts (Salge, 2011). Building on this, our study integrates ABV and BTOF perspectives to examine the moderating role of R&D income intensity discrepancy on the performance link between DTA and energy consumption intensity within NHS FTs.

R&D income reflects the scope and outcomes of innovation-oriented activities within NHS FTs, capturing income generated from R&D-related activities and funding secured from both government grants and private sector sources. The English NHS has long maintained a strong commitment to R&D, recognizing its central role in enhancing the quality of healthcare through evidence-based practice, the development of clinical guidelines, and active engagement in research (Milne et al., 2008). In general, NHS R&D activities span from pharmaceutical developments, medical devices, health technologies, and clinical and health services research, all aimed at improving population health (Gee and Cooke, 2018; Walshe and Davies, 2013). National policies further position R&D as a driver of economic growth, promoting industry partnerships and the adoption of cost-effective innovations (Gee and Cooke, 2018; Moore et al., 2012; Department of Health, 2011). Reflecting these trends in healthcare, recent years have brought a stronger emphasis on integrating new technologies, such as informatics solutions, AI-driven tools, and novel clinical techniques, into both research and service delivery (Department of Health, 2011; Walshe and Davies, 2013). This is reflected in initiatives that leverage advanced technology to enhance healthcare operations and service delivery, such as AI-powered chatbots, the platformization of services, data-sharing collaborations with private sector partners, and technically advanced clinical trials (Kerasidou and Kerasidou, 2023; Faulkner-Gurstein and Wyatt, 2023; Nadarzynski et al., 2019). Accordingly, R&D income represents not only a tangible outcome of these innovation-oriented activities but also as a performance feedback signal in the BTOF sense, shaping managerial attention and influencing how NHS FTs pursue digital transformation.

3. Hypotheses development

When managerial attention is directed toward digital transformation, the allocation of attention can be conceptualized through two mechanisms: exploratory attention and exploitative attention (Im and Rai, 2008; Krishnakumar et al., 2022; March, 1991). Exploratory attention reflects an orientation toward identifying novel alternatives and developing new knowledge beyond the firm's existing capabilities (March, 1991; Laureiro et al., 2014). In the context of digital transformation, exploratory attention is typically linked to the attempts to pursue technological alternatives and explore innovative processes (Cai and Canales, 2024; Walrave et al., 2017; Krishnakumar et al., 2022; Osiyevskyy et al., 2020). Such an attentional focus is believed to prioritize long-term technological improvement, efficiency enhancement, and relevant digital practices (Krishnakumar et al., 2022; Xiong et al., 2024; Sarfo et al., 2025; Lee, 2025). Consistent with research demonstrating a positive relationship between long-term managerial orientation and sustainability-related outcomes, exploratory attention is often highlighted to be associated with environmentally friendly innovation and practices (Saether et al., 2021; Wang and Bansal, 2012; Sarfo et al., 2025).

In contrast, exploitative attention reflects a short-term orientation toward digital performance, focused on optimizing current tasks through the refinement and extension of existing technologies and competencies (March, 1991; Laureiro et al., 2014; Osiyevskyy et al., 2020). In the digital transformation context, exploitative attention is typically directed toward enhancing existing technologies and innovations, emphasizing immediate performance gains and outcomes (Krishnakumar et al., 2022, Osiyevskyy et al., 2020). Nevertheless, organizations with relevant attentional focus often face increased energy consumption and resource demands (Axenbeck et al., 2024). Extant research has shown that physical capital, such as computers, servers, and cooling systems, acts as a necessary complement in supporting and enhancing digital transformation and innovation (Pothitou et al., 2017; Lange et al., 2020; Shi et al., 2022; Herring and Roy, 2007; Ren et al., 2021). These infrastructure support systems require considerable electricity to operate and be maintained (Axenbeck et al., 2024), thereby making increased energy consumption a likely and persistent consequence of digital transformation efforts (Lange et al., 2020).

Scholars have highlighted that organizations should hold an attentional position with a balanced proportion of exploration and exploitation (He and Wong, 2004; Gupta et al., 2006; Sabidussi et al., 2023). However, this might not be the same in the actual public sector context, since the optimal mix between the two mechanisms is difficult to achieve and hard to find (Lavie et al., 2011; Sabidussi et al., 2023). As noted previously, attention is a limited resource that needs to be selectively allocated to navigate overwhelming volumes of information (Ocasio, 1997; Brielmaier and Friesl, 2023). Accordingly, managerial attention is a so-called zero-sum game, in which increased allocation of attention to one domain reduces the attention available for another (Walrave et al., 2017; Shepherd et al., 2017). In the context of the NHS, scholars have noted that the development of digital transformations is typically short-term oriented (Mergel et al., 2019; Krasuska et al., 2021; McCarthy et al., 2019). Given the unique characteristics of public sector organizations, particularly their exposure to regulatory pressures and accountability demands (Schillemans, 2016; Bovens et al., 2014; Salge, 2012), they are highlighted to be structurally pressured toward short-term digital performance, with output-oriented and measurable outcomes, sometimes at the expense of long-term (Höglund et al., 2018; Osborne et al., 2015). Combined with the relatively early stage of digital transformation maturity within NHS FTs (Pope et al., 2024; Phiri et al., 2023), this tendency suggests that the exploitative attention mechanism is likely to dominate exploratory ones, contributing to increased overall energy consumption. Indeed, scholars in the relevant context have warned that the digital transformation is unintentionally generating substantial energy demands (Soluk and Kammerlander, 2021; Boppana, 2024). As public organizations increasingly integrate digital technologies, such as telemedicine, online platforms, artificial intelligence systems, and electronic health records in their activity (McAlister et al., 2022; Rodríguez-Jiménez et al., 2023; Sadr et al., 2024), the energy demand can rise significantly (Soluk and Kammerlander, 2021, Boppana, 2024). Accordingly, we propose our first hypothesis as follows:

H1. Digital transformation attention of NHS Foundation Trusts has a positive effect on their energy consumption.

3.1. *The moderating role of R&D income intensity discrepancy*

Managerial attention structures, as articulated in ABV, are dynamically influenced by organizational performance feedback, a concept central to BTOF (Berchicci and Tarakci, 2022). According to BTOF, attention priorities shift when organizational performance exceeds aspirations, potentially leading to alterations in resource allocation patterns (Cyert and March, 1963; Salge, 2011). In this context, innovation performance relative to aspirations becomes particularly relevant. NHS FTs that have exceeded their innovation aspirations, as measured by the discrepancy between current R&D income intensity and historical aspiration levels, may experience a shift in attention allocation (Greve, 2003a). R&D income intensity discrepancy, therefore, serves as a performance-based proxy for innovation outcomes relative to organizational aspirations. When FTs exceed their R&D income intensity aspirations (i.e., achieve a positive discrepancy), this indicates that innovation performance has moved beyond historical benchmarks. Such achievement allows managers to shift from an exploitative attention focus, which prioritizes short-term digital performance, toward an exploratory orientation that enhances long-term technological efficiency and promotes sustainability-oriented digital practices (Zhang et al., 2024a; Xiong et al., 2024; Osiyevskyy et al., 2020).

