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Review Article

A Systematic Literature Review on Resilient Digital Transformation, Examining How Organizations Sustain Digital Capabilities

Thira Chavarnakul [1], Li Da Xu [2], Zhuming Bi [3], Achyut Shankar [4], Gaurav Dhiman [5], Wattana Viriyasitavat [1], Danupol Hoonsopon [1*]

[1] *Chulalongkorn Business School, Chualongkorn University, Bangkok 10330, Thailand.*

[2] *Old Dominion University, Norfolk, VA, 23529, United States.*

[3] *Department of Civil and Mechanical Engineering, Purdue University Fort Wayne, IN, 46805, United States.*

[4] *Department of Cyber Systems Engineering, University of Warwick, Coventry, CV74AL, United Kingdom.*

[5] *Department of Electrical and Computer Engineering, Lebanese American University, Beirut, 03797751, Lebanon.*

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Abstract

In an era marked by relentless technological shifts and market volatility, digital transformation (DT) alone is insufficient. Organizations must develop Resilient Digital Transformation (RDT)—the organizational capabilities required to sustain DT over a medium-term horizon—to navigate these challenges effectively. This study primarily aims to propose a guideline for fostering RDT. Drawing on the PRISMA guidelines and a systematic review of 77 peer-reviewed papers, this study identifies and synthesizes key targets and drivers across three core pillars: Technology, Organization, and External Environment. These elements collectively foster organizational resilience. Specifically, this study highlights how adaptability, innovation, and scalability form the technological underpinnings of sustained digital maturity; meanwhile, effective governance frameworks, ongoing workforce development, and supportive cultures promote organizational agility. Externally, proactive stakeholder engagement, responsiveness to market shifts, and robust regulatory compliance help ensure the long-term viability of digital initiatives. The findings contribute to the existing literature by unifying an integrative framework illustrating how organizations can sense, seize, and reconfigure resources to embed resilience across strategic and operational processes. By moving beyond static maturity models, the framework stresses the continuous nature of digital transformation, offering both academics and practitioners a structured approach to sustaining competitive advantage amid incessant disruptions.

Keywords: Digital Transformation; Resilient Digital Transformation; Digital Capabilities; Sustainability.

1. Introduction

Digital Transformation (DT) is a key driver of organizational success in today's rapidly evolving business landscape, marked by technological advancements and external pressures [1]. It involves the strategic integration of digital technologies across all organizational functions to enhance efficiency, customer experience, and competitive advantage. Moreover, it supports alignment with broader environmental factors such as regulatory compliance and sustainability

* Corresponding author: danupol@cbs.chula.ac.th

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goals [2, 3]. Research highlights its role in optimizing operations, delivering personalized services, and sustaining competitiveness. While ongoing investment in technology, people, and processes is required—and challenges like cultural resistance and data security must be addressed—the long-term benefits outweigh the costs, making DT essential for sustainable success [4].

Resilient Digital Transformation (RDT) has become essential for corporations seeking to sustain competitive advantage and operational efficiency over the long term, particularly in the face of rapid technological change and market volatility. By integrating DT with resilience strategies, organizations enhance their adaptability, innovation capacity, and systemic agility—key enablers of sustainable growth and high-quality economic development. In capital-intensive and mature-stage industries, RDT fosters organizational resilience by optimizing innovation and responsiveness, while in sectors like manufacturing, digitalization enhances technological innovation capacity [5]. RDT also strengthens supply chain resilience through improved visibility and collaboration, crucial for industries such as electric vehicles and Fast-Moving Consumer Goods [6, 7]. Furthermore, it supports innovation resilience by facilitating recovery from disruptions and sustaining continuous innovation, influenced by network embeddedness and absorptive capacity [8]. A data-driven culture, enabled by digital tools, also reinforces supply chain robustness and trust with suppliers [9]. While challenges such as industry variation, enterprise size, and resource constraints may affect implementation, the strategic importance of RDT in fostering resilience and long-term competitiveness remains indisputable.

In this research, RDT is defined as "The organizational capabilities required to sustain digital transformation over a medium-term horizon." This concept is distinct from general organizational resilience—the broader capacity to adapt to any disruption—by specifically focusing on the continuity and progress of digital initiatives amidst challenges like cyber-attacks or rapid technological shifts that impact digital assets and strategies. While RDT contributes to overall organizational resilience, it addresses unique vulnerabilities and opportunities of digitalization, preventing conceptual dilution by concentrating on the specific capabilities needed to maintain digital efforts. Existing approaches like change management, low-code platforms, and Digital Public Infrastructure touch on key elements [10, 11], but an integrative RDT framework is lacking. Widely used models such as Deloitte's Digital Maturity Model (DMM), McKinsey's Digital Quotient (DQ), and MIT's transformation framework provide guidance on digital readiness but do not clearly focus on sustaining digital capabilities long-term, especially during disruptions [12, 13]. These models often prioritize short-term goals and static assessments, overlooking resilience as a measurable, strategic capability for digital endeavours [14, 15]. Consequently, limitations persist across these models, including the absence of explicit digital resilience dimensions, insufficient integration of dynamic capabilities vital for digital adaptation, inadequate attention to long-term cultural and talent evolution crucial for RDT [16, 17], and a lack of sensitivity to industry-specific and regional contexts that shape digital resilience needs [1].

Despite the growing number of studies exploring Resilient Digital Transformation (RDT) across diverse contexts—from sustainable digital transformation [18] and ambidextrous innovation [19] to pandemic-induced agility and SME antifragility [20] a critical and underexplored gap remains. These studies consistently emphasize that true resilience in digital initiatives extends beyond technology adoption; it requires sustained leadership commitment, adaptive capabilities, cultural transformation, and external collaboration. However, most existing research either addresses isolated aspects of resilience or concentrates on short-term adaptation, offering limited insight into how organizations can systematically embed and evolve digital capabilities over time. More importantly, there is a notable absence of an integrative framework that consolidates the technological, organizational, and environmental enablers necessary to sustain digital transformation through dynamic and uncertain conditions. This fragmentation has hindered both scholarly understanding and practical application. In response, this study conducts a systematic literature review to fill this gap by synthesizing current evidence and proposing a comprehensive RDT framework that captures the structural, cultural, and strategic mechanisms essential for embedding resilience as a core, enduring capability within digital transformation efforts.

In response to these gaps, this research conducts a Systematic Literature Review (SLR) to develop an integrative RDT framework that incorporates critical elements such as continuous innovation, adaptive governance, longer-term workforce development, and external ecosystem collaboration. This framework aims to bridge theory and practice, offering a more holistic and future-oriented model that supports organizations in sustaining DT as a core, enduring capability. This SLR synthesizes current research on RDT within corporate settings, focusing on three interrelated aspects: (1) the key factors and drivers RDT for organizational success, (2) the critical focus areas organizations must address to achieve and sustain RDT, and (3) the integrative frameworks that support the longer-term development of RDT capabilities. Guided by the PRISMA methodology, this study employs descriptive, bibliometric, and thematic analyses to comprehensively explore the academic and practical discourse surrounding RDT. The review is structured around the following research questions:

What are the key targets across the pillars of DT that organizations aim to promote, and how do these collectively contribute to RDT capabilities?

What are the primary drivers and enablers that make RDT essential for organizations, and what core focus areas must be addressed to achieve it?

What theoretical and conceptual frameworks can guide organizations in fostering RDT?

By addressing these questions, this review advances the academic understanding of RDT by identifying the elements that support its longer-term viability. Moreover, it offers practical guidance for organizations seeking to sustain and evolve their digital capabilities over time. The findings provide actionable insights into achieving RDT and emphasize the transformative roles of digital technologies, governance structures, and external environmental factors. In doing so, the review positions RDT as a strategic function essential to developing resilient organizations, sustainable business models, and long-term competitive advantage—an imperative in today's increasingly volatile and digitally driven environment.

The remainder of this article is structured as follows. Section 2 reviews the existing literature on Resilient Digital Transformation (RDT) and highlights major gaps of existing literature. Section 3 outlines the research methodology, including the systematic review process based on PRISMA guidelines. Section 4 presents the major findings, organized around the three core pillars of RDT: Technology, Organization, and External Environment. Section 5 discusses the theoretical and practical implications. Lastly, Section 6 concludes the study and outlines directions for future research.

2. Existing Surveys on RDT

Over the past few years, a growing body of literature has examined RDT across diverse organizational and industry contexts. Collectively, these studies highlight the importance of aligning long-term digital maturity with adaptability, agility, and, increasingly, sustainability objectives. They further stress that resilience cannot be achieved merely by adopting new technologies; rather, it demands cohesive strategies, dedicated leadership, cultural change, and the continuous development of organizational capabilities (See Table 1 for summary).

In a mixed-methods study on environmentally sustainable digital transformation (SDT), Feroz et al. [3] integrate a meta-synthesis of 195 articles, a questionnaire-based survey, and a Delphi method to reveal how digital initiatives merge with sustainability goals. Their findings identify 19 core capabilities, structured into seizing, sensing, and transforming domains, emphasizing iterative resource reconfiguration as central to resilience. However, while they clearly define these capabilities, the work leaves unanswered how organizations can maintain digital alignment amid ongoing market turbulence—an issue vital to RDT.

Similarly, Nyagadza [19] employs a systematic review and meta-analysis to investigate SDT for ambidextrous digital firms. Grounded in Business Model Theory (BMT), this research illustrates how SMACIT technologies (social, mobile, analytics, cloud, and IoT), supported by a conducive culture and committed leadership, foster both exploitative and explorative capabilities. Yet, although it underscores leadership and culture, the study calls for longitudinal methods to determine how firms preserve these dual capacities throughout extended transformation cycles.

Research on pandemic-related digital responsiveness sheds further light on this topic. Mangalaraj et al. [21], for example, link IT investment and digital capability development to organizational agility and resilience in retail. Their findings highlight reconfigurable operations and agile strategy execution as two pillars enabling strong market responses. However, this short-term lens does not fully account for how IT-driven resilience might develop into a stable, enduring capability.

Meanwhile, a systematic review by Sagala & Őri [20] focuses on SME resilience and antifragility. They suggest that DT, when coupled with dynamic capabilities, strategic foresight, and knowledge sharing, allows smaller firms to weather disruptive conditions. Although this introduces the concept of antifragility—where organizations emerge stronger from adversity—the authors do not explore the broader structural or governance factors required to sustain such resilience beyond immediate shocks.

Additional work by Dupin et al. [22] conceptualizes digital resilience through three levels—user, IT infrastructure, and the wider ecosystem—distinguishing "resilience through digital" (collaborative platforms, remote work) from "resilience to digital" (cybersecurity, system redundancies). While this framework broadens understanding of resilience factors, it offers limited guidance on how firms might iterate and renew these elements through extended digital rollouts.

Finally, Hokmabadi et al. [13] examine business resilience in SMEs and startups by emphasizing marketing capabilities—such as omnichannel strategies, social media analytics, and data-driven decision-making—as mechanisms for fostering digital resilience. Here, dynamic capabilities such as learning agility, collaborative innovation, and

ecosystem partnerships are deemed crucial in fast-paced markets. Nonetheless, while the study provides a robust framework for short-term resilience and competitive gain, it leaves unexplained how such strategies and metrics might become embedded in routine operations over the long term.

Taken collectively, these surveys underscore the multifaceted nature of RDT: from sustainability [3] and dual-capability development [19] to pandemic-driven adaptations [21], SME antifragility [20], and marketing-based resilience [13]. They collectively affirm a need for coherent strategies that integrate technology, leadership, and culture. Nonetheless, a significant gap persists: few studies offer granular insight into sustaining DT capabilities over extended periods. This gap underlines the value of further work examining governance structures, iterative metrics, and embedded routines that can preserve adaptability and resilience—even after initial digital adoption. Considering these observations, the investigation into RDT seeks to address precisely this need, building on earlier research to demonstrate how organizations can systematically embed and continuously expand their digital capabilities in dynamic environments.

Table 1. Existing surveys related to RDT

No.	Topic	Short Description	Why My RDT Is Needed
1.	Identifying organizations' dynamic capabilities for sustainable digital transformation: A mixed methods study [23]	Mixed-methods study integrating digital initiatives with sustainability; identifies 19 dynamic capabilities for SDT.	**Long-term integration challenge**: Shows how digital and ecological goals align but leaves open the question of how to maintain them over extended market volatility.
2.	Sustainable digital transformation for ambidextrous digital rms: systematic literature review, meta-analysis and agenda for future research directions [19]	Systematic review/meta-analysis emphasizing SMACIT and ambidexterity; underscores culture & leadership roles.	**Sustained dual capabilities**: Highlights need for longitudinal insights into how exploitative and explorative capacities can be upheld long after initial adoption.
3.	Digital Transformation for Agility and Resilience: An Exploratory Study [21]	Exploratory study on reconfigurable operations and agile strategy; uses COVID-19 retail data for short-term crisis.	**Beyond crisis response**: Demonstrates reactive success but lacks frameworks on turning agility into a stable, long-term organizational characteristic.
4.	Exploring digital transformation strategy to achieve SMEs resilience and antifragility: a systematic literature review [20]	SLR linking digitization to antifragility in SMEs, noting dynamic capabilities and knowledge sharing as key enablers.	**Deeper structural enablers**: Concept of antifragility is introduced but the mechanisms for institutionalizing it over time remain unexplored.
5.	A Systematic Literature Review on Digital Resilience in Organizations: Towards a Conceptualization [22]	Review defining resilience "through" and "to" digital, emphasizing holistic integration beyond technology adoption.	**Iterative renewal gap**: Outlines multiple perspectives but offers limited guidance on iterative refinement of these resilience factors as digital maturity evolves.
6.	Business Resilience for Small and Medium Enterprises and Startups by Digital Transformation and the Role of Marketing Capabilities - A Systematic Review [13]	Systematic review citing adaptive marketing and dynamic capabilities as critical for resilience in volatile markets.	**Embedding resilience in daily operations**: Extends marketing-based resilience frameworks but underexplores how firms continuously integrate and scale.

3. Research Methodology

This study follows a systematic literature review approach, as recommended by Snyder [24], chosen for its ability to effectively integrate various research viewpoints on sustainability initiatives and stakeholder alignment. This method provides a thorough analysis of the subject, encompassing different theoretical frameworks and research methods. To maintain rigor and transparency, the review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, including the 2020 update [25], to methodically identify, assess, and synthesize pertinent studies. By aligning with PRISMA standards, the review brings together literature on sustainability and stakeholder alignment, ensuring a well-organized and reproducible approach. The process is illustrated in Figure 1. Drawing on prior research on systematic literature reviews [18] and applying PRISMA principles, the study follows a three-phase procedure, which is detailed in the following sections.

3.1. Question Formulation

Formulating precise research questions is a foundational step in conducting a rigorous systematic review, as it offers a structured framework for identifying critical gaps in the literature and aligning with the study's overarching objectives [26]. Through iterative discussions, the authors refined the research scope to focus on essential scholarship surrounding RDT. This effort began with an extensive assessment of prior studies to pinpoint key targets and explore how existing research contribute to developing RDT capabilities. During this review, several significant gaps were identified, including the lack of an integrative framework of RDT and insufficient emphasis on established digital maturity models (e.g., Deloitte's Digital Maturity Model, MIT's Digital Maturity Framework, McKinsey's Digital Quotient, and BCG's Digital Acceleration Index). Additional challenges arose in harmonizing fast-growing technological innovation with sustained organizational strategy, highlighting the need for a resilience-oriented transformation model. These insights shaped the development of targeted research questions, as outlined in the Introduction section, which serve to guide the systematic analysis of RDT aimed at enhancing long-term organization's DT capabilities. By defining the research scope at this early stage, the study ensures methodological rigor and lays a solid foundation for identifying and synthesizing relevant approaches, contributing to the creation of an integrative framework that fosters effective and enduring DT.