Specifically, the underlying mechanism operates as follows: FTs with positive R&D income intensity discrepancy demonstrate success in innovation capabilities, fostering managerial confidence, generating organizational slack, and freeing attentional resources. These resources can, then, be redirected toward exploratory initiatives that emphasize the pursuit of novel alternatives and the development of new knowledge beyond the firm's existing capabilities (Sirmon et al., 2011; Wang and Cui, 2025; Xiong et al., 2024; Laureiro et al., 2014). This attentional shift promotes a more strategic deployment of digital technologies, prioritizing long-term technological advancement and efficiency improvements rather than exploitative mechanisms focused on short-term digital performance (Krishnakumar et al., 2022; Xiong et al., 2024; Sarfo et al., 2025; Lee, 2025). In particular, scholars have noted that when performance exceeds aspiration levels, managers experience reduced pressures to address immediate operational challenges associated with technological innovations. Hence, they are able to redirect their focus toward enduring strategic objectives that safeguard the organization's long-term viability (Xu et al., 2019). Such shifts are highly relevant for environmental performance, which typically requires sustained commitment and extended time horizons to yield tangible benefits (Li et al., 2024; Post et al., 2015; Saether et al., 2021; Long et al., 2023). Consequently, managers in organizations with a positive R&D income intensity discrepancy tend to adopt a more aspirational outlook and engage more intensively in forward-looking and long-term activities that foster both organizational growth and environmental responsibility (Xu et al., 2019). In doing so, positive R&D income discrepancy strengthens the exploratory mechanism while attenuating the positive association between DTA and energy consumption (Churchill et al., 2019; Lee, 2025; Xiong et al., 2024).

Beyond exploratory objectives associated with long-term strategic orientation, NHS FTs with stronger innovation performance (proxied by positive R&D income intensity discrepancy) are better positioned to identify and implement energy-efficient digital solutions. Their demonstrated innovative capabilities and knowledge bases enable these better-performing organizations to more effectively integrate sustainable practices into digital transformation initiatives, thereby mitigating negative environmental impacts. Indeed, organizations with better income-related R&D positions typically possess more highly skilled personnel, advanced technological infrastructure, and superior absorptive capacity, all of which collectively facilitate the shift from basic digital adoption toward more sustainability-oriented digital practices (Abbas et al., 2022). An increase in R&D income also enables organizations to mobilize additional resources, which generates a robust knowledge base to support proposed innovations (Fang and Liu, 2024; Peng and Tao, 2022). These capabilities enhance their ability to evaluate, select, and customize digital systems that align with operational and environmental objectives. Hence, it is often emphasized that improved technological performance, resulting from higher levels of R&D income intensity, is likely to lead to improvements in operational efficiency and foster a more sustainable use of natural resources and energy (Churchill et al., 2019).

Thus, building on both ABV and BTOF, we hypothesize that a positive R&D income intensity discrepancy will positively moderate the relationship between DTA and energy consumption. Specifically, NHS FTs exhibiting greater positive discrepancy in R&D income intensity are more likely to redirect DTA toward exploratory attention, which emphasizes long-term technological efficiency and sustainability-oriented digital practices, thereby reducing the expected increase in energy consumption. Accordingly, we formulate the second hypothesis as follows:

H2. The higher the positive R&D income intensity discrepancy, the weaker the positive relationship between the digital transformation attention of NHS Foundation Trusts and their energy consumption.

In contrast, we expect that when NHS FTs engage in digital transformation with negative R&D income intensity discrepancy (below historical aspirations), the positive relationship between DTA and energy consumption may be further amplified. According to BTOF, organizations performing below aspirations typically engage in "problemistic search", focusing primarily on addressing performance shortfalls rather than pursuing exploratory activities (Cyert and March, 1963; March, 1991; Blettner et al., 2015; Xiong et al., 2024; Zhang et al., 2024b). Thus, when FTs exhibit negative R&D income intensity discrepancy, this signals that their innovation performance is falling short of historical benchmarks, creating performance pressure that shapes their attention allocation patterns (Cyert and March, 1963; Ocasio, 1997). This underperformance relative to aspirations triggers specific behavioral responses that reinforce exploitative attention while suppressing exploratory efforts, as managers become increasingly focused on closing the innovation gap (Cyert and March, 1963; Greve, 2007; Fan et al., 2024). As managers intensify exploitative attention, they prioritize short-term digital performance improvements, which may accelerate digital deployment and infrastructural expansion, ultimately resulting in increased energy consumption and overall demand (Krishnakumar et al., 2022; Osiyevskyy et al., 2020; Lange et al., 2020; Axenbeck et al., 2024).

When innovation performance falls below aspirations, organizations typically concentrate on closing performance gaps rather than pursuing exploratory initiatives (Saemundsson et al., 2022; Xu et al., 2019). Consequently, managerial efforts are redirected from long-term objectives and sustainability-oriented innovation toward refining and expanding existing technologies and competencies. In public sector organizations, where digital transformation is normally expected and regulatory pressures and accountability demands are salient (Schillemans, 2016; Bovens et al., 2014; Salge, 2012), such underperformance typically encourages managers to intensify resource allocation toward fulfilling short-term performance improvements and realizing the value of ongoing digital initiatives (Fan et al., 2024; Greve, 2007; Zhang et al., 2024b). These shifts in attentional responses can lead to increased energy consumption, as the emphasis on immediate digital performance outcomes requires significant investment in digital infrastructures. Such infrastructures serve as essential complements for overcoming technological capability gaps and readiness constraints (Qin et al., 2025; Koo and Le, 2024; Guo et al., 2024; Ellström et al., 2022), thereby amplifying the energy demands and consumption associated with digital transformation (Myllymäki et al., 2024; Yang et al., 2023; Axenbeck et al., 2024; Lange et al., 2020).

In such contexts, the urgency to improve innovation outcomes can drive the rapid adoption of emerging technological innovations aimed at improving short-term performance outcomes, even when the environmental implications remain uncertain (Zhang et al., 2024a; Saemundsson et al., 2022; Xu et al., 2019). Under normal circumstances, firms operate within behavioral boundaries shaped by social expectations and legitimacy concerns, which generally constrain risk-taking (Jeong and Weiner, 2012; van Oosterhout et al., 2006; Xu et al., 2019). However, deteriorating performance often creates strain for managers and pressures them to pursue risky actions to achieve innovation and operational objectives, even at the expense of sustainability considerations such as energy efficiency or carbon reduction (Zhang et al., 2024a). One often-cited example is blockchain technology. While blockchain is often promoted for its potential to enhance efficiency and transparency in sectors such as healthcare (Attaran, 2022; Abu-Elezz et al., 2020; Tanwar et al., 2020), its decentralized validation mechanisms are frequently criticized for being highly energy-intensive and causing significant environmental harm (Bürer et al., 2019; Sarkodie et al., 2022; Jiang et al., 2021; Adewuyi et al., 2024).

As such, negative R&D income intensity discrepancy can trigger problemistic search, redirecting managerial attention toward closing innovation gaps that might be pursued at the expense of sustainability objectives. Under such circumstances, digital transformation initiatives may proceed under a reinforced exploitative attention mechanism, with relatively limited consideration of energy implications, thereby intensifying their contribution to overall energy consumption. Thus, we propose the final hypothesis as follows:

H3. The higher the negative R&D income intensity discrepancy, the stronger the positive relationship between digital transformation attention of NHS Foundation Trusts and their energy consumption.

4. Methodology

4.1. Data and sample

This study employs a panel data longitudinal design at the NHS FT level. The key reason for using trust-level data is its relative stability over time, which allows for the construction of a comprehensive and consistent sample. Moreover, the data required to construct the key variables is only publicly available at the trust level. Data collection for this study consists of two primary components. The first stage includes obtaining secondary data from NHS digital repositories and publicly accessible datasets. Specifically, data on energy consumption, the number of operational sites, and other related metrics were sourced from the Estates Returns Information Collection (ERIC). Hospital bed availability and occupancy rates were extracted from the NHS Bed Availability and Occupancy dataset. Population size data and regional geographic characteristics were gathered from the Integrated Care

Table 1
Keywords List.

Digital Transformation	Digital Transformation, Digital Innovation, Digital Modernization, Digital Advancement, Technology Transformation, Digital Agenda, Digital Transformation Journey, Digital Health and Care Plan, Digital Pioneer Project, Digital Readiness, Global Digital Exemplar, ICS Digital Strategy, Digital Evolution, Digital Strategy, Digital Roadmap, Local Digital Roadmap, Digital Capability Assessment, Digital Dashboard, Digital Funding, Digital Inclusion Framework, Digital Overhaul, Digital Shift, Digital Uplift, Capital Investment Initiative, Organizational Digital Culture, Paperless Initiative, Paperless Record, Paperless Strategy
Digital Governance	Chief Digital Officer, Commission of Digital Service, NHS Digital Policy, Government Digital Service Guidelines, Chief Technology Officer, Chief Clinical Information Officer, Information Governance, IT Governance, Data Steward, Data Privacy, GDPR, Caldicott Guardian, National Data Guardian
Information Systems	Electronic Health Record, Electronic Prescribing and Medicine, Electronic Prescribing System, Integrated Care System, Shared Care Record, Order Communication and Result Reporting, NHS App, Clinical Decision Support System, Clinical Data Analysis, Picture Archiving and Communication, Population Health Management, Data Interoperability, Information System Strategy, IT Strategy, Information System, Information Management, Information Transformation, Information Analysis, Information Sharing, Emergency Department Information System, Maternity Information System, Community Health System, Bed Management System, Laboratory Information Management System
Emerging Technologies & Automation	Artificial Intelligence, Deep Learning, Machine Learning, Big Data, Robotic Process Automation, Chatbot in Healthcare, Virtual Health Assistant, Blockchain in Healthcare, Blockchain, Augmented Reality, Augmented Reality in Medical Training, Natural Language Processing, AI Triage, Online Triage, Algorithmic Healthcare Resolution, Clinical Pathway Optimisation using AI, Digital Therapeutic, Digital Twin, Digital Twin in Healthcare, Data Analysis, Data Management, Data Lake, Data Mining, Data Warehouse, Health Data Science, Image Identification, Image Processing, Machine Vision, Precision Medicine through Digital Transformation, Prescriptive Analysis, Quantum Computing in Healthcare, Real World Data
Digital Infrastructure & Security	Cloud Computing, Cloud Platform, Cloud-Based Solution, Server Virtualization, High Performance Computing, IT Infrastructure Modernization, Infrastructure Refresh, Data Center Consolidation, LAN/WAN Modernization, Edge Computing in Healthcare, Multi-Factor Authentication, Two-Factor Authentication, Single Sign-On, Access Control, Information Security, Cyber, Cyber Security, Information Security Management System, Cyber Resilience, Security Operation Center, Security Assessment, Threat Detection, Vulnerability Scanning, Data Protection
Digital Healthcare Services	Telehealth, Telemedicine, Online Consultation, *E*-Consult, Virtual Ward, Remote Patient Monitoring, mHealth, Connected Health Solution, Tech-Enabled Care, Telecare, Telecoaching, Virtual Follow-Up, Real Time Monitoring Device, Online Symptom Checker, IoT, Internet of Things, Mobile Internet, Internet Plus, Industrial Internet, Community Care Digital, Ambient Assisted Living Technology, Implantable Medical Device, Patient Initiated Follow-Up, Remote Diagnostic, NHS App Strategy

These selected keywords are utilized to capture digital transformation initiatives and practices disclosed in the NHS Foundation Trust annual reports.

Board (ICB) dataset published by the UK National Statistics. Additionally, financial and accounting data, which are essential for constructing key moderating variables, were retrieved from the Trust Accounts Consolidation (TAC) dataset, published by NHS England. The second stage consists of manually collecting annual reports from NHS FTs, which were crucial for constructing the measure for DTA. These reports were systematically gathered from each FT's official website. It should be noted that some annual reports are no longer available on the official websites at the time of access. In such cases, the UK National Archives were used to retrieve as many annual reports as possible. The final sample comprises 118 NHS FTs, accounting for approximately 83 % of all hospital trusts in England. The dataset spans the period from 2016 to 2021, resulting in 638 trust-year observations.

4.2. Measurements

4.2.1. Energy consumption intensity

Energy consumption intensity is widely recognized as a fundamental indicator for measuring environmental performance (Atif et al., 2023; Axenbeck et al., 2024; Tudor et al., 2015; Andrieu et al., 2023; Padget et al., 2024). In private sector settings, the measure is typically calculated by dividing the total energy consumption by sales, thereby enabling comparative assessments of energy efficiency relative to economic activity intensity (Atif et al., 2023). However, applying this approach to public sector organizations, such as NHS FTs, presents practical challenges. As non-profit entities, NHS FTs do not report financial metrics, in particular sales, in a manner that is directly comparable to the conventional approach. To normalize this measure across organizations of varying scales, we divide total energy consumption by the total floor area (in square meters) of each FT (Brown et al., 2012). This operationalization accounts for differences in physical infrastructure and provides a more meaningful basis for inter-organizational comparison in the public healthcare context. Consistent with the ERIC guidelines on NHS energy disclosures, total energy consumption in this study is calculated by aggregating key sources of consumption, including electricity, gas, oil, and coal, while excluding renewable and third-party green energy consumption (Tudor et al., 2015).