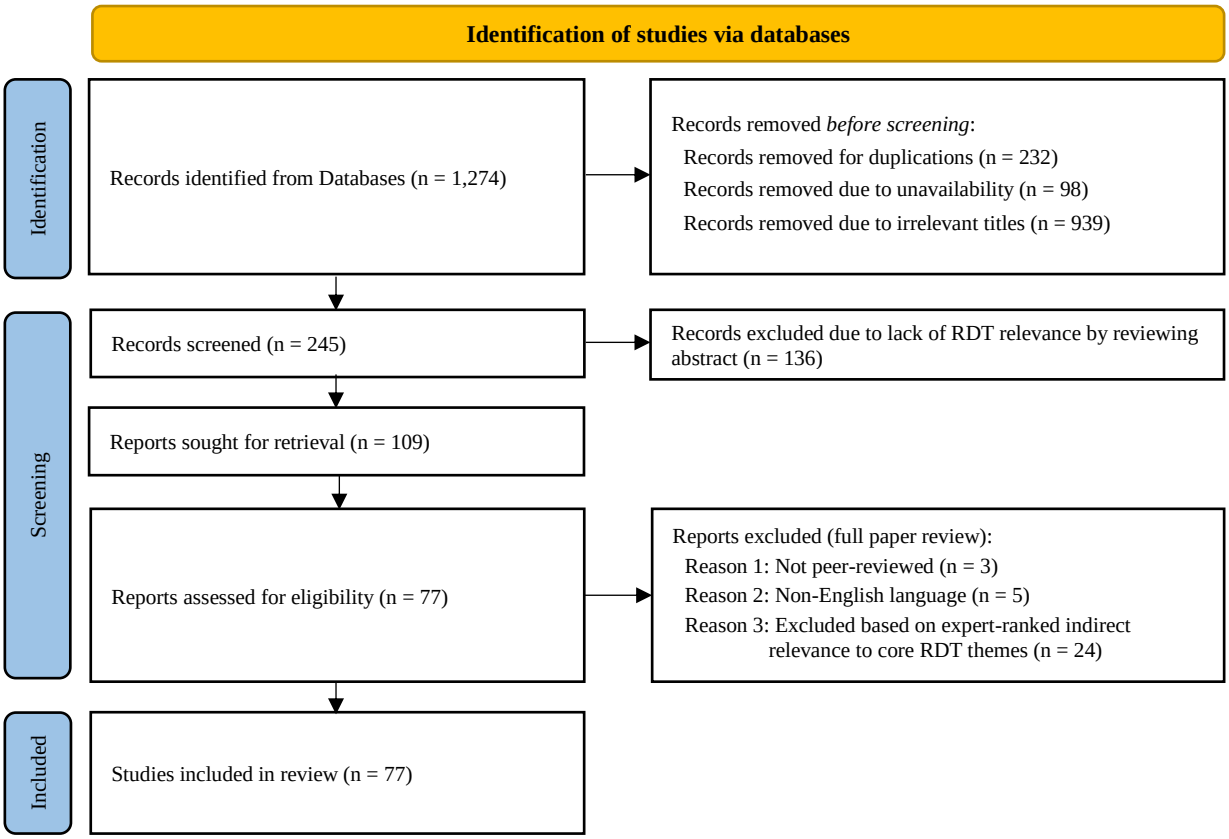


Figure 1. Research Methodology

3.2. Article Selection Protocol

Following the development of the research questions, a systematic and replicable literature search was undertaken to ensure breadth, transparency, and methodological rigor in identifying RDT-related studies. The search encompassed Scopus, Web of Science, IEEE Xplore, Semantic Scholar, and Google Scholar, covering peer-reviewed journals, conference proceedings, and other scholarly publications to capture diverse academic perspectives. In addition to journal articles, other relevant publication types were carefully included based on their scholarly merit.

A targeted search strategy was devised around three principal keyword categories: “resilient”, “digital”, and “transformation.” Since many publications connect “Sustainable Digital Transformation”, which is the main search string, to broader sustainability objectives, often referencing SDGs, this study employed specific exclusion to filter out articles primarily focused on ESG or SDG considerations. This narrower scope ensures the concentrate solely on the RDT aspects in question, preventing an oversaturation of sustainability-focused studies.

An initial exploratory search in Google Scholar facilitated the refinement of broad keywords, which were subsequently adapted to meet the syntax requirements of Scopus, Web of Science, Semantic Scholar, and IEEE Xplore. Boolean operators (AND/OR) and truncation methods were applied to maximize coverage. Article collection proceeded along two parallel paths: one aimed at gathering works focusing on RDT, and another centered on resilient digital maturity. Although different search strings were used for each path, consistent inclusion and exclusion criteria were applied across all databases. This approach ensured coherence in the selection process and laid the groundwork for a comprehensive evaluation of the literature. The primary keywords employed in this review is presented in Table 2:

Table 2. Search keywords

Resilient-related		Digital-related		Transformation-related		Excluding Words
Resilient	AND	Digital	AND	Transformation	NOT	SDGs
Adaptive		digitalization		Change		Green
Long-term		digitization		Evolution		ESG
Enduring		technology		Innovation		Climate
Sustainable		IT		Strategy		Carbon
				Agility		Circular Economy
						Sustainable Development

A snowballing approach was also adopted, whereby additional relevant articles were located through reference lists of high-impact papers. This step expanded the overall search and reduced the likelihood of overlooking important studies. Figure 1 illustrates the number of publications identified at each stage. To ensure both scholarly rigor and thematic alignment, the review employed a structured seven-step filtration process, guided by the systematic review method proposed by Tranfield et al. [27]. As an initial criterion, only peer-reviewed journal articles and high-caliber conference papers were included, while non-academic sources (e.g., opinion pieces, blogs, and grey literature) were excluded to preserve academic credibility [28]. Subsequently, the search was restricted to English-language publications to promote consistency in both interpretation and analysis. The chosen subject area was limited to business and technology management, reflecting the study's objective of identifying stakeholder engagement strategies within the realm of corporate sustainability. Following this initial filtering, 1,269 articles remained for further examination.

A multi-stage filtering procedure was adopted to refine the initial dataset. First, duplicates and clearly unrelated records were removed, leaving 245 articles. Next, a title-and-abstract screening ensured only those with explicit links to RDT remained, reducing the corpus to 109. Articles without accessible full texts were then excluded. A subsequent full-text evaluation confirmed the alignment of each study with the research scope. Three domain experts independently assessed the direct or indirect relevance of each article; those receiving at least two expert endorsements for direct relevance were included. Once this inclusion and exclusion process concluded, the remaining 77 papers underwent systematic analysis to uncover insights on RDT, including its key enablers, pillar-specific targets of DT**,** and conceptual frameworks aligned with the study's definition of RDT. These targets serve as focal points for sustaining long-term DT capabilities by outlining the areas where organizations must continually adapt and innovate.

3.3. Extraction, Analysis and Synthesis

To examine the final set of studies, this study employed two complementary techniques [29]: descriptive analysis, and thematic analysis. Descriptive analysis offered insights into publication trends by journal, year, and author affiliations, providing an overview of how RDT research has evolved within various academic domains. Thematic analysis was carried out in accordance with recognized methodological guidelines (e.g. Ben Slimane, Coeurderoy, and Mhenni; Lucas et al.). This study adopted a qualitative, thematic approach to identify recurring topics and core constructs related to RDT. In line with Wolcott's method, as advocated by Creswell & Poth, the study proceeded through four sequential phases:

Preliminary Review of Primary Studies: A close reading of each article was conducted to extract and summarize key findings relevant to DT capabilities and long-term resilience. This step ensured a broad understanding of each study's contributions and facilitated the collection of preliminary insights.

Coding, Condensing, and Reduction: Each finding was assigned a unique code, allowing us to categorize and group common themes linked to RDT objectives. Related codes were then refined and combined, aligning them with three foundational pillars of DT (see Figure 2). This phase culminated in a set of representative keywords that captured the central ideas of each article.

Contextualization and Framework Construction: Drawing on the identified themes, a multi-tiered framework was developed, encompassing drivers, enablers, targets, and strategic framework. This integrated structure synthesizes insights from the primary studies, aiming to strengthen long-term DT capabilities within organizations.

Presentation of Findings: Lastly, the identified themes and framework were presented using visual figures. This visual representation highlights key relationships among elements consisting of drivers, enablers, targets, and strategic framework, and clarifies how they integrate into a cohesive approach for fostering RDT.

Through this combined process, this literature review not only provides a descriptive RDT scholarship but also offers a thematically grounded framework to guide future research and practice.

3.4. Descriptive Analysis

A review of Table 3 reveals a fairly broad distribution of publication outlets in the final sample, though Others (one article per journal, Reports) constitutes the largest category at 53.25%. This broad Others classification suggests that much of the research on RDT comes from a wide array of single studies across various specialized journals or reports, rather than being clustered in a single venue. Among dedicated journals, Sustainability stands out with 10 articles from the 2016–2024 period, reflecting growing scholarly interest in linking DT to sustainable practices. Likewise, Conferences and Symposium publications (comprising 12 total) further indicate a high level of emerging, often preliminary research findings presented at academic forums. Meanwhile, journals suc as the Journal of Enterprise Information Management and the Journal of the Knowledge Economy contribute a smaller yet meaningful portion of the sample, emphasizing the interdisciplinary nature of RDT.

Table 3. Important journals, conferences, symposiums, theses, and dissertations included in the final sample

Journals/Conferences	2006-2010	2011-2015	2016-2020	2021-2024	Total	%
Sustainability				10	10	12.99
Journal of Enterprise Information Management				2	2	2.60
Journal of the Knowledge Economy				2	2	2.60
Preprint (arXiv and SSRN)				2	2	2.60
Book chapters				4	4	5.19
Thesis				4	4	5.19
Conferences and Symposium			2	10	12	15.58
Others (one article per journal, Reports)	1		1	39	41	53.25
Total	**1**		**3**	**73**	**77**	**100.00**

4. DT: Theoretical Frameworks and Development

4.1. Evolution of DT Framework

Early DT research focused on technology adoption and digital capabilities as key drivers of performance. Westerman et al. [30] defined DT as using technology to enhance enterprise performance, while Fitzgerald et al. [31] showed how emerging tools improved customer experience and operations. This tech-centric view encouraged investment in IT infrastructure, but scholars like Bharadwaj et al. [32] argued for integrating digital initiatives with business strategy. DT thus evolved into a strategic imperative aligned with broader goals. As digital efforts progressed, many failed due to non-technical issues, shifting attention to organizational factors. Kane et al. [33] emphasized that "strategy, not technology" drives DT, highlighting leadership, culture, and strategic clarity. Mature firms succeeded by fostering risk-taking and continuous learning. Hess et al. [34] stressed the role of top management and structural alignment, with governance and coordination ensuring strategic fit. By the mid-2010s, scholars viewed organizational transformation—mindset, talent, and processes—as equally vital as technology. Concepts like digital culture, change management, and dynamic capabilities underscored the need for adaptability [35], establishing organizational readiness and leadership as core pillars of DT.

Later research broadened DT beyond internal capabilities to include the external environment, recognizing that market forces and ecosystem dynamics significantly shape outcomes. Sebastian et al. [36] showed that firms adopt dual strategies—deepening customer engagement and digitizing operations—to meet rising expectations, while Vial [37] emphasized that external disruptions such as shifting customer behavior, new competitors, and regulations trigger strategic responses. Jacobides et al. [38] further highlighted that digital competition increasingly occurs at the ecosystem level, requiring external collaboration and adaptability. By the late 2010s, the literature converged on a holistic view of DT grounded in three interdependent dimensions: digital technology, organizational capability, and external environment.

Warner & Wäger [39] applied dynamic capabilities to DT, illustrating how firms sense, seize, and transform in response to digital opportunities. Verhoef et al. [40] mapped the DT journey across disciplines, stressing the integration of technology, organizational change, and market adaptation. Tangwaragorn et al. [1] reinforced this three-pillar framework by synthesizing DT drivers into internal and external domains, reflecting the growing consensus that successful transformation requires synergy across (1) technological, (2) organizational, and (3) environmental factors.

There is growing consensus that effective DT is built on three interdependent pillars (see Figure 2): technology, organization, and external environment [41, 42]. The technological pillar encompasses digital infrastructure, platforms, and data capabilities—such as cloud computing, AI, and analytics—that provide the foundation for transformation [31, 37]. The organizational pillar involves leadership, culture, structure, and dynamic capabilities needed to drive and sustain change [33, 41]. It emphasizes the importance of aligning digital efforts with agile strategies and internal processes. The external environment pillar reflects the impact of customer expectations, competitive dynamics, and ecosystem participation on transformation [36, 38]. Firms must respond to external pressures and collaborate across networks to create value. Collectively, these pillars form a holistic framework now widely adopted in DT literature, underscoring that lasting transformation requires integrated progress across technological, organizational, and environmental dimensions.

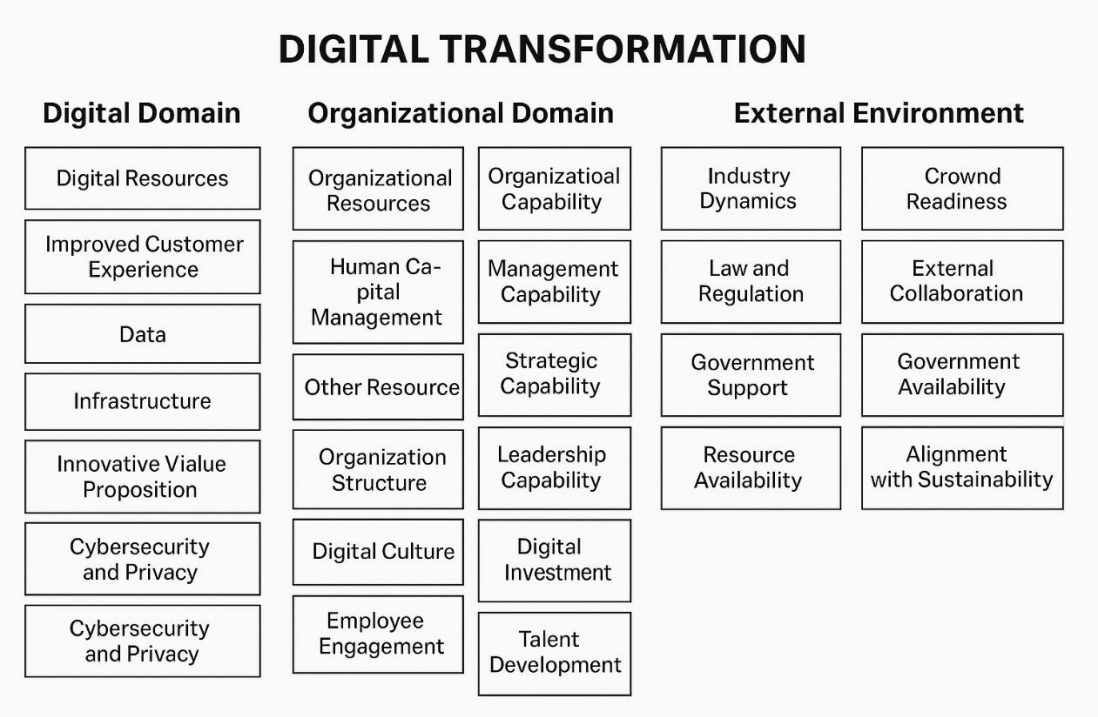


Figure 2. DT framework

4.2. RDT Definitions

The concept of RDT emerges from the intersection of two vital organizational imperatives: DT and organizational resilience. DT is widely recognized as a key enabler of organizational agility and innovation, particularly through the adoption of advanced technologies [5]. In parallel, organizational resilience reflects an entity's capacity to absorb shocks, adapt to rapidly changing conditions, and maintain performance in the face of uncertainty [42]. Recent scholarship emphasizes the synergy between these two. Resilience, when embedded, becomes essential for sustaining progress amid disruption. Resilient organizations are characterized by their ability to "endure, develop and compete" under adverse conditions [42, 43]. Consequently, scholars and practitioners underscore the necessity for enduring capabilities that span leadership, strategy, technological infrastructure, and organizational culture [44–46]. Despite growing attention to DT, the literature predominantly focuses on the early stages of implementation, such as the adoption of technologies, performance outcomes, and barriers to change. Far less attention has been directed toward the medium-term challenge of sustaining digital maturity after initial transformation phases [47, 48]. This creates a conceptual and empirical gap in understanding how organizations retain their digital advancement over a multi-year horizon.

To address this gap, the present study defines RDT as the medium-term organizational capabilities required to sustain a given level of DT. These include strategic alignment, leadership continuity, adaptive culture, and continuous learning processes [44]. The concept of digital resilience—defined as the ability to detect, respond to, and recover from disruptions—reinforces the idea that resilience underpins sustained transformation. While existing studies focus on implementation, performance outcomes, or resilience as separate constructs, few examine the specific aspects to maintain digital capabilities over time. By framing RDT as a dynamic capability rather than a final stage, this study offers a new perspective on long-term transformation and contributes to a stronger theoretical foundation.

4.3. Aspect of RDT from Prominent Digital Maturity Frameworks

Digital maturity is a key determinant of successful DT. Prominent frameworks such as Deloitte's DMM, MIT's model, McKinsey's DQ, and BCG's DAI provide guidance by emphasizing agility, innovation, and culture; however, their focus is largely on achieving digital maturity rather than maintaining the aspect of RDT over time. This highlights a key gap, as existing models define digital maturity but do not explicitly address *RDT*. While they guide transformation, they lack a focus on sustaining digital capabilities over the medium term.

Deloitte's Digital Maturity Model (DMM) assesses organizations across five dimensions—Customer, Strategy, Technology, Operations, and Organization & Culture [49]. It emphasizes culture and talent processes that drive digital progress, highlighting the need for continuous capability building. While DMM provides a roadmap for transformation and helps leaders assess and plan digital initiatives [48], its focus is on reaching higher maturity rather than sustaining it over the medium term. It lacks a mechanism to measure or maintain digital maturity after initial transformation [50, 51], relying instead on periodic reassessment without explicitly addressing long-term resilience.

Similarly, MIT's digital maturity framework identifies traits of "digitally maturing" companies but does not prescribe a structured model. Kane et al. [52] found that these organizations foster adaptive cultures, scale digital experiments, and align strategy with core business capabilities to enhance agility. While these elements align with RDT, MIT's framework remains largely descriptive, outlining maturity characteristics without offering tools for sustained transformation. It implicitly acknowledges that DT requires continuous adaptation—described as "a journey, not a destination" [53]—but does not define how to maintain a given level of digital maturity over time [50, 54].

McKinsey's Digital Quotient (DQ) quantifies digital performance across 32 practices in five categories [55], covering aspects of resilience such as agile delivery and digital culture. High "adoption and scaling" scores indicate a firm's ability to expand digital initiatives, reinforcing sustained digital gains. However, DQ is primarily a diagnostic tool, offering a snapshot of maturity and best practices rather than a framework for maintaining digital resilience. While McKinsey acknowledges that digital leaders must continually invest to stay competitive, the model itself does not prescribe how organizations can navigate medium-term challenges beyond improving assessed practices [50, 56].

BCG's Digital Acceleration Index (DAI) similarly benchmarks digital maturity through self-assessment, emphasizing speed and year-over-year progress. Research shows that digitally mature firms perform better and recover faster from crises like COVID-19 [57–59]. Although DAI highlights key resilience enablers—such as integrated technology and adaptable operations—it primarily serves as a benchmarking tool rather than a framework for sustaining digital maturity. The model assumes that continuous investment in digital accelerators ensures long-term competitiveness. However, even firms with high DAI scores risk stagnation if they fail to adapt. While DAI provides valuable insights into digital capabilities, it lacks an explicit focus on mechanisms required for ongoing resilience beyond periodic assessments.

Across these frameworks, a common gap emerges, while they guide organizations toward higher digital maturity, none explicitly address how to sustain that maturity over a medium-term horizon. The emphasis remains on progression rather than long-term stability, underscoring the need for a dedicated approach to RDT.

5. Results and Discussion

Based on Figure 3, the distribution of papers across sector clusters reveals significant variation in research focus. The largest category is "Not Specified" with 24 papers (32%), indicating a substantial portion of the literature lacks clear sector identification. Technology-focused papers dominate the specified categories, with "Technology Companies Only" representing 12 papers (16%), followed by "Technology + Multiple Sectors" and "Technology + Manufacturing" with 8 (11%) and 7 (9%) papers respectively. The "Other" category contains 9 papers (12%), suggesting diverse sector applications not fitting established classifications. Financial, public sector, and healthcare technology applications each account for 3-4 papers (4-5%), while transportation and logistics technology represent 2 papers (3%). Single-paper representations (1%) exist in retail-related categories and the education sector, highlighting potential areas for future research development. This distribution underscores technology's cross-sectoral integration while revealing significant gaps in sector-specific applications within the current literature.

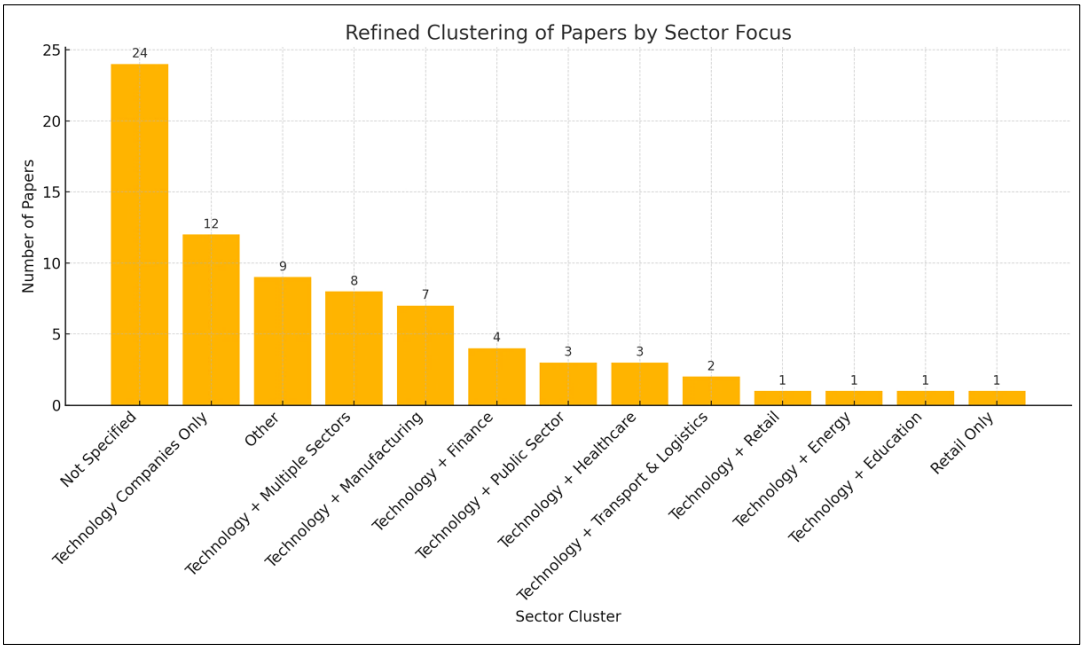


Figure 3. Distribution of Sectors in RDT

5.1. Organizational Targets for Digital Resilience in the DT Pillars

To ensure methodological transparency and reliability, the literature synthesis involved a coding process conducted independently by three domain experts. Initially, each expert independently reviewed and coded the collected literature, identifying relevant themes aligned with the targets. After this independent coding phase, a collaborative discussion was held to reconcile discrepancies, refine thematic definitions, and ensure consensus. Only themes consistently recognized across all three experts were included in the final conceptual framework, thus enhancing the rigor and reliability of the synthesis.

5.1.1. Technology Pillar

The resilience of the Technology Pillar within DT significantly depends on an organization's achievement of three critical targets: Adaptability, Innovation, and Scalability. Based on the comprehensive synthesis of recent literature, each target is essential in enabling organizations to sustain their DT capabilities over a medium-term horizon. Table 4 provides a structured mapping of studies to nine key targets across the three RDT pillars—Technology, Organization, and External Environment—highlighting both direct and indirect contributions. This synthesis illustrates how existing literature supports each target, thereby reinforcing their conceptual relevance to sustaining digital transformation.

The *Adaptability* target, defined as the capacity to swiftly adjust to emerging challenges and evolving technological landscapes, is consistently highlighted in the literature. For instance, Adisa et al. [60] identified strategic digital agility and rapid responsiveness as essential for adapting effectively to ongoing digital shifts. Similarly, the work by Gracia-Perez et al. emphasizes adaptability through enhanced digital resilience frameworks. Studies by Gao et al. [61] further underline adaptive strategies such as digital buffering during crises.

The *Innovation* target emphasizes the need for continuous technological advancements. Literature underscores innovation's role in maintaining competitive advantage through digital disruption recognition and green innovation portfolios [60]. Moreover, the study in [62] discusses how digitalization and AI drive innovation, suggesting continuous technological evolution as crucial for sustained resilience. Kokinou et al. [9] recommend that ongoing innovation in digital technologies fosters adaptive and robust supply chains.

For *Scalability*, involving the ability to effectively expand and sustain technology initiatives, also emerges as pivotal. Research indicates that scalable digital infrastructures such as integrative technology utilization and structural digitalized change significantly contribute to sustained operational effectiveness [60]. Additionally, the concept of digital leapfrogging, as explored in [61] emphasizes scaling digital services post-crisis, further highlighting scalability's importance. The work by Khon [63] also supports this notion, implicitly advocating scalable information system solutions for long-term sustainability.

In conclusion, achieving resilience in the Technology Pillar of DT necessitates a strategic focus on these interconnected targets: Adaptability, Innovation, and Scalability. As evidenced through the literature synthesis, these capabilities collectively enable organizations to proactively sustain and evolve their DT initiatives, thereby ensuring resilience amidst rapidly evolving technological environments.

Table 4. Associated studies towards organizational targets

1. Technology Pillar	
1.1 Adaptability	
Direct:	[9, 13, 20, 21, 22, 23, 46, 50, 56, 60, 62-114]
Indirect:	[115-117]
1.2 Innovation	
Direct:	[13, 20, 21, 23, 46, 50, 56, 60, 62, 64, 65, 67, 68, 70, 72-92, 96, 98, 100, 103-105, 108, 109, 111, 113, 115-118]
Indirect:	[9, 66, 69, 71, 93-95, 97, 99, 102, 107, 110, 114]
1.3 Scalability	
Direct:	[13, 67, 68, 70, 99, 105, 118]
Indirect:	[9, 20, 21, 23, 46, 50, 60, 62, 64, 65, 69, 71, 72, 78, 80-87, 90-95, 98, 108]
2. Organization Pillar	
2.1 Employee Retention and Upskilling	
Direct:	[9, 13, 19, 21, 23, 45, 46, 50, 56, 62, 63, 66-68, 71, 74, 76, 77, 81, 87, 93, 95, 96, 98, 100, 102-105, 108, 110-113, 116, 118-121]
Indirect:	[20, 60, 69, 73, 80, 82-86, 88, 106, 107, 109, 114, 115, 117, 122]
2.2 Governance Frameworks	
Direct:	[13, 20, 21, 23, 50, 56, 60, 69, 72, 75, 77, 82, 83, 85-87, 94, 98, 100, 102-105, 107-110, 112, 114, 115, 120, 121]
Indirect:	[19, 46, 61, 62, 68, 70, 73, 80, 97, 99, 101, 106, 111, 113, 116, 117, 119]

2.3 Organizational Culture	
Direct:	[9, 13, 19, 20, 21, 23, 45, 46, 56, 60, 62, 63, 70, 73, 74, 76, 81-83, 85, 87, 93, 94, 98, 100, 102-105, 108, 113, 119, 120, 123]
Indirect:	[50, 61, 67-69, 71, 72, 75, 77, 80, 86, 97, 99, 101, 106, 107, 109-112, 114-118, 122]
3. External Environment Pillar	
3.1 Stakeholder Engagement	
Direct:	[9, 13, 20, 21, 23, 46, 56, 60, 62, 64, 69, 70, 72, 74-77, 80, 81, 83-87, 92-95, 103, 104, 108, 111, 116, 117, 120, 121, 123-125]
Indirect:	[22, 66-68, 71, 73, 78, 79, 82, 88, 91, 96, 107, 109, 112-115, 119, 122]
3.2 Market Dynamics	
Direct:	[9, 13, 20-23, 46, 50, 56, 60, 62, 64, 66-89, 91-96, 103, 106-109, 111-117, 119-125]
Indirect:	[104]
3.3 Regulatory Compliance	
Direct:	[46, 60, 72, 75, 77, 92, 94, 95, 121-123]
Indirect:	[13, 62, 66, 70, 71, 74, 81, 82, 84, 87, 89, 108, 111, 116, 117, 120]

5.1.2. Organization Pillar

The resilience of the Organization Pillar within DT hinges prominently on three interdependent targets: Employee Retention and Upskilling, Governance Frameworks, and Organizational Culture. Each of these targets is essential to sustaining DT capabilities over a medium-term horizon, as illustrated through an extensive review of recent literature. Table 3 explicitly associates each reviewed paper with the relevant target category.

Employee Retention and Upskilling are critical, as organizations need skilled personnel who can adapt to evolving technologies, just as adaptable infrastructure is essential in the technology pillar. This requires continuous learning in automation, data analytics, and AI, ensuring workforce agility to sustain DT. For instance, Gull et al. [43] highlight the necessity of addressing digital core competencies among staff to overcome transformation barriers. Likewise, Angel [68] underscores the importance of bridging workforce skill gaps through ongoing employee training. Additionally, Herz & Trauntschnig [85] identify long-term employee retention and continuous skill development as instrumental in preserving organizational knowledge and driving successful DT.

Governance Frameworks serve as structural foundations, guiding effective decision-making, resource allocation, and compliance. Studies such as Mick et al. [103] emphasize the significance of clearly defined digital strategies and governance structures in achieving transformation success. Further reinforcing this, Kuppusamy and Chaitanya Datti [66] outlines the role of governance mechanisms like strategic blueprints and policy regulations at the national level to bolster resilience during digital transitions. Internally, organizations implementing robust governance frameworks, as discussed in [126] align digital initiatives strategically with broader corporate objectives, ensuring resilience against potential disruptions.

Organizational Culture emerges as pivotal, with a culture receptive to adaptability, experimentation, and continuous learning enhancing digital resilience. The study by Herz & Trauntschnig [85] notes the challenges posed by resistance to change and highlights the benefits of cultivating a culture of innovation and agility. Similarly, Kohn [63] underscores the importance of an entrepreneurial mindset, promoting rapid learning and adaptability across organizations. Fleron et al. [69] further confirms that active engagement and fostering a positive attitude toward change significantly mitigate employee resistance, thereby driving sustainable DT.

Together, these three interconnected targets constitute the core organizational capabilities for achieving RDT. Their interdependence highlights the importance of a comprehensive approach to sustaining digital initiatives amidst continuous technological evolution and external uncertainties.

5.1.3. External Environment Pillar

Resilience in the External Environment Pillar significantly depends on achieving three critical targets: Stakeholder Engagement, Market Dynamics, and Regulatory Compliance. These interconnected targets, supported by extensive literature and explicitly associated with each paper in Table 3 of this manuscript, collectively enable organizations to sustain DT capabilities over the medium-term.

Stakeholder Engagement involves proactive collaboration and integration of stakeholder insights, identified consistently as essential for DT resilience. Park & Hong [64] highlight open innovation and stakeholder integration for business model innovation. Mick et al. [103] underscores the importance of customer-centric and partnership-driven ecosystems for successful transformations. Similarly, the seminal work by Padmanabhan and Viswanathan emphasize

multi-stakeholder collaborations to build robust trust and governance structures. Additional research, including [75, 105] further illustrates how stakeholder-oriented approaches enhance transparency, trust, and innovation during transformations.