4.2.2. Digital transformation attention

The literature in the field has highlighted two conventional approaches to measuring DTA, including quantitative descriptive and textual analysis (Li, 2022; Yang et al., 2023). However, the first approach, such as survey-based questionnaires, often faces challenges related to low response rates and limited data availability, which is particularly likely in our research context (Yang et al., 2023). In contrast, textual analysis enables consistent measurement over time and a scalable approach across a broad set of organizations. Accordingly, we adopt a textual analysis approach to capture DTA using the annual reports, which serve as a primary and publicly available communication channel for disclosing important information (Li et al., 2022; Rizov et al., 2022; Tian et al., 2023). DTA is operationalized through a keyword intensity metric, calculated as the ratio of the total count of digital transformation-related keywords to the total word count of each annual report (Rizov et al., 2022). To construct the keyword dictionary, we conducted a review of the existing literature that employed similar methodological approaches (Rizov et al., 2022; Fang and Liu, 2024; Lee et al., 2024). This initial process yielded a set of 72 keywords. We then refined and expanded this list through a two-step process. First, we consulted with domain experts in healthcare and digital transformation to ensure contextual relevance. Second, we used ChatGPT 4o to validate and extend this list, enhancing both its coverage and semantic precision. The final set includes 155 keywords, which are organized into structured thematic areas and presented in Table 1.

4.2.3. R&D income intensity discrepancy

Innovation performance, in relation to aspirations, can be measured in various ways depending on data availability and research context (Zhong et al., 2022; Goyal and Goyal, 2022; Martínez-Noya and García-Canal, 2021; Tian et al., 2024). While indicators such as patent counts are commonly used in private-sector studies (Zhong et al., 2022; Martínez-Noya and García-Canal, 2021; Tian et al., 2024), comparable measures in the FT context are not disclosed in the same form as those of private firms. Drawing on the TAC database, we use the R&D income reported by NHS FTs, classified as part of operating income, as a meaningful proxy for a trust's strategic prioritization of research and innovation. R&D income intensity in this study is calculated as the ratio of total annual research and development income to total assets (Brown

Table 2
Variables, measures, and data sources.

Variable	Measures	Data Source
Energy Consumption Intensity	Total energy consumed from non-renewable sources (i.e., electricity, gas, oil, and coal) divided by the total internal floor area (measured in square meters) of the Foundation Trust.	NHS Estates Returns Information Collection (ERIC)
Digital Transformation Attention (DTA)	Count of total digital transformation-related keywords divided by the total number of words in the annual report.	Foundation Trust websites and UK National Archives
R&D Income Intensity Discrepancy (Positive)	Current year R&D income intensity minus the three-year average R&D income intensity prior to the current year.	NHS Trust Accounts Consolidation (TAC) dataset
R&D Income Intensity Discrepancy (Negative)	Three-year average R&D income intensity prior to the current year minus the current year R&D income intensity.	NHS Trust Accounts Consolidation (TAC) dataset
Teaching Status	1 if the Foundation Trust has teaching status, and 0 if the Foundation Trust has no teaching status.	NHS Estates Returns Information Collection (ERIC)
London Dummy	1 if the Foundation Trust is located in London, and 0 if the Foundation Trust is not located in London.	NHS Estates Returns Information Collection (ERIC)
Number of Sites	Natural log of the number of sites managed by a Foundation Trust.	NHS Estates Returns Information Collection (ERIC)
Bed Occupancy	Proportion of Foundation Trust beds occupied relative to total bed capacity.	NHS Bed Availability and Occupancy dataset
Population Served	Total population served by the Foundation Trust in a given region.	Integrated Care Board (ICB) dataset
CEO Gender	1 if the CEO is identified as male, and 0 if the CEO is identified as female.	Foundation Trust websites and UK National Archives

and Floros, 2012; Nguyen et al., 2010; Brown and Petersen, 2011). To capture variations in R&D income discrepancy, we construct a measure (RDIID) that compares a trust's current-year R&D income intensity to its historical values. Following a spline function approach, we distinguish between positive and negative R&D income intensity discrepancy. Positive discrepancy is defined as the amount by which a trust's R&D income intensity in a given year exceeds its own three-year historical average. It is set to zero if the current intensity is less than or equal to the historical average. Conversely, negative discrepancy captures the extent to which a trust's R&D income intensity falls below its three-year historical average, and is set to zero when the current value is greater than or equal to the average.

4.2.4. *Controls*

Following established practice in healthcare and management research, this study incorporates a series of control variables to account for potential confounding factors that may influence the hypothesized relationships (Sturdy et al., 2022; Veronesi et al., 2023). First, FT teaching status is utilized to capture potential variations associated with trusts engaged in teaching versus those primarily focused on other services. To account for geographical variation, we include the population served, which captures differences in the population size served by an NHS FT in a given region. We also include a London dummy variable to reflect the potential effects specific to London, where provider concentration and inter-organizational competition tend to be more intense. Logistical complexity is controlled by the number of operational sites (units) managed by each trust (Veronesi et al., 2023). To capture variability in operational capabilities and patient turnover, we control for the bed occupancy ratio, measured as the percentage of occupied beds in each NHS FT. Moreover, recognizing potential implications related to leadership characteristics, we control for the gender of chief executive officers (CEOs). Information on CEOs was extracted from the annual reports of each NHS FT. In cases where the direct information regarding the CEO's gender was not explicitly stated, we used ChatGPT 4 to approximate gender based on their names. As part of the fixed-effects model specification, we include year-specific dummies and geographic location dummies based on ICB regions. Detailed measures, descriptions, and data sources for all variables are provided in Table 2.

4.3. *Models*

The methodological framework for this research generally aligns with established practices in contemporary healthcare management and digital transformation research (Sturdy et al., 2022; Veronesi et al., 2023; Rizov et al., 2022). To estimate the impact of DTA on energy consumption intensity for our main effect H1, we employ a fixed-effects regression model with cluster-robust standard errors at the FT level. The fixed-effects approach effectively controls for unobserved heterogeneity across FTs and addresses potential within-trust temporal autocorrelation. Consistent with prior research, we include year and region fixed effects to control for potential unobserved factors (Rizov et al., 2022; Veronesi et al., 2023). A statistically significant Hausman (1978) test confirmed the appropriateness of using fixed-effects estimation over random-effects. The model is specified as follows:

$$\begin{aligned}\text{EnergyConsumptionIntensity}_{it} = {} & \beta_0 + \beta_1\text{DTA}_{it} + \beta_2\text{TeachingStatus}_{it} \\ & + \beta_3\text{LondonDummy}_{it} + \beta_4\text{NumberofSites}_{it} \\ & + \beta_5\text{BedOccupancy}_{it} \\ & + \beta_6\text{PopulationServed}_{it} \\ & + \beta_7\text{CEOGender}_{it} + \beta_8\text{YearDummies}_{it} \\ & + \beta_9\text{RegionDummies}_{it} + \varepsilon_{it}\end{aligned} \tag{1}$$

In the model equation, i denotes the foundation trust, t denotes time, and ε denotes the error term. DTA represents the digital transformation attention.

To further explore the moderating effects as outlined in hypotheses H2 and H3, this study examines whether variations in RDIID, categorized as positive or negative discrepancy relative to performance aspirations, moderate the relationship between digital transformation attention and energy consumption intensity. We extend our analysis by incorporating interaction terms between DTA and RDIID. The specified model is as follows:

$$\begin{aligned}\text{EnergyConsumptionIntensity}_{it} = {} & \beta_0 + \beta_1\text{DTA}_{it} + \beta_2\text{RDIIDPositive}_{it} \\ & + \beta_3\text{RDIIDNegative}_{it} + \beta_4\text{DTA}_{it} \times \text{RDIIDPositive}_{it} \\ & + \beta_5\text{DTA}_{it} \times \text{RDIIDNegative}_{it} + \beta_6\text{TeachingStatus}_{it} \\ & + \beta_7\text{LondonDummy}_{it} + \beta_8\text{NumberofSites}_{it} \\ & + \beta_9\text{BedOccupancy}_{it} + \beta_{10}\text{PopulationServed}_{it} \\ & + \beta_{11}\text{CEOGender}_{it} + \beta_{12}\text{YearDummies}_{it} \\ & + \beta_{13}\text{RegionDummies}_{it} + \varepsilon_{it}\end{aligned} \tag{2}$$

In the model equation, i denotes the foundation trust, t denotes for time, and ε denotes the error term. DTA represents the digital transformation attention. RDIID Positive represents the positive research and development income intensity discrepancy. RDIID Negative represents the negative research and development income intensity discrepancy.

Table 3
Descriptive statistics and the correlation matrix.

Variables		M	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	Energy Consumption Intensity	390.551	151.458	1.000									
2.	DTA	0.001	0.000	0.025	1.000								
3.	RDIID (Positive)	0.001	0.003	0.049	−0.041	1.000							
4.	RDIID (Negative)	0.002	0.006	0.060	0.141***	−0.129***	1.000						
5.	Teaching Status	0.204	0.403	0.256***	0.012	0.109***	0.131***	1.000					
6.	London Dummy	0.141	0.348	0.112***	0.096**	0.031	0.188***	0.186***	1.000				
7.	Number of Sites	2.867	1.567	−0.347***	0.039	0.008	−0.067*	0.050	0.111***	1.000			
8.	Bed Occupancy	0.843	0.094	0.044	−0.179***	−0.010	−0.053	0.163***	−0.063	0.179***	1.000		
9.	Population Served	1,672,992	703,737	0.024	−0.032	0.039	−0.007	0.084**	0.036	−0.025	−0.057	1.000	
10.	CEO Gender	0.524	0.500	−0.081**	0.123***	0.139***	0.014	0.046	−0.037	0.126***	0.057	−0.161***	1.000

Significance is reported for two-tailed tests. $^{*}p \leq 0.1$. $^{**}p \leq 0.05$. $^{***}p < 0.01$.

5. Results

The descriptive statistics and correlation matrix are reported in Table 3. The Pearson correlations indicate that multicollinearity is not a concern, as the associations among variables of interest are well below usual thresholds (Sturdy et al., 2022). To further address the concern, we applied Variance Inflation Factor (VIF) diagnostics, which yielded values below 2, thereby reinforcing the reliability and consistency of our regression estimates. For the descriptive statistics, it should be noted that the energy consumption intensity yields relatively higher numbers because the ratios are calculated based on the total floor area of FTs.

5.1. Main regression analysis

Hypothesis H1 is tested to investigate whether DTA is positively related to energy consumption intensity in the NHS FT context. Table 4, Columns (1) and (2) present the results of our analysis. As shown in Column (2), which reports the findings of our baseline model and includes the control variables, DTA is statistically significant at the 1 % level ($\beta = 105{,}824.7$, $p < 0.01$). Interestingly, contrary to expectations derived from private sector studies, which typically report negative associations (Bokrantz et al., 2017; Bürger et al., 2019; Plekhanov et al., 2023; Bai et al., 2023), our results indicate a significant positive relationship between DTA and energy consumption intensity. Meanwhile, Column (1) in Table 4 presents the model without any controls, and the coefficient of DTA remains positive and statistically significant ($\beta = 105{,}654.7$, $p < 0.01$). Overall, our results indicate that increased DTA relates positively to energy consumption intensity, supporting hypothesis H1.

5.2. Moderating effects

To deepen our understanding of the relationship between energy consumption intensity and DTA, we further tested the moderating effects of R&D income intensity discrepancy, as proposed in Hypotheses H2 and H3. In Column (3) of Table 4, we add the moderators RDIID (Positive) and RDIID (Negative) without interaction terms. Neither coefficient is statistically significant, suggesting that variations in RDIID alone do not exert a direct effect on energy consumption intensity. However, as shown in Table 4, Column (4), the interaction term between DTA and positive RDIID (DTA × RDIID Positive) is negative and statistically significant ($\beta = -14{,}883{,}798$, $p < 0.05$). To further elaborate, we conducted a simple slope test of the interaction effect, as shown in Fig. 1. The analysis revealed that when RDIID (Positive) is low, DTA is strongly and positively related to energy consumption intensity ($\beta = 148{,}008.4$, $p < 0.01$). Meanwhile, at high levels of RDIID (Positive), the effect of DTA on energy consumption intensity is weaker and no longer statistically significant ($\beta = 63{,}663.45$, $p < 0.1$). This finding generally provides support for Hypothesis H2, indicating that a higher positive R&D income intensity discrepancy reduces the strength of the positive relationship between DTA and energy consumption intensity. Conversely, the interaction term between DTA and negative RDIID (DTA × RDIID Negative) is positive but not statistically significant ($\beta = 754{,}457$, $p > 0.1$), suggesting that the relationship between DTA and energy consumption intensity is not affected when FTs exhibit a negative R&D income intensity discrepancy.

Beyond the hypothesized relationships, the analysis also reveals some interesting results regarding the control variables. The coefficients of teaching status, London dummy, and number of sites are statistically significant across different model specifications. In particular, the positive and significant coefficient of teaching status suggests that NHS FTs engaged in teaching activities tend to exhibit higher energy consumption intensity compared to their non-teaching counterparts. Similarly, the positive coefficient of the London dummy indicates that trusts located in London display higher energy consumption intensity relative to those located elsewhere. By contrast, the number of sites is negatively

Table 4
Fixed effects regression results.