Market Dynamics pertains to the ability to anticipate and adapt to evolving market conditions and technological advancements. Research by Chen et al. [81] emphasizes the ongoing necessity of adjusting business models to market changes. Ethier et al. [94] highlight how strategic adaptability ensures competitive advantage in shifting markets. Additionally, Saeed et al. [77] further demonstrate how accelerated digital technology adoption during market disruptions necessitates robust cybersecurity. Further supporting these findings, the works by Gupta et al. [56] and Li [79] emphasize organizational agility and responsiveness as vital to adapting to rapid market dynamics.

Regulatory Compliance involves proactively addressing evolving regulatory standards, crucial for long-term resilience. The work by Park et al. [72] outlines the critical role of stringent data governance in regulatory compliance during extensive digitalization initiatives. Sadii [95] highlights the necessity of regulatory compliance for healthcare continuity. Similarly, Adisa et al. [60] illustrates regulatory adaptability by legal firms during digital shifts amid crises. Further evidence from Saeed et al. [77] and Hokmabadi et al. [13] reinforces that aligning with compliance frameworks such as GDPR is essential for maintaining trust and operational resilience.

Strategically achieving these three critical targets allows organizations to sustain and adapt their DT initiatives effectively. This comprehensive approach enhances organizational resilience, ensuring effective adaptation to evolving external demands and uncertainties.

5.2. Dynamic Capabilities Theory as a Foundation for RDT

DT rarely constitutes a single event; rather, it unfolds as an ongoing cycle of adapting technologies, strategies, and organizational structures in response to ever-changing environments. Such fluidity underscores the importance of Dynamic Capability Theory (DCT) for RDT. DCT holds that organizations can sense emergent opportunities, seize them through strategic action, and reconfigure resources to maintain agility and innovation [127, 128]. As Eisenhardt & Martin [129] suggest, these dynamic capabilities span processes like product innovation or alliance formation [130]. Beyond mere technological upgrades, DT involves strategic renewal of business models, structures, and culture [131], a progression essential for sustaining digital initiatives over a medium-term horizon. By aligning dynamic capabilities with key targets in the Technology Pillar (Adaptability, Innovation, Scalability), the Organization Pillar (Employee Retention and Upskilling, Governance Frameworks, Organizational Culture), and the External Environment Pillar (Stakeholder Engagement, Market Dynamics, Regulatory Compliance), RDT emerges as a cohesive approach that counters common failings in strategic change and endures amid ongoing digital turbulence [39, 132]. Such capabilities deliver the adaptive resilience needed to transform short-lived modernization efforts into sustained competitive advantage.

5.2.1. Dynamic Capabilities in the Technology Pillar of RDT

This Pillar concerns a organization's capacity to deploy and leverage digital technologies for strategic renewal. The following analyzes how dynamic capabilities foster Adaptability, Innovation, and Scalability.

Adaptation: Dynamic capabilities drive technological adaptation by continually aligning IT assets and digital capabilities with emerging trends. Central to this alignment is sensing capability, which systematically scans the environment for technologies ranging from cloud platforms to AI, assessing their potential threats and opportunities [133]. Empirical evidence underscores the role of "digital scouting" in identifying promising innovations and avoiding obsolescence, with Warner & Wager [39] highlighting how robust sensing routines help incumbents renew IT capabilities amid disruptive forces. Additionally, strategic reconfiguration processes enable firms to modify and redeploy digital resources in response to detected changes. Continuous learning mechanisms—such as knowledge articulation and experience accumulation [130]—further ensure these adaptations are both timely and sustainable, helping firms maintain momentum in DT and reinforce resilience as the technological landscape evolves.

Innovation: Dynamic capabilities enable firms to seize new opportunities and creatively recombine resources [133]. Specifically, seizing capabilities foster strategic agility and rapid prototyping, allowing organizations to experiment with emerging digital technologies and swiftly convert these experiments into market-ready offerings. This process is both learned and repeatable, as illustrated by product development routines [129]. In DT, innovation often involves business model renewal, wherein digital technologies introduce novel modes of creating and delivering value. Consequently, in the context of RDT, dynamic capabilities prevent stagnation after early successes, ensuring that innovation remains iterative, continuous, and forward-looking.

Scalability: Even highly innovative digital initiatives can stagnate in the absence of mechanisms to adjust capacity in response to market demands. In this context, reconfiguring or transforming capabilities, facilitate the fluid orchestration of resources to scale digital solutions. Modern cloud architectures and modular platforms provide a critical

technical foundation for such flexibility, permitting capacity adjustments at relatively low marginal cost [39]. Equally important is the rapid reallocation of resources when innovations gain traction or when market conditions shift, guided by dynamic capabilities that refine workflows, and IT infrastructures. As a result, scalability becomes an integral feature of a firm's DT trajectory, ensuring that initial successes develop into sustained competitive advantage.

5.2.2. Dynamic Capabilities in the Organization Pillar of RDT

In the organization pillar, dynamic capabilities—particularly managerial and organizational competencies like coordination, learning, and resource integration—enable effective governance, foster an agile culture, and drive continuous workforce upskilling, all of which are essential to achieving resilience and sustaining digital initiatives over time [130, 132].

Employee Retention and Upskills is pivotal, with dynamic capabilities—especially knowledge absorption and integration—enabling structured learning and upskilling routines. Dynamic managerial capabilities [134] and deliberate learning processes [130] support practical mechanisms like in-house academies and knowledge-sharing communities, as exemplified by firms launching "Digital Academies" to foster IT and analytics expertise. Empirical evidence from Warner and Wager [39] highlights workforce digital proficiency as a core micro-foundation of dynamic capabilities, aligning with Teece's argument on reconfiguring human capital through hiring, training, or redeployment. By sensing and swiftly addressing emerging skill gaps, organizations maintain learning agility, sustain transformation initiatives, and mitigate talent shortages over time.

Governance Frameworks hinges on structures, decision-making processes, and resource-allocation mechanisms that align the organization with its digital strategy [130, 133]. Managerial integration [128], as a core dynamic capability, enables the reconfiguration of internal structures to address shifting conditions, while strategic decision-making routines [129] facilitate timely resource commitments. Incumbent firms often redesign organizational structures and governance to be more agile and flexible [132], for example by decentralizing decision-making, forming cross-functional digital teams, or creating innovation hubs—all of which require dynamic capabilities. In RDT, governance must remain fluid, with managers continually sensing bottlenecks and reorganizing units, workflows, or steering committees.

Organizational Culture powerfully shapes DT, with innovative, agile, and learning-oriented cultures fueling progress and risk-averse cultures hindering it [131]. Dynamic capabilities [134] embed learning orientations and entrepreneurial mindsets, enabling continuous sensing and adaptation. Firms with strong dynamic capabilities typically embrace change and calculated risk-taking [129], underscoring the need for a "digital mindset" in both sensing and transforming routines. Empirical research, including Ellstrom et al. [135], shows that DT depends on the organization's willingness to experiment, reflecting Boston Consulting Group's finding that ~70% of digital initiatives underperform partly due to a deficient digital mindset. Dynamic capabilities address this by fostering experimentation, open communication, and continuous learning, reshaping cultural norms: sensing and learning mechanisms heighten awareness of external shifts, while transforming mechanisms (e.g., revising incentives or structures) institutionalize cultural evolution [127]. Illustrative approaches include cross-functional collaboration and celebrating "fast failures," as seen in Microsoft's cloud transformation [131]. Ultimately, an adaptive culture amplifies dynamic capabilities, and exercising those capabilities further entrenches innovation-friendly values, forming a virtuous cycle vital to RDT.

5.2.3. Dynamic Capabilities in the External Environment Pillar of RDT

Because DT occurs within a broader ecosystem of markets, competitors, partners, customers, and regulators, a resilient strategy must dynamically engage stakeholders, maintain market responsiveness, and ensure regulatory compliance in line with Dynamic Capability Theory's emphasis on aligning the firm with its evolving environment [136].

Stakeholder Engagement: DT often entails collaboration beyond firm boundaries, involving customers, suppliers, and technology partners [136-138]. Dynamic capabilities underpin this external relationship management—or "partnering agility"—which involves sensing collaborative opportunities, seizing them by forming alliances, and reconfiguring resources across organizational boundaries [139]. Innovation ecosystem navigation emerges as a micro-foundation of dynamic capabilities, enabling rapid partnership formation and adjustment [39]. Additionally, customer agility capitalizes on user feedback to co-create digital offerings, thus strengthening adoption and sustaining transformation [140]. Ultimately, these relational capabilities ensure organizations remain integrated within digital ecosystems, fostering stakeholder buy-in and responsiveness throughout the transformation journey [129].

Dynamic Market: Dynamic capabilities were originally conceptualized to enhance a "evolutionary fitness" by aligning with shifting customer demands, competitive maneuvers, and technological disruptions [136]. In the digital era, where market preferences can change rapidly, sensing enables continuous scanning—via data analytics, user feedback, and trend scouting—while seizing facilitates timely resource reallocation (e.g., scaling digital offerings or launching

new channels) [131, 132]. Research underscores that organizations with robust dynamic capabilities, including swift decision-making processes [129], exhibit stronger market responsiveness, leading to better outcomes in fast-moving digital contexts [141]. For instance, [142] find that SMEs possessing high levels of sensing and flexibility adapt their digital strategies more effectively during external shocks. Additionally, portfolio agility—shifting investments among digital products—enhances market responsiveness in tech-centric industries [132]. Overall, dynamic capabilities keep organizations attuned to evolving markets throughout DT, ensuring digital solutions remain relevant and competitive over time.

Regulatory Compliance: Digital innovation is continuously reshaping laws and standards around data privacy, cybersecurity, and digital finance, necessitating "regulatory agility"—the capacity to anticipate and respond to policy changes without derailing strategic objectives [136] (Adapting, Shaping, Evolving: Refocusing on the Dynamic Capabilities–Environment Nexus | Academy of Management Collections). Dynamic capabilities facilitate this through vigilant sensing of regulatory trends and flexible transforming of internal processes, supported by mechanisms like compliance task forces and government relations teams. For example, banks that sensed impending open banking rules could seize the opportunity by developing compliant APIs and transforming IT governance to secure data sharing, ultimately leveraging compliance for competitive advantage [143]. Such adaptability is integral to evolutionary fitness, with Helfat & Martin [134] emphasizing that dynamic capabilities enable purposeful modification of the resource base [127]. Consequently, organizations that treat compliance as an ongoing agile process—for instance, experimenting in regulatory sandboxes or rapidly adjusting algorithms—safeguard their DT journey from disruptive setbacks, ensuring it remains both innovative and resilient amid external institutional shifts.

In summary, dynamic capability theory provides a robust lens for understanding how DT can remain resilient over time. By sensing emerging trends, seizing strategic opportunities, reshaping organizational structures, fostering a learning culture, engaging ecosystem partners, and adapting to regulatory shifts, organizations can continuously renew their digital strategies and operations. This approach emphasizes cultivating the adaptive capacities necessary to integrate, build, and reconfigure competences, positioning the organization to thrive in a rapidly evolving environment and ensuring that DT becomes an ongoing, sustainable competence.

5.3. An Integrative Framework for RDT

From Figure 2, building on a rigorous literature review and coding process, the subsequent framework for RDT integrates key targets derived from three principal pillars—Technology, Organization, and External Environment. Each of these pillars encompasses interrelated drivers, corroborated by both direct and indirect evidence from contemporary scholarly work. The coming sections synthesize these drivers and explain how dynamic capabilities—encompassing the identification, adoption, and reconfiguration of organizational competences—underpin the attainment of each target. By unifying these pillars through a cohesive strategic lens, the framework presents a structured approach for organizations to cultivate and sustain RDT over the medium term. See Figure 4 for the integrative framework of RDT.

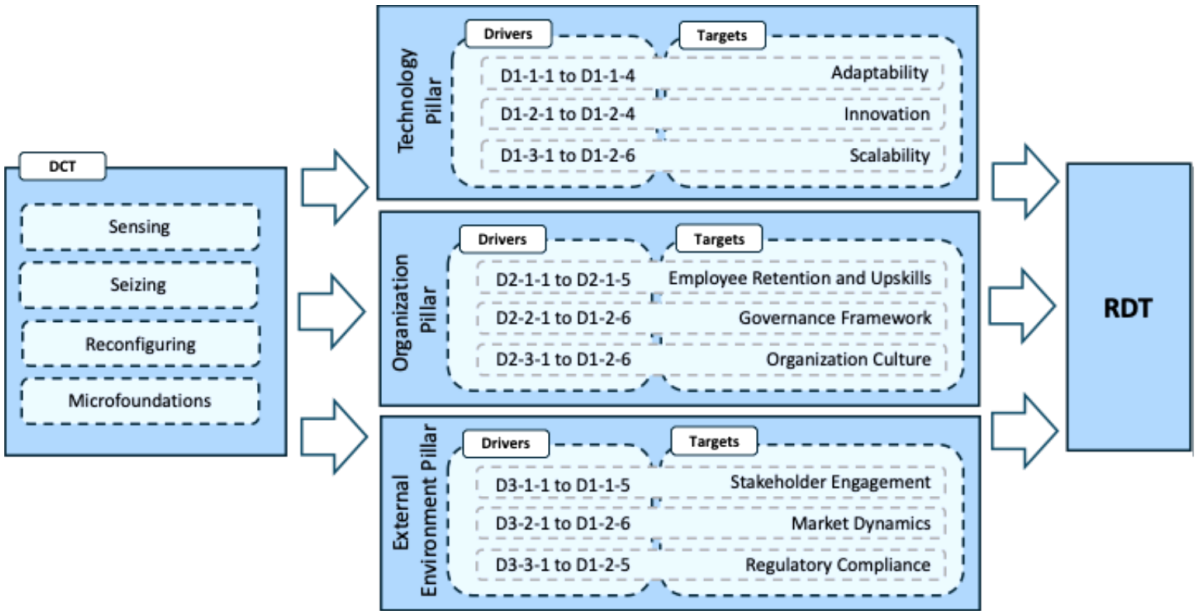


Figure 4. An Integrative Framework for RDT

5.3.1. Technology Pillar - Adaptability

Organizations must build technological foundations that enhance adaptability, foster innovation, and maintain resilience. There are main drivers synthesized from literature as shown below:

D1-1-1: Flexible Digital Infrastructure and Reconfigurable Technologies: Adaptability demands flexible, scalable infrastructures that can be reconfigured swiftly in response to disruptions or new opportunities [119]. Cloud migration and cloud-based systems facilitate rapid scalability and on-demand resource allocation [90], while a common platform-driven digital architecture provides a standardized flexible foundation for technology upgrades [56]. Redundancy and diverse technological options—such as multiple service providers—enable organizations to withstand shocks and pivot quickly [122], and managing or phasing out legacy systems remains vital for agility. Reconfigurability also involves governance structures that support remote-working capabilities and bolster digital core capacity [22, 70, 122]. Flexible IT infrastructures, potentially enabled by bimodal IT, help integrate new technologies with minimal disruption, thus sustaining medium-term DT [46]. Ultimately, orchestrating an everything-as-a-service technology strategy can account for exogenous shocks and safeguard the longevity of IT investments [121].

D1-1-2: Agile Governance, Strategy, and Processes: Agile governance and processes support prompt decision-making and realignment of technology initiatives, allowing organizations to pivot rapidly during crises [73, 83]. Embracing trade-offs between efficiency and flexibility is essential for ongoing DT [70], and clear governance frameworks can guide roles, responsibilities, and escalation paths for real-time responsiveness [83]. Strategic redesign of digital resources—through updated policies, organizational shifts, and workforce training—helps maintain alignment with evolving market conditions [23, 60]. Indigenous R&D capabilities further reinforce dynamic resource integration for continuous recalibration [89]. By adjusting digital strategies rather than adhering rigidly to initial plans, enterprises can better absorb external shocks and sustain adaptability [23].

D1-1-3: Data-Driven Insights and Intelligent Analytics: Data gathering and analytics enable swift, evidence-based responses to change, helping organizations anticipate disruptions and respond to emerging patterns [56, 122]. Data aggregation capability and intelligent analytic capability bolster adaptation by supporting new value creation and informed strategic decisions [88]. Easy-to-use, reliable technology further encourages the workforce to leverage insights [63]. Effective data management—covering collection, integration, cleaning, and analysis—enables rapid adjustments of strategies and workflows [97, 102]. Big data analytics can uncover trends that necessitate immediate operational pivots [98], while integrating multiple ICT resources supports cohesive digital ecosystems generating real-time intelligence [46, 109]. As digital capability matures, organizations accelerate decision-making and capitalize on emerging opportunities [99].

D1-1-4: Security, Preparedness, and Balanced Trade-offs: Robust security and preparedness measures mitigate vulnerabilities, ensuring organizations can pivot swiftly to address cyber threats or data breaches [97]. Establishing communication mechanisms and incident-response procedures can contain damage, protect continuity, and reinforce digital resilience [97]. Fostering employee confidence in secure technology usage also supports an agile environment [22]. Balancing efficiency with flexibility is often managed by incorporating redundancies and multiple technologies, allowing rapid recovery [70]. DT must preserve security while maximizing adaptability [100, 101], bridging technology, talent, and governance to maintain organizational vitality [112].

Analysis towards DCT: Adopting DCT as a lens, organizations can integrate flexible digital infrastructures, agile governance, data-driven insights, and robust security measures to foster RDT within the Technology Pillar. By leveraging DCT's sensing capabilities, firms proactively scout emerging technologies—such as cloud computing, AI, and intelligent analytics—to identify opportunities and threats early, while seizing capabilities drive rapid, evidence-based decision-making and strategic realignment through agile governance and adaptive processes. Reconfiguring capabilities then enable the dynamic restructuring of IT assets, ensuring scalable, secure, and continuously optimized systems that balance efficiency with flexibility. Together, these interwoven dynamic capabilities build a robust digital ecosystem that sustains adaptability over the medium term (see Figure 5),

5.3.2. Technology Pillar - Innovation

Emerging technologies, platform ecosystems, data-driven experimentation, and a strong innovation infrastructure form the foundation for ***RDT***. This section outlines how organizations can leverage these elements to drive continuous innovation and competitive growth ***from existing surveyed literature***.

D1-2-1: Emerging Technologies and Digital Capabilities: Investing in and adopting new digital technologies—such as AI, machine learning, cloud computing, blockchain, and IoT—forms the core of innovation-oriented transformation [74, 100, 101, 105, 107, 108, 110, 120]. When organizations develop robust digital capabilities—through

training, knowledge-building, and dynamic skill sets—they strengthen their capacity to introduce and manage technological innovations [85, 88, 123]. Higher levels of digital maturity, including digital intensity and transformation-management intensity, also amplify a company's ability to leverage these emerging technologies successfully [73]. Procedural innovativeness and the exploration of novel applications further expand an organization's innovation frontier by embedding creativity into everyday processes [71, 72]. Ultimately, these efforts require continual digital innovation investments to sustain technology-driven improvements [110, 119].

D1-2-2: Platforms, Networks, and Ecosystem-Based Innovation: Leveraging existing digital technology platforms allows organizations to extend and scale their innovative offerings [67]. Digital networks and platforms nurture collective value creation through collaboration with complementors, partners, and external innovators, thus spurring novel product and service ideas [78, 99]. Integrating social, mobile, analytics, cloud, and IoT (SMACIT) technologies into a broader ecosystem fosters new kinds of digital services and business models [83]. Moreover, open innovation practices through these platforms enable shared resource exchange and knowledge flows, strengthening resilience as firms connect with diverse stakeholders and markets [99]. Leaders must also focus on defining and enhancing their unique value proposition, selecting where to innovate in-house versus where to integrate third-party solutions, thereby maximizing competitive advantage [96, 104].

D1-2-3: Experimentation, Data-Driven Insight, and Continuous Learning: Rapid experimentation with digital tools and platforms supports agility and accelerates innovation [70], especially when organizations embed risk-taking and iterative learning into their strategies [63]. By collecting and analyzing vast amounts of operational and customer data, companies gain the descriptive, predictive, and prescriptive insights necessary to spot emerging opportunities and refine their offerings [109, 115]. Experimentation and development of digital initiatives—backed by user-centric innovation—allow firms to quickly prototype and adapt solutions to real-world needs [63, 103]. Organizations that actively exploit these data-driven innovations in products, services, and processes are better positioned to renew their competitive edge over time [46]. Furthermore, strategic decisions about where to integrate external technologies versus where to innovate internally help balance speed, cost-effectiveness, and uniqueness in new solutions [63].

D1-2-4: Infrastructure, Mindset, and Value Creation for Sustained Innovation: Establishing a solid IT infrastructure—comprising resilient systems, efficient data management, and flexible procedures—provides the technological backbone for continuous innovation. Within such an environment, leveraging advanced digital solutions to generate new products, services, and revenue streams becomes far more feasible [96]. At the same time, building a pervasive "digital mindset" among leaders and employees ensures that innovation efforts are embraced across the organization's culture, not limited to isolated initiatives [107]. Through continuous digitization, real-time decision-making, and integrated technology usage, firms can more effectively reimagine their value propositions and capitalize on emerging trends [21, 80, 103]. By aligning these technological foundations with a clear commitment to iterative learning and external collaboration, companies establish a robust innovation environment that propels medium-term DT.

Analysis towards DCT: Leveraging DCT, organizations drive continuous innovation by dynamically sensing emerging digital technologies and opportunities, seizing them through strategic investments and open innovation practices, and reconfiguring their IT infrastructures and business models for sustained transformation. By investing in advanced solutions such as AI, machine learning, cloud computing, blockchain, and IoT, firms enhance their ability to detect disruptive trends and foster collaborative ecosystems via digital platforms and networks. Rapid experimentation, data-driven insights, and a pervasive digital mindset further underpin agile decision-making and iterative learning, ultimately aligning technology, talent, and value creation for resilient innovation over the medium term (see Figure 5).

5.3.3. Technology Pillar - Scalability

Scalable DT relies on flexible infrastructures, modular architectures, effective data management, automation, and strategic technology investments. Synthesized from existing literature, this section examines the key enablers that support resilient and sustainable growth.

D1-3-1: Cloud Infrastructure and On-Demand Computing: A significant factor for scalability within is the adoption of cloud computing, which offers flexible, on-demand computing resources. Studies highlight that migrating to cloud platforms enables organizations to quickly adjust capacity to manage fluctuating workloads, thereby enhancing resilience during both growth phases and crisis periods [74, 90, 119]. Organizations adopting suitable cloud deployment models report greater efficiency and adaptability, illustrating how scalable cloud solutions underpin RDT in diverse sectors [67]. Moreover, cloud-based infrastructure supports multichannel offerings and expansion into larger digital ecosystems, thereby facilitating agile responses to changing market conditions [80].

D1-3-2: Modular and Flexible Technology Architectures: Designing modular systems and flexible architectures is critical for scaling in line with evolving operational requirements. This modularity allows organizations to integrate new technological components and expand functionality without compromising existing systems [78, 83]. By partitioning technology stacks into manageable modules, organizations can easily upgrade or replace elements,

enhancing the adaptability crucial for RDT [101, 122]. Flexible architectures also provide a robust foundation for distributed operations and continuous innovation, ensuring that technological growth does not outpace organizational capacity to manage it [103].

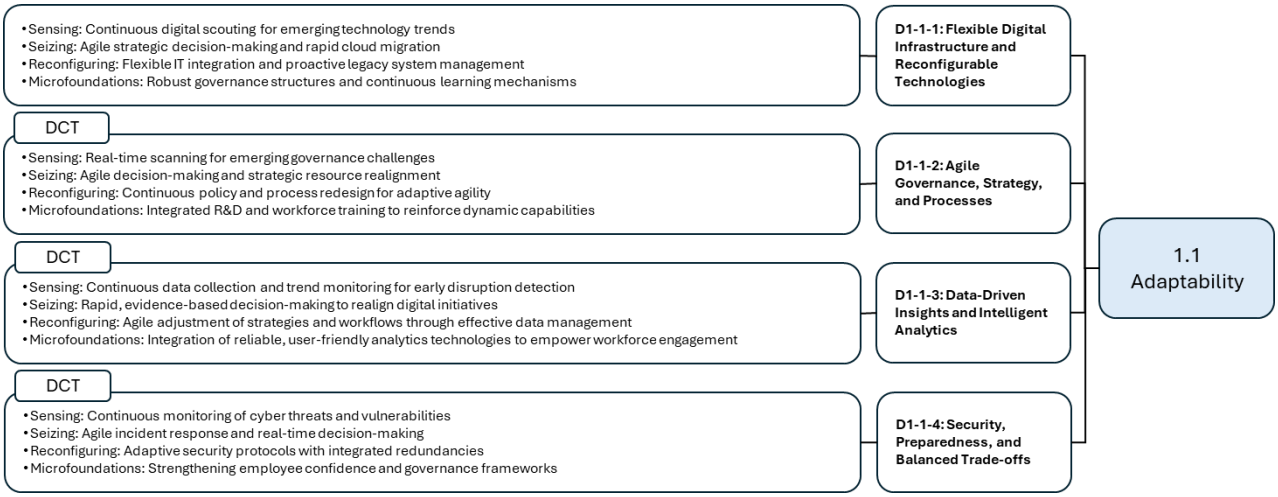
D1-3-3: Infrastructure Readiness and Redundancy: Several sources emphasize the need for reliable infrastructure investments, including high-speed networks, bandwidth capacity, and redundancies, to handle surges in digital workloads [66]. Maintaining redundancies in data and IT systems—such as backup sites and mirrored servers—supports resilience by minimizing downtime during unexpected disruptions [62, 71]. This focus on infrastructural readiness extends to ensuring sufficient resource provisioning to absorb sudden increases in customer or process demands [46]. Robust networks and standardized IT/OT architectures form a key backbone for scalable, secure operations [100, 103].

D1-3-4: Data Management and Analytics Capabilities: Scalable DT hinges on the ability to manage and exploit rapidly expanding data volumes. Efficient data governance frameworks help organizations handle a large amount of new data streams securely and maintain performance at scale [72, 96]. Adopting big data analytics—built upon robust data infrastructures—enables real-time decision-making and timely identification of emerging trends, which are vital for sustaining growth in digital services [98, 107]. Moreover, dependable software solutions and well-structured data pipelines reduce operational bottlenecks and strengthen an organization's ability to scale effectively as new users, partners, or markets are integrated. [63, 109].

D1-3-5: Automation and Platform-Based Approaches: Implementing automation within business processes is an essential factor driving scalability by reducing manual workloads and operational overhead [90, 93]. Automated workflows enable organizations to absorb higher transaction volumes and maintain consistent service quality [78]. Additionally, platform integration cultivates collaborative ecosystems that facilitate multilateral interactions, thereby enabling expansion through horizontal scaling across diverse services or vertical growth through the enhancement of existing offerings [88, 99]. By doing so, platform-based strategies strengthen DT efforts against market volatility and provide a foundation for sustained future growth [60].

D1-3-6: Strategic Technology Investments for Growth: Building a scalable technology environment necessitates strategic technology investments that anticipate future growth trajectories [83, 94]. Organizations that proactively allocate resources to ensure robust infrastructures position themselves to adapt swiftly as user demand surges [21, 104]. The potential for technology reuse, reconfiguration, and cost-effective resource acquisition further underscores how planned investments help maintain cost efficiency and sustain digital capabilities over time [107–109]. By aligning these investments with overarching strategic objectives, firms enhance the sustainability of their scaling efforts and reinforce long-term resilience in DT [56, 122].

Analysis towards DCT: Leveraging DCT for scalability, organizations can dynamically sense, seize, and reconfigure digital resources to build a resilient infrastructure. Cloud computing provides on-demand capacity adjustments and multichannel support, while modular architectures enable seamless upgrades and integration of new technologies. Robust infrastructure readiness—ensured through high-speed networks, ample bandwidth, and system redundancies—complements automation and platform-based approaches that streamline operations and support both horizontal and vertical scaling. Strategic technology investments further align these dynamic capabilities with long-term growth, transforming initial digital innovations into a scalable, competitive ecosystem (see Figure 5).



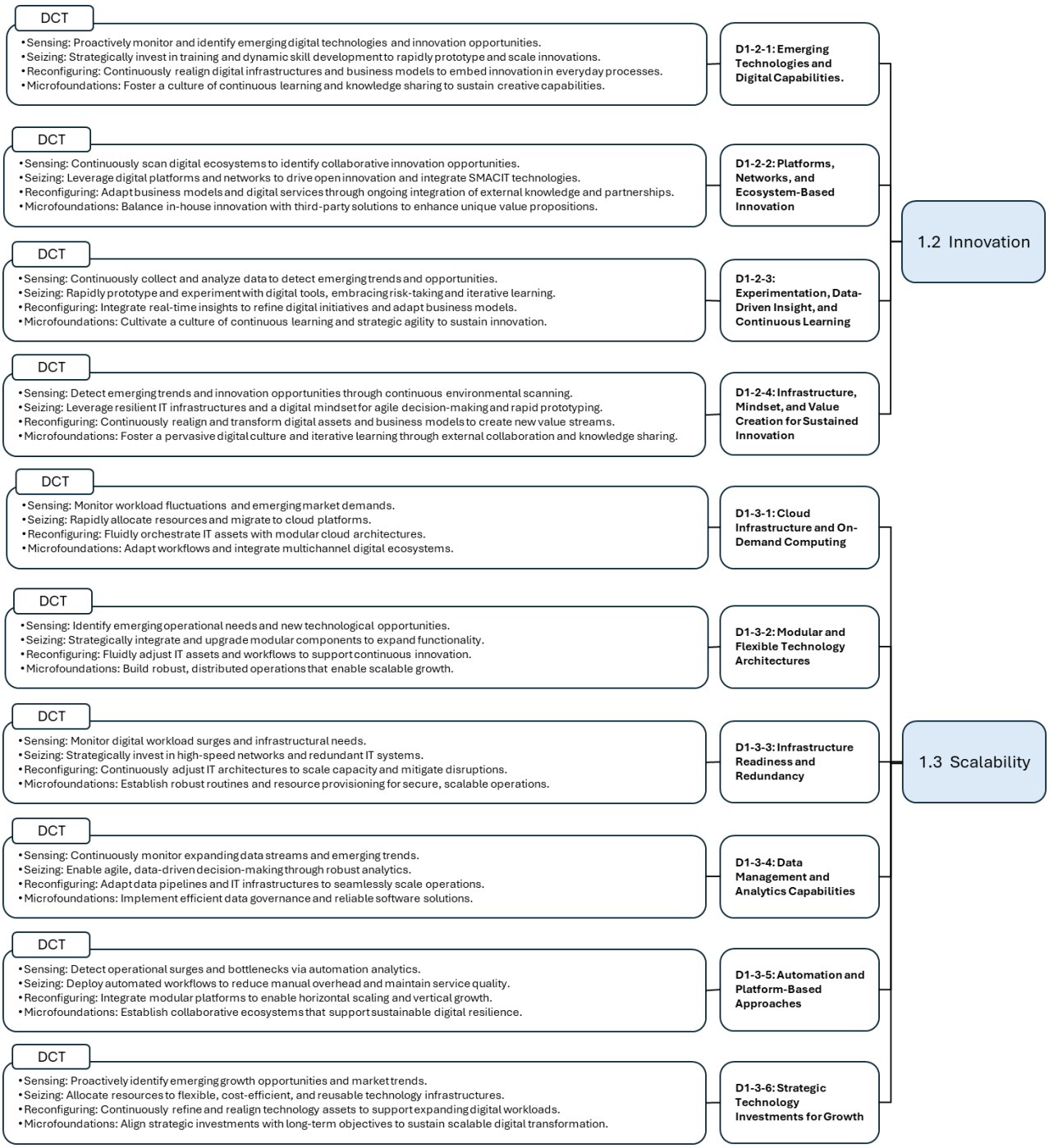


Figure 5. DCT-driven technology pillar for adaptability, innovation, and scalability

5.3.4. Organization Pillar – Employee Retention and Upskills

Below is the synthesized drivers under the Organization Pillar gearing towards RDT. Each theme highlights related drivers and discusses their significance for sustaining DT over a medium-term horizon.