	(1)	(2)	(3)	(4)
Intercept	325.529***	−596.599	−647.177	−622.213
	(25.097)	(1097.571)	(1095.676)	(1046.999)
DTA	105,654.7***	105,824.7***	107,825.332***	118,164.545***
	(38,003.94)	(31,074.083)	(29,837.577)	(29,617.08)
RDIID (Positive)			2733.814	10,779.787***
			(1969.184)	(3402.204)
RDIID (Negative)			287.851	−441.226
			(1224.482)	(2023.783)
DTA × RDIID (Positive)				−14883798**
				(5824929)
DTA × RDIID (Negative)				754,457
				(35169423)
Teaching Status		96.828***	94.67***	95.8***
		(29.316)	(29.4)	(29.209)
London Dummy		239.341***	237.81***	237.776***
		(82.742)	(82.166)	(82.178)
Number of Sites		−36.712***	−36.644***	−36.851***
		(5.477)	(5.527)	(5.522)
Bed Occupancy		38.956	44.527	52.412
		(81.05)	(82.066)	(82.972)
Population Served		0.001	0.001	0.001
		(0.001)	(0.001)	(0.001)
CEO Gender		2.328	−0.179	−0.517
		(14.12)	(14.46)	(14.419)
Year Dummies	Yes	Yes	Yes	Yes
Region Dummies	Yes	Yes	Yes	Yes
Observations	638	638	638	638
Adjusted R-squared	0.309	0.459	0.459	0.462

Notes: Robust standard errors clustered at the NHS Foundation Trust level are in parentheses. Significance at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

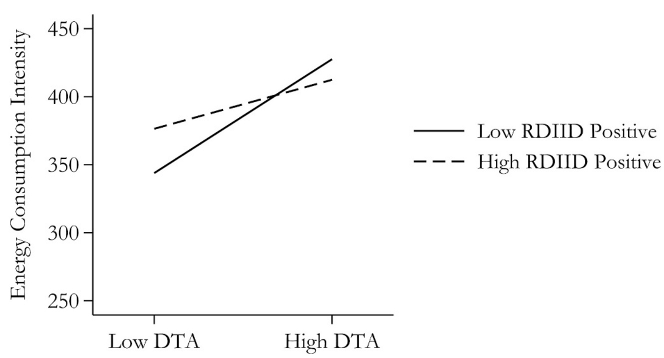

Fig. 1. Moderating effect of RDIID (Positive) on relationship between DTA and energy consumption intensity.

associated with energy consumption intensity. This suggests that trusts managing a larger number of sites may benefit from factors such as economies of scale in logistical distribution or more efficient use of resources across multiple facilities, thereby reducing energy consumption intensity (Binderbauer et al., 2023).

5.3. Robustness tests

5.3.1. Alternative dependent variable

To assess the robustness of our findings, we re-estimated our models using an alternative measure of the dependent variable: carbon emission intensity. Consistent with standard practice in healthcare sustainability research, we applied government-issued greenhouse gas (GHG) conversion factors to the different types of energy consumption (Tennison et al., 2021). These conversion factors were obtained from the UK Department for Business, Energy & Industrial Strategy (BEIS), which is widely regarded as the authoritative source for emissions accounting in the UK public sector (Tudor et al., 2015; Tennison et al., 2021; Rizan et al., 2021). Given the limitations of publicly available data, we do not differentiate between Scope 1 and Scope 2 emissions in our analysis, since Scope 1 emissions in the NHS setting require additional inputs, such as NHS fleet and leased vehicles, which are not publicly available (Tennison et al., 2021). Instead, we calculated total carbon emissions by multiplying the consumption values of each energy type by their respective GHG conversion factors. We then derived the carbon emission intensity by normalizing the total emissions against the total floor area (in square meters) of each FT. Table 5 presents the re-estimated regression results, which confirm that both the main effect and the moderating effects are consistent and robust.

5.3.2. Outliers

To address the concern related to the sensitivity of the regression estimations to potential outliers, we re-estimated our models by winsorizing the 1 % and 3 % level observations for each tail. To further ensure robustness, we also applied a different standard by winsorizing the 10 largest and 10 smallest observations. The results of the re-estimated models for both our main effect and interaction effects are consistent and not altered in any form.

5.3.3. Lagged dependent variable

Although autocorrelation is generally not considered a major concern in fixed effects models, particularly when cluster-robust standard errors are applied, we conducted an additional robustness check by incorporating lagged dependent variables into our models. This approach accounts for potential temporal persistence and path dependency in organizational practices (Sturdy et al., 2022; Veronesi et al., 2023; Rizov et al., 2022). We re-estimated the models using both our main and alternative dependent variables, with or without relevant interaction terms. The direction and significance of the main and interaction effects remain consistent after including lagged dependent variables.

5.3.4. Instrumental variable test

We acknowledge potential endogeneity concerns, which are frequently highlighted in panel data analyses (Hao et al., 2024; Zeng et al., 2022; Zhou et al., 2022). The two-stage least squares (2SLS)

Table 5
Fixed effects regression results with alternative dependents.

	(1)	(2)	(3)	(4)
Intercept	73.62***	−133.592	−149.519	−143.95
	(5.42)	(226.013)	(226.812)	(218.398)
DTA	22,747.08***	22,359.668***	22,948.493***	24,781.26***
	(8113.1)	(6548.609)	(6324.215)	(6309.851)
RDIID (Positive)			602.167	2176.9***
			(417.137)	(754.411)
RDIID (Negative)			−26.181	−209.27
			(261.949)	(422.503)
DTA × RDIID (Positive)				−2915963**
				(1264835)
DTA × RDIID (Negative)				202,748
				(728701)
Teaching Status		21.074***	94.67***	20.95***
		(5.727)	(29.4)	(5.713)
London Dummy		49.958***	237.81***	49.81***
		(16.804)	(82.166)	(16.71)
Number of Sites		−7.762***	−36.644***	−7.82***
		(1.189)	(5.527)	(1.199)
Bed Occupancy		−1.077	44.527	2.02
		(16.92)	(82.066)	(17.528)
Population Served		0.000	0.001	0.000
		(0.000)	(0.001)	(0.000)
CEO Gender		0.911	−0.179	0.32
		(3.093)	(14.46)	(3.157)
Year Dummies	Yes	Yes	Yes	Yes
Region Dummies	Yes	Yes	Yes	Yes
Observations	638	638	638	638
Adjusted R-squared	0.35	0.485	0.486	0.488

Notes: Robust standard errors clustered at the NHS Foundation Trust level are in parentheses. Significance at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

regressions with instrumental variables were conducted to address these concerns. Following established practices, we constructed an instrumental variable based on the average level of digital transformation of other FTs located in the same region (Zhou et al., 2022). After incorporating the instrument, we re-estimated our regression analysis of the main effect based on the same controls, and the results remain consistent with our findings. As shown in Table 6, the Kleibergen-Paap rk LM statistic is 32.338, which rejects the null hypothesis of under-identification at the 1 % significance level. The Cragg-Donald Wald F statistic is 516.329. The Kleibergen-Paap rk Wald F statistic is 20.816, exceeding the Stock-Yogo critical threshold of 16.38 for a 10 % maximal IV size. These results indicate that the endogenous regressor is strongly correlated with the instrument. Moreover, the overidentification test (Hansen J statistic) yields a value of 0.000, further suggesting that the model is exactly identified and providing no evidence against the null hypothesis that the instrument is valid.

Table 6
Instrumental variable test.

	Energy Consumption Intensity
DTA	109,576.14***
	(29,788.65)
Teaching Status	96.84***
	(29.27)
London Dummy	239.05***
	(82.59)
Number of Sites	−36.71***
	(5.47)
Bed Occupancy	40.29
	(81.54)
Population Served	0.000
	(0.000)
CEO Gender	2.25
	(14.08)
Year Dummies	Yes
Region Dummies	Yes
Observations	638
Kleibergen-Paap rk LM Statistic	32.338***
Cragg-Donald Wald F Statistic	516.329
Kleibergen-Paap rk Wald F Statistic	20.816
Hansen J statistic	0.000

Notes: Robust standard errors clustered at the NHS Foundation Trust level are in parentheses. Significance at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.3.5. *Propensity score matching*

Propensity score matching (PSM) was used to address the potential problems of selection bias. We matched pairs of FTs using nearest-neighbor matching, estimated via a logit model, without replacement and with a 0.02 caliper, based on our controls of teaching status dummy, London dummy, number of sites, beds occupancy ratio, and population served. Table 7 illustrates the PSM test results for the analysis. As shown, the test yielded a matched sample of 889 observations, consisting of 436 treated observations (with digital transformation mentions in their annual reports) and 453 control observations (without mentioning digital transformation in their annual reports). We found no statistically significant differences between the two groups in the matched sample, indicating that selection bias was minimized. We then estimated the average treatment effect of 21.678 ($t = 2.08$, $p < 0.05$). Further confirming our findings, the average treatment effect of the analysis revealed no statistically significant differences between the two groups of FTs. Table 7 presents the PSM test results.

5.3.6. *Heckman two-stage*

We further adopted the Heckman two-stage model to address another important aspect of the potential problems of selection bias. In the first stage, we estimated a probit selection model to assess the likelihood that an FT would pay any attention to digital transformation.

Table 7
Propensity Score Matching (PSM) model results.

Treatment	Treated (N)	Control (N)	Average Treatment Effect	SE	t-Statistic
Total Energy Consumption	436	453	21.678	10.441	2.08**

The estimated parameters from this model were then used to calculate the inverse Mills ratio (IMR), which was subsequently incorporated in the second-stage regressions. Following a common practice, we constructed the prevalence of DTA as our instrumental variable (Cao et al., 2023). This variable was calculated by dividing the number of FTs mentioning digital transformation in the same close regional group in the same year (excluding the focal one) by the total number of FTs in that peer group in that year (excluding the focal one). Consistently, the Heckman two-stage model confirms our findings, indicating that our analysis is not likely to be biased by self-selection. Table 8 provides details on the Heckman two-stage model results. To assess the validity of the exclusion restriction, we confirmed the low correlation between our main independent variables and the IMR (Certo et al., 2016; Bhagwat et al., 2020).

6. Discussion and conclusion

This study investigates the potential impact of digital transformation on organizational environmental performance in the context of NHS FTs. Drawing on ABV as a theoretical lens, our empirical findings reveal a robust and statistically significant positive relationship between DTA and energy consumption intensity. Contrary to the conventional understanding from the private sector, where digital transformation efforts are often linked to better environmental performance (Bokrantz et al., 2017; Bürger et al., 2019; Plekhanov et al., 2023; Bai et al., 2023), our research indicates that FTs with greater attention to digital transformation tend to exhibit higher levels of energy usage. The findings to some extent confirm the dominant position of the exploitative attention mechanism in the current stage development of digital transformation in the FTs. Within the context, the managerial attention is pressured to focus on the short-term digital performance, prioritizing factors such as infrastructure expansion and rapid development (Qin et al., 2025; Koo and Le, 2024; Guo et al., 2024; Ellström et al., 2022), which consequently lead to increased energy consumption (Myllymäki et al., 2024; Yang et al., 2023; Axenbeck et al., 2024; Lange et al., 2020). This is consistent with the literature, which highlights that the digital transformation is unintentionally generating substantial energy demands (Soluk and Kammerlander, 2021; Boppana, 2024).

Table 8
Heckman two-stage model.

Panel A First Stage Model	Probit
Regional prevalence	−0.124 ***
	(0.024)
Teaching Status	0.140
	(0.111)
London Dummy	−0.24**
	(0.112)
Number of Sites	−0.068**
	(0.031)
Bed Occupancy	−1.964***
	(0.515)
Population Served	0.000**
	(0.000)
Intercept	1.951***
	(0.473)
Year dummies	Yes
Chi-square (d.f.)	74.75*** (11)
Pseudo R-squared	0.062

Panel B Second Stage Model	
Intercept	−393.666
	(1136.99)
DTA	96,190.115***
	(31,292.994)
Teaching Status	81.975***
	(27.581)
London Dummy	403.746***
	(138.633)
Number of Sites	−40.485***
	(6.121)
Bed Occupancy	34.877
	(108.387)
Population Served	0.000
	(0.001)
CEO Gender	5.582
	(14.112)
Inverse Mills Ratio	53.831
	63.055
Year Dummies	Yes
Region Dummies	Yes
Adjusted R-squared	0.391

Notes: Robust standard errors clustered at the NHS Foundation Trust level are in parentheses. Significance at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Extending the analysis with insights from BTOF, we further examined the moderating effects of RDIID on the performance link between DTA and energy consumption intensity. While negative RDIID does not exhibit a significant moderating effect, we observed that NHS FTs with a higher level of positive RDIID weaken the positive relationship between DTA and energy consumption intensity. The findings confirm the literature, which suggests that the FTs with positive R&D income intensity discrepancy might redirect their managerial attentions from the contemporary focus (Sirmon et al., 2011; Wang and Cui, 2025; Xiong et al., 2024; Laureiro et al., 2014), since they have demonstrated success in innovation capabilities, creating confidence, organizational slack, and attentional resources (Zhang et al., 2024a; Xiong et al., 2024; Osiyevskyy et al., 2020). In the NHS FTs context, this attentional shift is likely to be associated with the transition from exploitative to exploratory attention mechanisms, which allows FTs to focus on explorations of more strategic and measured deployment of digital technologies, prioritizing long-term technological improvement and efficiency enhancement over the immediate and short-term digital performance (Krishnakumar et al., 2022; Xiong et al., 2024; Sarfo et al., 2025; Lee, 2025). Consequently, managerial attention within the context is more likely to emphasize long-term technological efficiency and sustainability-oriented digital practices that advance environmental outcomes (Xu et al., 2019). In this way, the positive link between DTA and energy consumption intensity is weakened (Churchill et al., 2019; Lee, 2025; Xiong et al., 2024).

6.1. Theoretical contributions

Taken together, this study offers three important theoretical contributions. First, it enriches the ongoing academic debates at the intersection of digital transformation and organizational environmental performance by shedding light on the nuanced environmental consequences of digital transformation in public sector settings. Existing research often positions digital transformation as a driver of efficiency gains, governance improvements, and competitive advantage, but its environmental implications remain ambiguous, with mixed findings derived from private-sector studies (Zhang et al., 2025; Fang and Liu, 2024; Li et al., 2022; Cao et al., 2024). By empirically investigating English NHS FTs, our study provides novel insights into how digital transformation impacts organizational energy consumption intensity. In doing so, we directly respond to recent scholarly calls for a deeper understanding of sustainability outcomes associated with digital transformation, particularly within sectors such as healthcare that bear significant environmental responsibilities (Guandalini, 2022; Ologeanu-Taddei et al., 2025; Kotlarsky et al., 2023). To the best of our knowledge, this is the first study to empirically examine the relationship between digital transformation and OEP within NHS FTs.