D2-1-1: Digital Skills, Continuous Learning, and Training: Ensuring employees possess essential digital skills is crucial for RDT [13, 62, 69]. Continuous learning and targeted training maintain workforce adaptability amid evolving technologies [13, 66, 74]. These initiatives bolster digital resilience, enhancing employee capability to handle uncertainties and cyber incidents [22]. Consequently, organizations mitigate skill obsolescence and promote ongoing professional development [20, 63, 83, 85]. Effective upskilling thus supports daily operations and medium-term DT objectives [87, 123].

D2-1-2: Knowledge Management, Collaboration, and Expertise-Sharing: Robust knowledge management practices are critical for retaining institutional know-how, accelerating the development of digital capabilities, and enabling continuous learning [93, 115]. Tools such as webinars, e-modules, documented repositories, and knowledge-

sharing sessions encourage employees to disseminate expertise, thus scaling organizational learning [23, 56, 86]. Engaging subject-matter experts and motivating them to share experiences fosters an environment where employees collectively expand their skill sets [13]. Active collaboration across different teams also supports integrative technology utilization, as employees become adept at leveraging multiple digital tools and processes [100, 103]. By internalizing best practices and facilitating frequent knowledge exchange, organizations strengthen their medium-term resilience in a rapidly shifting digital landscape [96].

D2-1-3: Organizational Culture of Innovation and Adaptability: An innovative and adaptive culture underpins employee engagement and retention during DTs [13, 120]. By championing open-mindedness and readiness for change, organizations encourage employees to embrace novel technologies and processes [60, 122]. Leaders may introduce initiatives—such as pro-environmental culture campaigns or agile mindsets—to drive acceptance of new digital methods [98, 103]. This environment empowers staff to experiment and contribute, fueling continuous innovation that brings about new in-house skills [105]. Ultimately, when employees perceive the organization's cultural stance as supportive of creativity and risk-taking, they are more inclined to remain and help sustain the digital agenda [100].

D2-1-4: Leadership, Managerial Mindfulness, and Strategic Alignment: Leadership commitment and managerial mindfulness are essential for assessing workforce gaps, orchestrating training, and aligning upskilling initiatives with broader organizational strategies [71, 73]. Digital leaders play a decisive role in setting a clear direction, deciding which employees and competencies are critical for transformation, and fostering an environment that prizes continuous improvement [13, 96]. Their adaptability encourages rapid skill acquisition and knowledge sharing across the organization [96]. Moreover, leadership that prioritizes human resource change management—such as by allocating resources to talent development and championing collaborative processes—helps avert common pitfalls of DT [20, 86]. Through strong reward and recognition mechanisms, leaders reinforce employees' willingness to learn and grow, ultimately boosting retention of skilled individuals [56].

D2-1-5: Employee Empowerment, Well-Being, and Retention: Retaining a digitally capable workforce depends on making employees feel valued, supported, and empowered to influence transformation outcomes [9]. When individuals have meaningful input in digital projects and see their skills recognized, they are more engaged and loyal to the organization [56, 77]. Addressing employee well-being—by monitoring technostress, offering mental health support, or providing flexible work arrangements—further strengthens resilience [83, 102]. Providing continuous support and suitable training formats ensures that staff with diverse learning preferences can adapt and excel [63]. Such an inclusive, supportive environment preserves vital institutional knowledge and grows the organization's internal expertise for future digital initiatives [93, 103, 120].

Analysis towards DCT: Leveraging DCT for enhancing employee retention and upskilling entails a continuous cycle of sensing, seizing, and reconfiguring that empowers organizations to adapt to evolving digital landscapes. By dynamically sensing emerging skill gaps and cultural shifts, firms can proactively identify training needs and best practices; seizing opportunities through targeted initiatives like digital academies, knowledge-sharing communities, and leadership-driven talent development; and reconfiguring HR practices to integrate well-being, empowerment, and strategic alignment into a cohesive learning environment. This integrated approach not only preserves institutional knowledge but also cultivates a resilient, engaged, and adaptable workforce poised to sustain DT over the medium term (see Figure 6).

5.3.5. Organization Pillar – Governance Framework

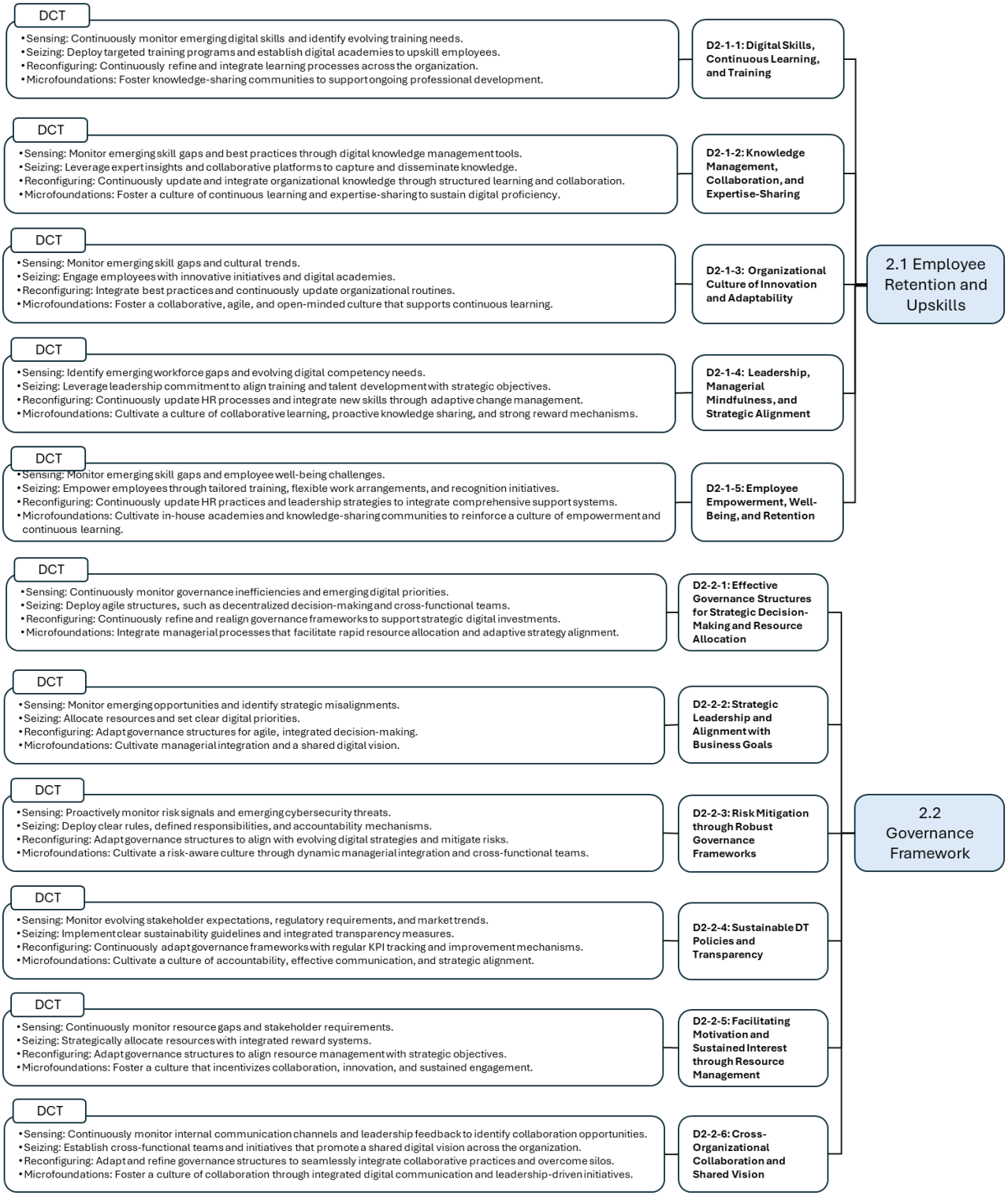
Effective governance and leadership are critical to steering DT toward long-term resilience. This section explores governance structures, strategic leadership, risk management, and collaborative practices that underpin sustainable transformation efforts.

D2-2-1: Effective Governance Structures for Strategic Decision-Making and Resource Allocation: Robust governance frameworks facilitate strategic decision-making and efficient resource allocation, essential for successful DT and resilience. Clearly defined governance processes help organizations strategically invest in evolving digital capabilities such as innovation, enhancing the alignment and impact of DT efforts [62, 80, 83, 120].

D2-2-2: Strategic Leadership and Alignment with Business Goals: Strategic leadership significantly impacts DT by aligning digital initiatives with overarching business objectives. Effective leaders provide clear guidance, ensure consistent communication of strategic directions, and embed DT as a key organizational priority. This alignment ensures that digital efforts are not fragmented but reinforce the organization's broader strategy, enhancing medium-term

resilience [9, 23, 62, 64, 73, 74, 80, 83, 92, 100, 120]. Leadership commitment and managerial competencies are indispensable elements within governance structures. Effective digital leaders ensure organizational commitment, oversee comprehensive DT strategies, allocate necessary resources, and cultivate a shared digital vision. These competencies and commitments significantly affect DT implementation success and long-term resilience [56, 63, 78, 93, 100, 102].

D2-2-3: Risk Mitigation through Robust Governance Frameworks: Governance frameworks play a crucial role in mitigating risks associated with DT. Effective governance includes clear rules, defined responsibilities, and strong accountability mechanisms. Such structures enable organizations to proactively manage cybersecurity threats, avoid resource misallocation, and ensure compliance, contributing significantly to organizational resilience during transformation efforts [77, 80, 83, 87, 120].



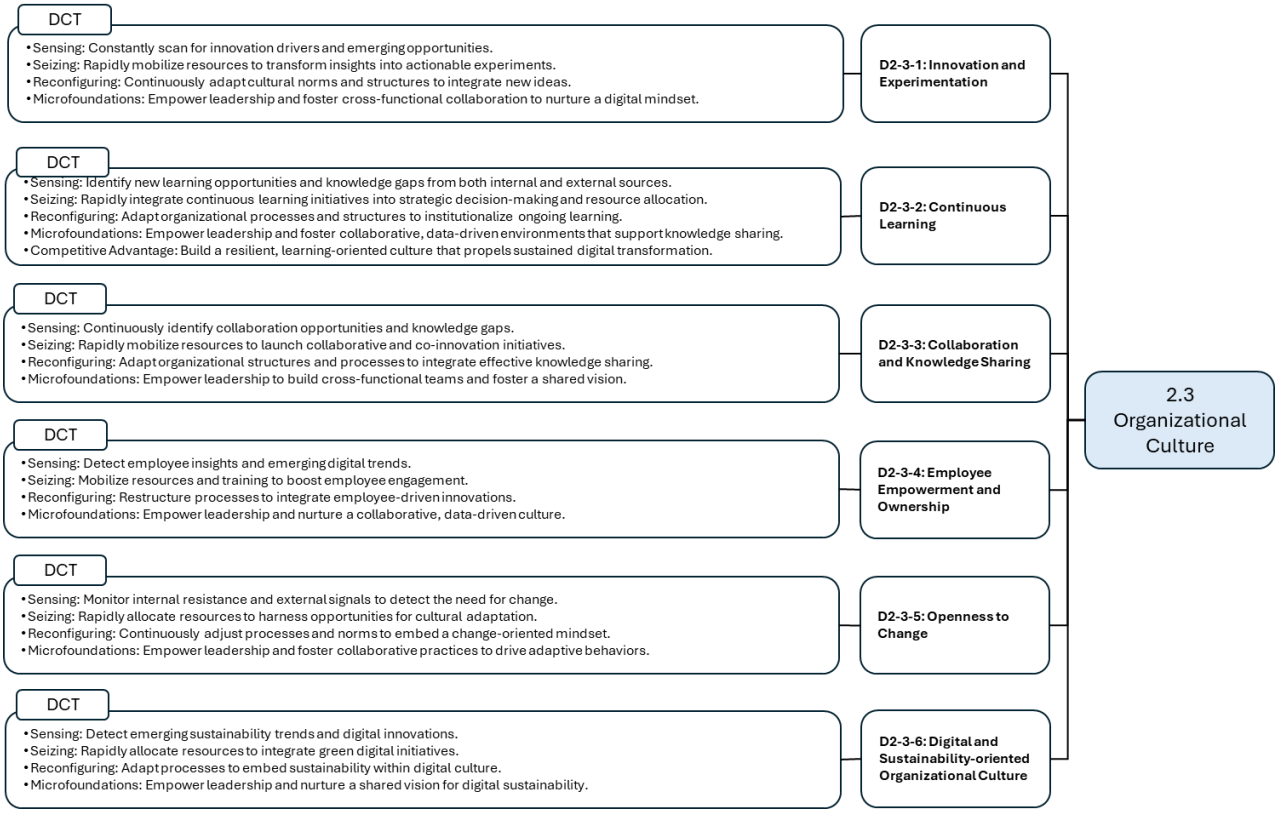


Figure 6. DCT-driven organization pillar for employee retention & upskilling, governance framework, and organizational culture

D2-2-4: Sustainable DT Policies and Transparency: The development and transparent implementation of sustainable DT policies are fundamental governance components. Organizations benefit from explicitly defined sustainability guidelines, integrated transparency, and effective communication strategies, enhancing stakeholder trust and accountability during DT initiatives [20, 60, 67]. Governance frameworks should incorporate continuous monitoring, evaluation, and improvement mechanisms. Regular tracking through Key Performance Indicators (KPIs) linked to digital strategies ensures alignment, accountability, and adaptation of DT initiatives to changing organizational needs and external environments, thereby supporting sustained resilience [63, 83].

D2-2-5: Facilitating Motivation and Sustained Interest through Resource Management: Governance frameworks must effectively manage and facilitate access to crucial resources such as financial capital, technological support, and compliance with regulatory requirements. These elements collectively maintain organizational motivation and sustained interest in DT, ensuring ongoing resilience and adaptability to evolving market conditions [45, 66, 94]. Embedding reward and recognition mechanisms into governance frameworks can significantly enhance DT success. Such mechanisms incentivize collaboration, innovation, and alignment with transformation goals, reinforcing desired behaviors and ensuring ongoing engagement from employees and leadership alike [56].

D2-2-6: Cross-Organizational Collaboration and Shared Vision: Cross-organizational collaboration supported by governance frameworks is essential for sustained DT. Clear internal communication channels, collaborative processes, and leadership-driven shared visions help organizations overcome barriers and sustain transformational efforts effectively. This collaborative governance approach significantly contributes to organizational adaptability and digital resilience [75, 105].

Analysis towards DCT: Leveraging DCT for effective governance frameworks demonstrates how the sensing-seizing-reconfiguring cycle drives DT success. Through this perspective driver, organizations continuously sense market shifts and internal inefficiencies to identify governance gaps, seize opportunities by deploying agile processes like cross-functional teams and decentralized decision-making, and reconfigure their structures to ensure adaptability in the face of disruption. This dynamic orchestration enables strategic leadership to align digital initiatives with business objectives, mitigate emerging risks, ensure transparency and sustainability, optimize resource allocation to maintain motivation, and foster cross-organizational collaboration—all contributing to medium-term resilience and sustained competitive advantage (see Figure 6).

5.3.6. Organization Pillar–Organizational Culture

Organizational culture plays a pivotal role in RDT. Existing literature highlights how innovation, continuous learning, collaboration, empowerment, openness to change, and a sustainability-oriented mindset collectively strengthen digital resilience and adaptability.

D2-3-1: Innovation and Experimentation: Organizations that embrace a culture of innovation and experimentation are better positioned for sustained DT. This cultural approach encourages piloting new ideas and innovative practices, allowing the organization to adaptively respond to technological advancements and market disruptions, reinforcing resilience [56, 63, 72, 73, 96, 100, 120, 122]. An adaptable and agile organizational culture is critical for sustaining DT over the medium-term horizon. Organizations must readily respond to global changes and unexpected environmental conditions by fostering cultural adaptability and agility to support innovation and experimental opportunities [65, 67, 72, 73, 75, 83, 100, 120]. Mitigating organizational inertia and minimizing bureaucratic barriers significantly enhance the sustainability of DT. Organizations need to foster agile processes, reduce bureaucratic hurdles, and encourage active employee participation in transformative changes [63, 79, 102].

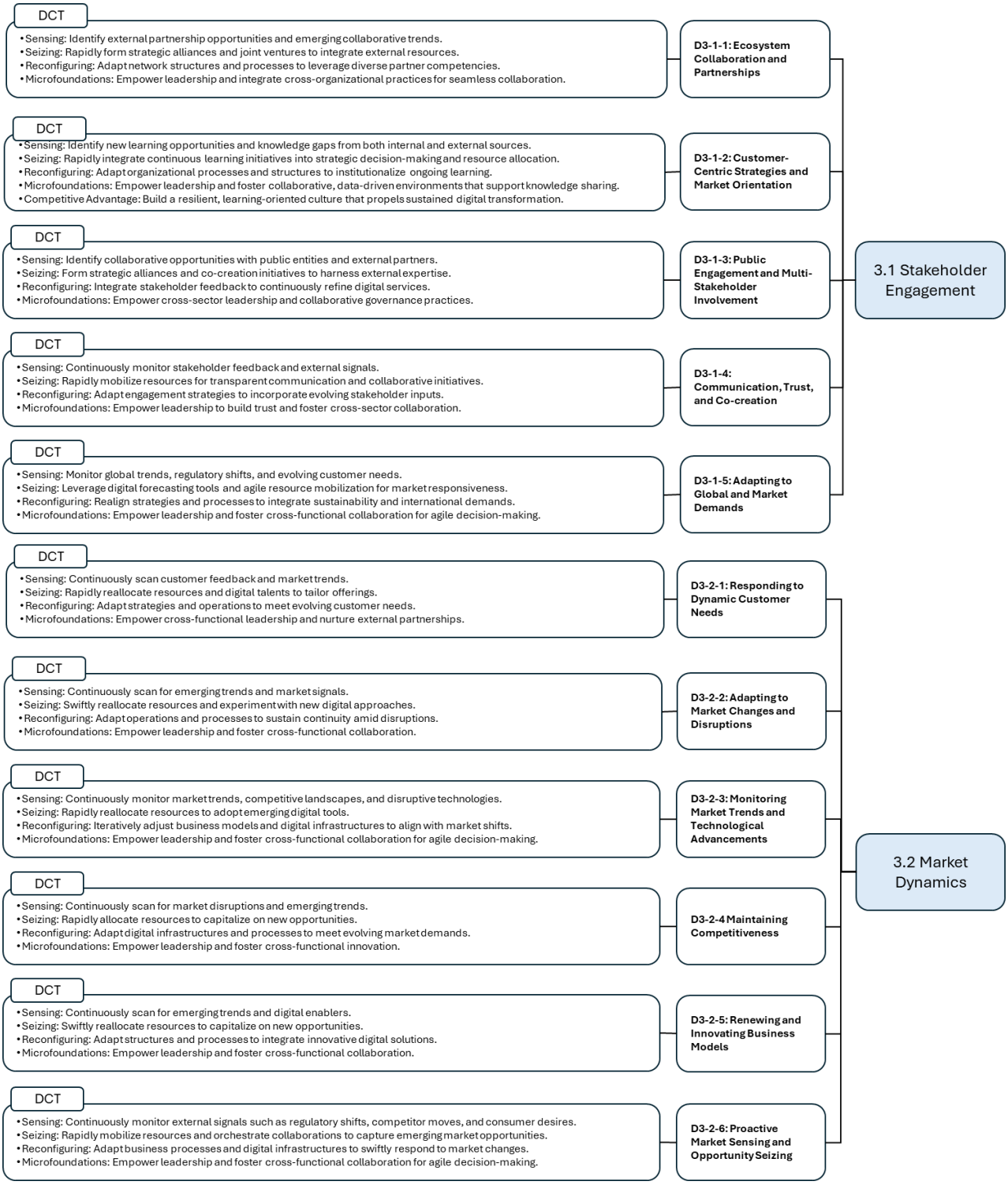


Figure 7. DCT-driven external environment pillar for stakeholder engagement, market dynamics, and regulatory compliance

D2-3-2: Continuous Learning: A culture emphasizing continuous learning significantly strengthens organizational resilience in DT by equipping organizations to adapt dynamically to evolving technological landscapes and external disruptions. Continuous learning involves systematically acquiring new knowledge, reflecting on past experiences, and proactively adapting strategies to overcome challenges and barriers encountered during DT journeys [9, 56, 60, 69, 75, 83, 115]. Moreover, continuous learning extends beyond individual skills development, encompassing organizational-level capability to document, analyze, and reuse acquired knowledge. Organizations can institutionalize continuous learning through systematic knowledge capture and reuse, supporting sustained digitization processes [115]. Similarly, fostering a data-driven culture through effective tools directly supports continuous learning, enabling organizations to translate data into actionable insights for better decision-making [9]. At a strategic level, continuous learning requires organizations to align ongoing training programs closely with emerging digital needs, ensuring employees remain adaptable as new technologies are introduced. This alignment is emphasized by frameworks highlighting continuous skill upgrades as foundational elements of DT success, especially in environments experiencing continuous technological change [60, 83]. Continuous learning constitutes not merely employee development but a broader organizational culture of reflective practice, strategic adaptation, and proactive responsiveness.

D2-3-3: Collaboration and Knowledge Sharing: A collaborative culture, both internally and externally, strengthens digital resilience and ensures successful DT sustainability. Collaborative networks facilitate knowledge sharing, resource integration, and co-innovation efforts, contributing to a collective vision and commitment towards transformation [13, 20, 56, 69, 75, 97, 100, 102, 115, 120]. Developing and clearly communicating a shared vision is critical for overcoming resistance and fostering collective commitment towards DT. Leaders play a key role in aligning organizational values, creating coherence around digital goals, and reinforcing shared objectives [56, 62, 63, 79, 97, 105].

D2-3-4: Employee Empowerment and Ownership: Empowering employees to take ownership of digital initiatives enhances the sustainability of DT by fostering greater engagement, a heightened sense of responsibility, and stronger alignment with organizational objectives. The empowerment encourages employees to participate in digital projects, contribute innovative ideas, and proactively address emerging challenges, thereby substantially increasing the effectiveness of digital initiatives [100, 120]. This empowerment is closely associated with the cultivation of a data-driven culture, wherein employees are granted access to data and actionable insights, enabling informed decision-making across all organizational levels. Organizations that strategically invest in empowering their workforce through targeted training, clear communication, and participatory governance structures tend to demonstrate enhanced resilience, particularly in critical areas such as cybersecurity, where engaged employees play pivotal roles in mitigating risks [77, 97]. Furthermore, active involvement in the DT process encourages commitment to organizational objectives while simultaneously reduces resistance to change. Such empowerment not only enhances employee motivation but also ensures that individual goals are closely aligned with broader organizational strategies [9].

D2-3-5: Openness to Change: An organizational culture that fosters openness to change is fundamental to minimizing resistance and sustaining DT over the medium term. Organizations that systematically build change capacity y are better positioned to manage the complexities and uncertainties inherent in digital initiatives [120]. Openness to

change is also a key component of structural capital, enhancing an organization's ability to absorb external shocks and adapt to evolving technological landscapes [71]. Moreover, the development of an adaptive mindset enables firms to respond proactively to dynamic environments [122]. Empirical studies indicate that resistance among employees remains a major barrier to the successful and sustainable implementation of DT, highlighting the critical role of cultivating a receptive organizational culture. Embedding openness to change reciprocally supports continuous learning, iterative improvement, and greater resilience in the execution of digital initiatives, reflecting organization's capabilities in RDT [63, 83]. Ultimately, cultivating cultural adaptiveness serves as a critical enabler for organizations striving to sustain DT efforts within increasingly volatile and complex environments [100].

D2-3-6: Digital and Sustainability-oriented Organizational Culture: Developing a dynamic, digitally oriented culture that embeds sustainability as a core value is crucial for sustaining DT. Organizations must undertake deliberate cultural adjustments to integrate sustainability principles in response to increasing global demands and pressures, thereby reinforcing organizational resilience and enhancing the long-term effectiveness of DT initiatives [19]. While integrating sustainability principles may initially introduce certain complexities, a strategically developed sustainability-oriented culture can foster innovation, improve operational efficiency, and enhance organizational resilience. Conversely, organizations that fail to incorporate sustainability into their cultural and strategic frameworks are likely to encounter escalating challenges, including heightened regulatory pressures, reputational risks, and reduced competitiveness in an increasingly sustainability-driven global market [98]. Embedding sustainability within digital culture also promotes agility, environmental responsibility, and proactive risk management [63, 87].

Analysis towards DCT: DCT serves as a pivotal driver for cultivating a digitally oriented, sustainability-embedded organizational culture. Organizations must continuously sense emerging trends in digital innovation and sustainability, seize opportunities through agile decision-making and resource mobilization, and reconfigure cultural norms and processes to integrate eco-friendly practices. Empowered leadership and cross-functional collaboration—key microfoundations—foster a shared digital vision that not only drives innovation and operational efficiency but also builds resilience against environmental and regulatory challenges. This integrative approach creates a lasting competitive advantage by ensuring that the organization remains adaptive and forward-thinking (see Figure 6).

5.3.7. External Environment Pillar – Stakeholder Engagement

This section examines drivers including ecosystem collaboration, customer-centric strategies, multi-stakeholder involvement, trust-building, and market adaptability collectively strengthen RDT under stakeholder engagement focus.

D3-1-1: Ecosystem Collaboration and Partnerships: The formation of ecosystem collaborations by integrating multiple external partners, including technology providers, industry associations, and government agencies, is critical for stakeholder engagement. These networks enable organizations to expand resource capabilities, knowledge, and expertise, thereby enhancing their digital resilience and medium-term sustainability [13, 64, 120]. Examples include joint ventures and strategic alliances designed to reshape business models [64] and the creation of public-private ecosystems, whereby shared infrastructure and common standards advance digital adaptability [44, 70]. Collaborative efforts extend across the public sector, where cross-agency strategies and learning from mutual barriers help drive collective DT and resilience [69]. Similarly, orchestrating digital resilience with diverse partners involves understanding and leveraging each other's resources, knowledge, and skills for a more robust "champion" role [92, 121]. Moreover, ecosystem engagement is an essential enabler for SMEs and larger firms alike, allowing them to harness complementary competencies and create synergies that bolster RDT [93].

D3-1-2: Customer-Centric Strategies and Market Orientation: This ensures that digital initiatives align with evolving consumer demands. Digital marketing, e-commerce solutions, and direct engagement through digital platforms foster more resilient and adaptable organizations that can swiftly meet changing preferences [13, 73]. Focusing on understanding customer needs [120] and embracing market-oriented strategies [71] ensures DT efforts enhance customer value and strengthen business continuity. Digitization can improve customer experience by offering seamless interactions, agile service delivery, and customizable solutions [73, 74]. Such an outward-looking focus enables organizations to anticipate and absorb external shocks through consistent adaptation of digital offerings to shifting consumer behaviors [79, 81]. Encouraging customer involvement at all stages also drives feedback loops, further refining digital solutions in real time [78, 83].

D3-1-3: Public Engagement and Multi-Stakeholder Involvement: Effective public engagement and multi-stakeholder collaboration play a pivotal role in strengthening the RDT capabilities of a firm by broadening the range of external resources, knowledge, and support systems required to sustain DT. In the public sector, actively incorporating government entities, citizens, and external partners fosters greater transparency and responsiveness in digital service delivery, consequently enhancing organizational adaptability [69]. Engaging citizens in co-creation processes or policy dialogues amplifies digital resilience, ensuring that digital initiatives directly reflect public needs while simultaneously cultivating trust in e-government platforms [72]. Establishing agreements and partnerships through multi-stakeholder collaboration facilitates the sharing of infrastructure, the exchange of specialized knowledge, and the establishment of

supportive ecosystems [102]. By aligning national-level digitalization strategies with local initiatives, public-sector entities can expand their capacity for continuous innovation and support resilience through ongoing communication of priorities and progress [75]. This alignment, when complemented by external support from academia, technology vendors, and government agencies, empowers organizations to adopt more robust and future-ready digital solutions [103]. Engaging a broad spectrum of stakeholders—including policymakers, industry practitioners, consumers, and non-governmental organizations—ensures DT strategies remain inclusive, responsive, and capable of evolving together with societal demands [98].

D3-1-4: Communication, Trust, and Co-creation: Establishing open communication channels, nurturing trust, and fostering co-creation with external stakeholders are critical for promoting RDT capabilities. Transparent messaging and proactive engagement minimize resistance to digital initiatives, while trust is vital in contexts like data privacy and cybersecurity to assure stakeholders of system integrity [63, 77]. Furthermore, co-creation practices—where partners, customers, and value chain members collaborate on product or service innovation—expand collective expertise and reinforce an organization's resilience against market disruptions [88, 123]. Actively seeking stakeholder feedback and facilitating iterative refinement ca ensure continuous alignment of digital initiatives with evolving market and societal needs, thereby sustaining their long-term DT efforts [99, 104].

D3-1-5: Adapting to Global and Market Demands: Adapting to global and market demands significantly reinforces a firm's capacity to sustain DT. Organizations must proactively respond to customer preferences, competitive pressures, and international requirements, thereby solidifying the organizational capabilities integral to resilient DT [78, 81]. Concurrently, market turbulence requires leveraging digital tools for forecasting and customization [79], while stakeholder expectations around social and environmental value compel the integration of sustainability [123]. Monitoring external signals—regulatory shifts, evolving customer needs, and competitor moves—enables proactive strategic realignment, preserving relevance in dynamic environments [89, 90, 94].

Analysis towards DCT: DCT, organizations can enhance RDT by integrating ecosystem collaboration, public engagement, and adaptive market responsiveness. By continuously sensing external signals—ranging from market trends and regulatory shifts to partner capabilities—firms seize opportunities through strategic alliances, co-creation initiatives, and transparent communication, and they reconfigure their processes to integrate stakeholder feedback and evolving public needs. Underpinned by proactive leadership and robust cross-sector collaboration, these dynamic capabilities build trust, foster innovation, and create a competitive advantage that sustains DT over the medium term. This integrated approach is illustrated in Figure 7.

5.3.8. External Environment Pillar – Market Dynamics

This section explores how market dynamics including customer responsiveness, market sensing, technological adaptation, and business model innovation drive digital resilience and long-term competitiveness.

D3-2-1: Responding to Dynamic Customer Needs: Adapting to evolving customer expectations stands out as a critical driver of market dynamics for RDT. Organizations that actively cultivate digital talents and form external partnerships can better design agile ecosystems capable of addressing changing consumer demands [64]. Being customer-centric also enhances an enterprise's ability to handle unforeseen market contingencies; as digital tools improve businesses' capacity to understand client preferences and tailor operations accordingly [73]. Moreover, continuous monitoring of customer needs through data analytics helps organizations forecast shifts in preferences, enabling them to update products, services, and strategies to remain competitive [79].

D3-2-2: Adapting to Market Changes and Disruptions: Organizations face constant pressure to manage rapid technological shifts, disruptive events, and global uncertainty. Resilience and agility in digital infrastructure support navigation through crises and periods of drastic fluctuation [119]. In events such as the COVID-19 pandemic, DT has become essential for businesses with limited adaptability struggling to remain viable [66]. The ability to experiment rapidly with new digital approaches further equips firms to respond effectively to external shocks [70, 122]. Even the public sector must pivot swiftly to changing societal needs, emphasizing the overarching importance of adaptability in uncertain markets [69]. Volatile, uncertain, complex, and ambiguous (VUCA) markets require digital resilience to handle the unpredictability that modern enterprises face [61, 99]. Developing strong digital capabilities equips organizations to sense, seize, and adapt to environmental fluctuations, thereby transforming potential vulnerabilities into strategic advantages [90, 101]. Overall, bridging supply chain visibility with real-time analytics and flexible operations ensures firms can weather disruptive forces and maintain continuity across dynamic market conditions [19, 103, 104].