Second, this study extends the theoretical scope of ABV by applying its assumptions to the public sector, and particularly to a healthcare setting. Although ABV has been widely used to explain firm behaviors in private-sector contexts, its application and validation in public organizations remain limited (Alshahrani et al., 2022; Kumar and Thakur, 2024; Born et al., 2024). By showing that in NHS FTs, managerial attention to digital transformation is directly associated with higher energy consumption intensity, our study broadens the theoretical boundaries of ABV. On the one hand, our findings reinforce ABV's central premise that managerial focus critically shapes organizational outcomes, while on the other hand, extend its explanatory power beyond conventional financial and operational measures to include sustainability-related performance (Brielmaier and Friesl, 2023; Born et al., 2024; Tang et al., 2018). In doing so, this study also demonstrates ABV's explanatory power in a public sector setting, where strategic priorities are driven by service delivery demands and sector-specific responsibilities rather than the competitive, market-generated pressures that typically shape private-sector decision-making (Denicolò and Panunzi, 2025; Gartenberg and Serafeim, 2023; Almquist et al., 2013; Modell, 2012).

Third, this study advances BTOF by showing that aspirational performance mechanisms operate differently in public-sector organizations. In contrast to private sector studies where the relevance of both types of discrepancies has been observed (Xu et al., 2019; Saemundsson et al., 2022), our findings reveal an important asymmetry in that positive performance feedback discrepancy redirects managerial attention toward the exploratory mechanism, whereas negative discrepancy does not significantly alter the relationship. This pattern suggests that aspiration-driven responses in public organizations may be conditioned by other confounding factors, such as non-market goals, and therefore BTOF requires refinement to account for contexts where strategic priorities extend beyond mere financial performance. Meanwhile, the study also addresses a critical theoretical gap at the intersection of ABV and BTOF by empirically demonstrating how managerial attention mechanisms are reconfigured through performance feedback processes. While existing research has predominantly operationalized ABV-specific constructs in isolation (Gavetti et al., 2007; Gavetti et al., 2012; Ocasio, 2011; Li et al., 2022), our analysis demonstrates the dynamic interplay between attention allocation and performance aspiration by identifying the critical moderating role of R&D income intensity discrepancy in altering the environmental outcomes of managerial attention.

6.2. Policy and practical implications

This study also offers several important practical implications. First, it expands practitioners' understanding of the environmental outcomes associated with digital transformation efforts in the public sector. The NHS has long been recognized as one of the world's leading adopters of healthcare innovations, with many NHS FTs having independently and locally implemented advanced information technology solutions (Phiri et al., 2023). Nevertheless, our findings suggest that in the public sector, managerial attention toward digital transformation does not necessarily lead to improvements in environmental performance. Rather, heightened DTA is associated with increased energy consumption, highlighting the need for greater caution when adopting digital solutions. As far as NHS FT managers are concerned, this calls for a shift from a narrow focus on digital transformation gains to a more integrated strategy that balances digital innovation with environmental objectives. For example, one actionable practice for managers consists of placing greater emphasis on green innovations and the use of renewable energy during digital transformation, particularly when energy consumption increases (Tang et al., 2023; Feng et al., 2022; Xu et al., 2024).

Second, this study offers practical guidelines regarding the moderating effects of R&D income intensity discrepancy. Although the environmental outcomes of digital transformation are undesirable in the NHS setting, our findings suggest that technological innovations and digital initiatives do not inevitably and always damage sustainability outcomes. When NHS FTs exhibit positive R&D income intensity discrepancy, DTA is associated with reduced energy consumption, implying better environmental outcomes. In other words, simply pursuing rapid digital adoption is not a panacea for achieving sustainability goals. Practitioners should develop a more nuanced understanding of the importance of maintaining and strengthening innovation-related environmental performance. Positive R&D income intensity discrepancy is to be regarded, and pursued, as a critical enabler for realizing the environmental benefits of digital transformation. For example, when formulating digital transformation strategies, practitioners should account for the level of R&D income, prioritizing implementation in FTs with stronger R&D performance, while exercising greater caution and incorporating additional safeguards in contexts where R&D income is relatively low.

Third, the implications of the study also hold for policymakers. The public sector, particularly healthcare systems like the English NHS, plays a central role not only in delivering essential services to the public but also in advancing broader environmental objectives (Brown et al., 2012; Tennison et al., 2021). Given the NHS's substantial contribution to England's greenhouse gas emissions and the rising pressures posed by climate change on healthcare systems (Tennison et al., 2021), it is critical for policymakers to recognize that digital initiatives, if not carefully managed, may inadvertently exacerbate environmental challenges rather than alleviate them. Nevertheless, this does not mean that policymakers should avoid promoting digital initiatives in the public sector. Rather, policymakers should treat digital modernization and environmental sustainability as interdependent objectives, ensuring that digital transformation is pursued in coordination with environmental goals and thereby narrowing the gap between technological advancement and environmental or sustainability goals.

6.3. Limitations and future research direction

This study has some limitations that highlight potential directions for future research. First, the measurement of attention to digital transformation is based on keywords extracted from the annual reports of NHS FTs. While textual analysis using word frequency is a well-established method in business research on managerial attention (Li et al., 2022; Rizov et al., 2022), its application in the NHS context remains underexplored. Digital transformation in NHS FTs is more complex and policy-driven than in private firms, and variation in reporting may limit the extent to which keyword frequency reflects actual transformation efforts. To address this, we consulted domain experts and used a broader set of keywords to enhance validity. Nonetheless, future work could employ complementary methods to capture the multifaceted nature of digital transformation in public healthcare.

The second limitation concerns the availability of direct OEP indicators for NHS FTs. In the absence of trust-level emissions data, this study relied on proxy measures derived from energy consumption and conversion factors (Tennison et al., 2021). While widely accepted, this approach involves approximation and may not reflect the true footprint of each trust. Encouragingly, some trusts have recently begun reporting detailed metrics such as carbon savings and decarbonization achievements. These emerging data sources present opportunities for future research to refine measures of environmental outcomes and examine the relationship between digital transformation and carbon reduction with greater precision.

The third limitation relates to the methodological approach. While quantitative analysis identifies broad patterns, it cannot fully capture the nuances of managerial decision-making or the mechanisms implied by ABV. Qualitative or mixed-methods approaches could provide richer insights into how managerial attention shapes environmental outcomes. Future research could also extend this inquiry to other public services, such as transport, defense, or utilities, where environmental impact is high. Studying these contexts would help establish whether the dynamics observed in the NHS apply more broadly across public sector organizations.

CRediT authorship contribution statement

Dingli Xi: Writing – original draft, Methodology, Investigation, Data curation. **Minhao Zhang:** Writing – original draft, Project administration, Investigation, Formal analysis, Conceptualization. **Gianluca Veronesi:** Writing – review & editing, Investigation.

Declaration of competing interest

None.

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Data availability

Data will be made available on request.

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