D3-2-3: Monitoring Market Trends and Technological Advancements: Keeping abreast of competitive landscapes, market trends, and disruptive technologies is indispensable for RDT. Not only do these insights guide the adoption of emerging digital tools, but they also illuminate shifts in consumer behavior, regulatory environments, or industry standards [13, 120]. Technological advancements increase the necessity of strategic realignment and continuous scanning for opportunities or risks [66, 96]. Through proactive market sensing, firms can more swiftly integrate relevant enablers into ongoing digital initiatives, reinforcing their medium-term resilience [56, 63].

D3-2-4 Maintaining Competitiveness: Sustaining a competitive edge in volatile markets requires continual digital adaptation to match the pace of technological breakthroughs and consumer-driven disruptions. This strategic integration enables organizations to remain proactive rather than reactive in their approach [50]. RDT emerges as a critical factor for addressing the demands of rapid change and maintaining market relevance [120]. In highly competitive business, digital resilience—underpinned by dynamic capabilities—facilitates quick pivots toward more efficient business processes and innovative practices [63, 93, 94]. Consequently, competitive pressure serves as an ongoing catalyst driving organizations to refine their DT frameworks [96].

D3-2-5: Renewing and Innovating Business Models: Market dynamics—particularly technological disruptions—frequently compel organizations to renew and innovate their business models [78]. DT provides the flexibility to adjust existing structures, expand into new market segments, and build resilience against future turbulence [123]. By proactively identifying and integrating new enablers, firms can adapt their processes and resources to leverage emerging opportunities, avoid obsolescence, and sustain DT over time [56, 92].

D3-2-6: Proactive Market Sensing and Opportunity Seizing: Sensing external signals—such as regulatory shifts, competitor maneuvers, and emerging consumer desires—enables organizations to act preemptively rather than merely react [122]. Proactive market sensing supports early identification of disruptive potentials, ensuring timely adjustments that mitigate risks and amplify potential gains [89]. In parallel, dynamic capability frameworks emphasize orchestrating internal and external resources to recognize valuable market openings and adapt business processes accordingly [9, 121]. Such preparedness not only enhances the organization's resilience to external disruptions but also enables it to capitalize on emerging market opportunities [88, 92].

Analysis towards DCT: Leveraging Dynamic Capability Theory, organizations can proactively sense external signals—such as regulatory shifts, competitor maneuvers, and emerging consumer desires—through continuous market intelligence and data analytics; they can seize opportunities by rapidly reallocating resources and integrating innovative digital tools; and they can reconfigure their business models and operational processes to adapt swiftly to disruptive market changes. Underpinned by robust microfoundations like empowered leadership and cross-functional collaboration, this dynamic approach transforms market vulnerabilities into strategic advantages, ensuring sustained competitiveness in volatile environments (see Figure 7).

5.3.9. External Environment Pillar–Regulatory Compliance

Regulatory frameworks and compliance requirements are key drivers shaping RDT. This section discusses how legal mandates, cybersecurity standards, environmental regulations, and policy guidance reinforce digital resilience and sustainable growth.

D3-3-1: Regulatory Mandates and Standardization: Government regulations and industry standards frequently serve as catalysts for organizations to support their DT efforts. For instance, the presence of technology diffusion regulations motivates businesses to invest in digital infrastructures that boost resilience, while standards and frameworks (e.g., ISOs, EU directives) set clear guidelines for secure and interoperable technology adoption [13, 66]. Adherence to these mandates, such as the EU's digital operational resilience act, drive organizations to systematically incorporate operational continuity and risk management measures into their digital strategies [71]. In higher education, the need to meet compliance standards likewise compels universities to adopt digitally enhanced operations, thus reinforcing overall sustainability and resilience [67]. Organizational commitment to meeting environmental or social mandates demonstrates how stricter regulations encourage sustainable transformation. SMEs, for instance, align digital strategies with regulatory demands to maintain competitiveness and foster long-term viability [120]. By following established standards, organizations strengthen their capacity to resist disruptions and preserve continuity of digital initiatives, forming a core aspect of RDT.

D3-3-2: Data Protection and Cybersecurity Regulations: An increasing regulatory focus on data protection and cybersecurity drives organizations to implement robust defense measures within their DT journeys. Rules such as the General Data Protection Regulation (GDPR) and evolving acts on data governance obligate organizations to safeguard personal information and uphold rigorous security controls [122]. Compliance with these frameworks can mitigates legal and reputational risks, and solidifies the organization's digital infrastructure [77]. Law firms, for example, have emphasized new internal policies and remote-work technologies to protect sensitive client data, underscoring how cybersecurity regulations shape digital resilience during crises [60]. In parallel, meeting cybersecurity standards frequently involves staff training, continuous risk monitoring, and system hardening [93, 97]. Sectors including retail e-commerce and financial services demonstrate how data governance structures—complete with dedicated privacy officers—ensure alignment with frameworks like GDPR or national data laws [83]. By formulating clear policies for data handling, security, and accountability, organizations limit vulnerabilities and promote trust among customers and partners [92]. In parallel, the capacity to handle and protect large volumes of data is fundamental for modern digital services, reinforcing the synergy between governance mandates and corporate sustainability goals. Ensuring compliance with data privacy standards supports the maintenance of robust, future-proof digital solutions [103]. As a result, data privacy compliance also undergirds the broader objective of RDT by safeguarding critical assets and securing operational continuity in volatile market conditions.

D3-3-3 Environmental and Social Compliance: In industries with significant environmental impact, compliance requirements accelerate the adoption of green technologies and sustainable practices. Environmental regulations in polluting sectors compel organizations to integrate digital solutions that track, manage, and reduce ecological footprints [123]. Such adaptations align DT with broader sustainability objectives, promoting resilience by minimizing legal and societal pressures. Similarly, the push for environmentally responsible operations has led enterprises to embed green initiatives—such as ESG reporting and low-carbon footprints—into their digital strategies [87]. Meeting these standards fosters trust among regulators, consumers, and investors, thus safeguarding the enterprise's reputation and ensuring a more sustainable transformation path [23]. As DT increasingly converges with eco-friendly imperatives, regulatory directives often serve as both a constraint and a catalyst for cultivating RDT.

D3-3-4: Government Policy Guidance and Legal Frameworks: Government policies and legal frameworks heavily influence how organizations prioritize, fund, and structure their DT roadmaps. In certain contexts, public policy incentives—such as tax breaks or grants—encourage organizations to invest in indigenous R&D, thus creating strategic advantages for local economies [89]. The necessity of complying with these governance structures often triggers or accelerates digital initiatives aimed at ensuring competitiveness and operational sustainability [84]. This influence extends broadly across sectors, from municipalities adopting legal provisions for e-services [102] to healthcare ecosystems reconciling data security, resilience, and sustainability mandates [95]. By adhering to established laws and regulations, organizations align their DT with recognized standards, reinforcing the stability and longevity of their RDT capabilities [100, 105].

D3-3-5: Holistic Compliance for Digital Resilience: Organizations recognize the integrative nature of regulatory compliance, which overlaps cybersecurity, sustainability, and operational requirements. A holistic approach to compliance fosters digital resilience by systematically linking security, risk management, and continuous improvement in a digitally enabled business model [95]. Healthcare providers, for example, must coordinate multiple regulations—data protection, patient safety, and cybersecurity—to maintain trust and continuity of digital services [97]. More broadly, the synergy between compliance mandates and DT strengthens organizations against both near-term risks and long-range uncertainties [96]. Legal inefficiency and incomplete regulations also shape the ecosystem in which service firms operate, underscoring that effective DT strategies must account for potential legislative gaps and future rulemaking [99].

Analysis towards DCT: Leveraging Dynamic Capability Theory, organizations can embed a holistic compliance approach into their DT by continuously sensing evolving regulatory mandates—from data protection and cybersecurity to environmental and social standards—and seizing opportunities to align digital investments with emerging legal requirements and public policy incentives. By reconfiguring internal processes and business models to integrate diverse compliance dimensions, firms transform regulatory challenges into strategic advantages that mitigate legal, reputational, and operational risks while enhancing digital resilience. Robust microfoundations, anchored in agile leadership, dedicated compliance teams, and proactive government relations, ensure that these dynamic capabilities fortify digital infrastructures and secure long-term competitiveness (see Figure 7).

6. Organizational Implementation of Resilient Digital Transformation

This section examines how leading organizations have successfully operationalized RDT principles across the three pillars identified in the framework. Microsoft exemplifies the Technology pillar through its cloud-first transformation, continuously sensing emerging technologies and reconfiguring IT assets to establish the flexible digital infrastructure necessary for sustained innovation [39]. Similarly, DBS Bank built technological adaptability through cloud migration and modular architectures that support ongoing digital evolution rather than one-time transformation [21]. In the Organization pillar, LEGO demonstrates exceptional implementation by fostering experimentation and continuous learning following near-bankruptcy in the early 2000s, establishing governance mechanisms that balance control with flexibility while systematically developing workforce capabilities [85]. Siemens similarly established clear governance structures through their Digital Enterprise portfolio, creating decision-making processes that align digital initiatives with broader organizational objectives [62]. For the External Environment pillar, the Danish public sector actively incorporates multi-stakeholder involvement in digital service development, creating collaborative networks that enhance the resilience of public digital initiatives [69], while DBS Bank demonstrated exceptional responsiveness to market dynamics by continuously adapting digital offerings to evolving customer needs [56].

These case studies validate the RDT framework's core proposition that sustainable digital transformation requires integration across technological, organizational, and external dimensions. The organizations' success stems from their ability to develop and maintain the specific targets identified in the framework: adaptability, innovation, and scalability in the Technology pillar; employee retention/upskilling, governance frameworks, and adaptive culture in the Organization pillar; and stakeholder engagement, market responsiveness, and regulatory compliance in the External Environment pillar. Importantly, these organizations demonstrate how dynamic capabilities underpin RDT by continuously sensing emerging opportunities, seizing them through strategic action, and reconfiguring resources—aligning perfectly with the framework's theoretical foundation [133].

The RDT framework represents a significant advancement in digital transformation research by addressing the critical gap between initial implementation and medium-term sustainability. While existing digital maturity models (e.g., Deloitte's DMM, McKinsey's DQ) focus primarily on achieving transformation, this framework provides the missing guidance on maintaining digital capabilities over time. For industry practitioners, it offers invaluable guidance by providing a structured approach to medium-term resilience beyond initial digital adoption, identifying specific capabilities required across technological, organizational, and external dimensions, emphasizing the dynamic nature of digital transformation rather than treating it as a one-time event, and offering actionable targets that organizations can systematically develop to enhance resilience. By highlighting how organizations have operationalized these principles, the framework bridges theory and practice, helping organizations transform one-time digital initiatives into sustainable competitive advantages that endure through ongoing market and technological disruptions.

This systematic review demonstrates the critical importance of Resilient Digital Transformation (RDT) for organizations operating in increasingly volatile environments. Drawing on prominent DT frameworks, the study identifies that successful and enduring transformations demand continuous alignment of technological infrastructure with an adaptive organizational culture and an agile external engagement strategy. Specifically, robust governance frameworks, ongoing workforce upskilling, and active collaboration with stakeholders and regulators all emerge as crucial pillars of RDT. By highlighting the interplay between dynamic capabilities and long-term sustainability, the review underscores how organizations can evolve beyond one-off digital initiatives and instead embed resilience into their core strategies. Overall, the findings affirm that developing adaptability, innovation, and scalability within the technology pillar, combined with strong governance and stakeholder engagement, forms the foundation of enduring digital capabilities that can help organizations remain competitive despite economic and technological disruptions.

6.1. Theoretical Contributions

This review makes two major theoretical contributions. First, by synthesizing multiple research streams on digital maturity and resilience, it addresses the gap in existing frameworks (e.g., Deloitte's DMM, McKinsey's DQ) that primarily focus on achieving rather than *sustaining* digital transformation. The integrated framework proposed here extends Dynamic Capability Theory by demonstrating how "sensing," "seizing," and "reconfiguring" can each underpin medium-term resilience, particularly when organizations anticipate emerging technologies, realign resources, and refine governance structures. Second, it offers a conceptual basis for understanding RDT as an ongoing cycle of innovation, driven simultaneously by technological, organizational, and external environment factors. This theoretical lens clarifies why seemingly successful DT efforts often fail to endure, highlighting the need for explicit resilience mechanisms that adapt to market shifts.

6.2. Managerial Implications

From a practical standpoint, the findings help organizations map out concrete steps for sustaining digital gains. Rather than treating DT as a one-time adoption of tools, practitioners are advised to embed adaptive processes (e.g., agile governance, real-time analytics) and cultivate a culture that embraces risk-taking and iterative learning. Likewise, the review indicates that stakeholder engagement—both within and outside the firm—plays a pivotal role in mitigating resistance and maintaining buy-in, especially as digital initiatives expand over time. This approach ensures that RDT strategies become integral to day-to-day operations, helping managers better balance technological upgrades with human and regulatory considerations.

7. Conclusions

This study proposes an integrative framework for Resilient Digital Transformation (RDT), synthesizing findings from 77 peer-reviewed articles across technological, organizational, and external environment pillars to guide long-term digital maturity and strategic resilience.

7.1. Limitations

Despite its methodological rigor, this review has several limitations. First, the exclusive focus on English-language literature in business and technology management may omit relevant insights from other disciplines or languages, limiting the generalizability of findings. Second, rapid developments in digital technologies—such as generative AI and quantum computing—may not yet be fully represented in the reviewed literature. Finally, although the conceptual framework provides a strong theoretical foundation, empirical validation across different industries, cultural settings, and geographical regions is necessary to confirm its applicability and utility.

7.2. Directions of Future Research

Future research should pursue longitudinal designs that track how digital strategies evolve over time, particularly in response to disruption. Mixed-method approaches—such as structural equation modeling (SEM), multi-criteria decision-making (MCDM), and in-depth case studies—can offer deeper insights into how leadership, organizational culture, and

digital capabilities converge to foster resilience [80, 93]. Exploring dynamic capabilities, including how organizations sense, seize, and reconfigure resources, can help uncover mechanisms underlying adaptive transformation, especially in smaller or resource-constrained enterprises [71, 85]. Another critical area is the integration of cybersecurity into RDT frameworks. Future work should examine how threat detection, data governance, and privacy protocols can be embedded in transformation processes to reduce vulnerability [77]. Moreover, aligning these safeguards with sustainability goals—such as energy efficiency and ethical data use—will support more holistic digital strategies [87]. Researchers are also encouraged to expand investigations across varied organizational and national contexts. Comparative studies in underrepresented regions like India and Brazil could reveal how local socio-economic conditions shape digital resilience strategies [64, 119]. These avenues will enable the refinement of theoretical models and deliver actionable insights for practitioners seeking to strengthen digital transformation in an increasingly volatile environment.

8. Declarations

8.1. Author Contributions

Conceptualization, T.C., L.X., Z.B., A.S., G.D., W.V., and D.H.; methodology, T.C., W.V., and D.H.; software, W.V.; validation, T.C., W.V., and D.H.; formal analysis, W.V. and D.H.; investigation, T.C., W.V., and D.H.; resources, T.C., W.V., and D.H.; data curation, T.C., W.V., and D.H.; writing—original draft preparation, T.C., W.V., and D.H.; writing—review and editing, T.C., W.V., and D.H.; visualization, V.W.; supervision, L.X, Z.B., A.S., and G.D.; project administration, D.H.; funding acquisition, W.V. All authors have read and agreed to the published version of the manuscript.

8.2. Data Availability Statement

Data sharing is not applicable to this article.

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8.4. Institutional Review Board Statement

Not applicable.

8.5. Informed Consent Statement

Not applicable.

8.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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